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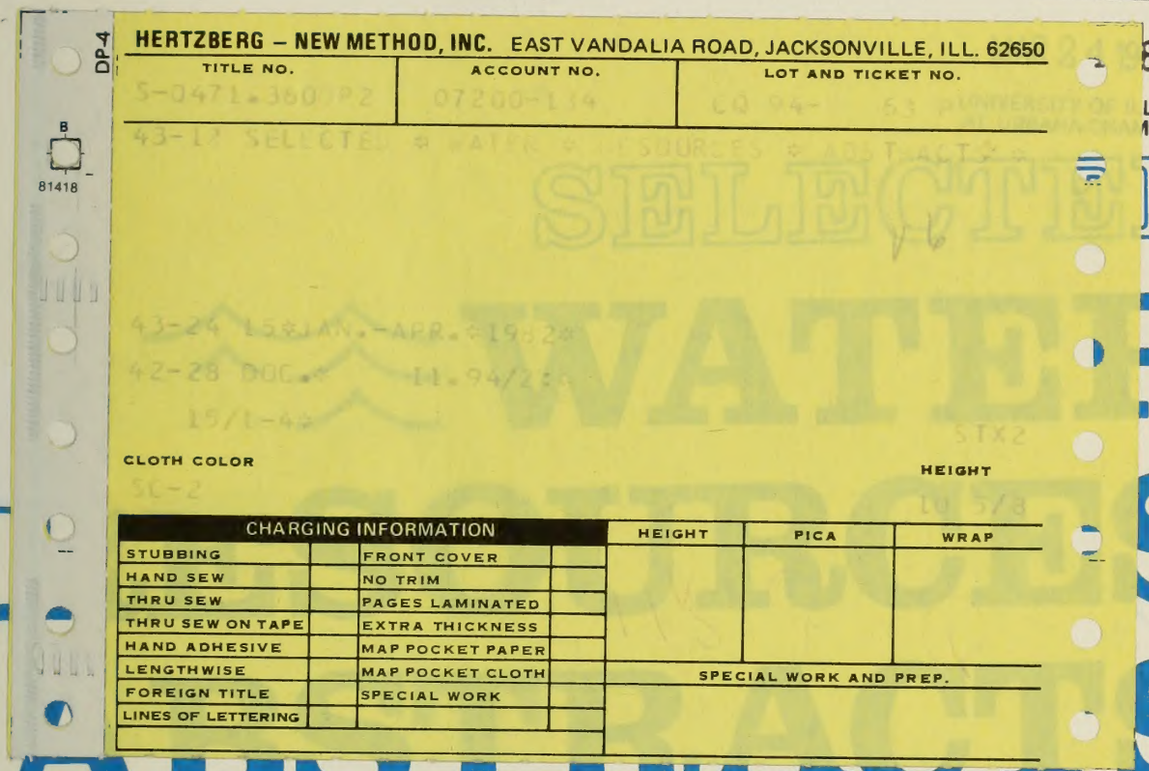

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SELECTED WATER RESOURCES ABSTRACTS

VOLUME 15, NUMBER 1
JANUARY 1, 1982

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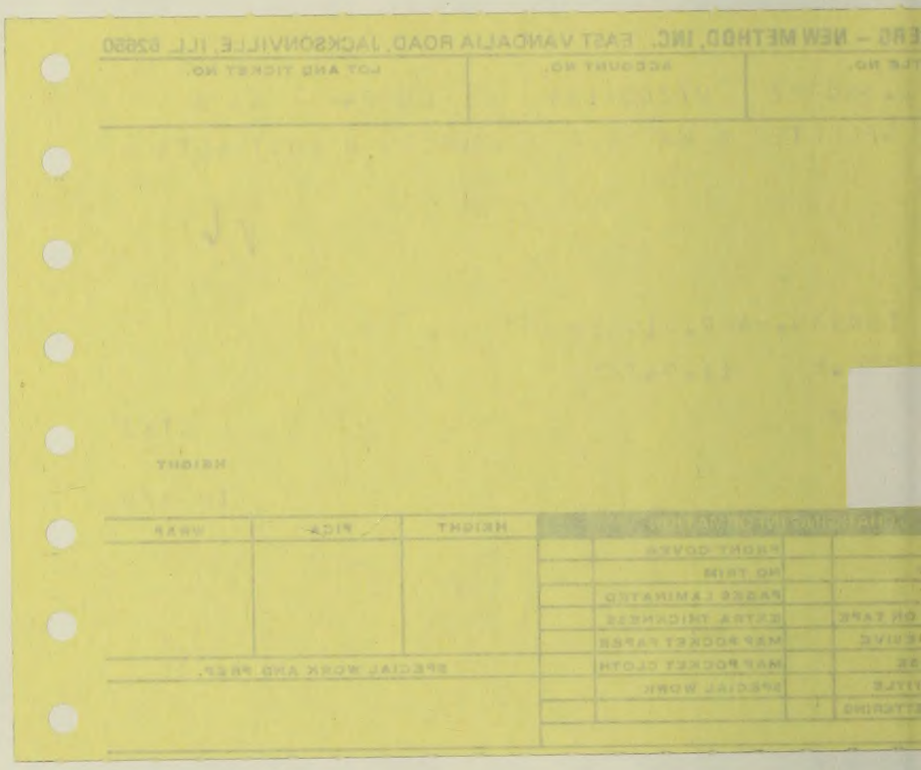

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SELECTED WATER RESOURCES ABSTRACTS

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Office of Water Research and Technology,
U.S. Department of the Interior

VOLUME 14, NUMBER 1
JANUARY 1, 1981

The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through August 31, 1983.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

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PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology
U.S. Department of the Interior
Washington, D.C. 20240

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CONTENTS

SUBJECT FIELDS AND GROUPS

Please use the edge index on the back cover to locate Subject Fields and Indexes.

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

PREDICTING LAKE LEVELS BY EXPONENTIAL SMOOTHING,
Department of the Environment, Edmonton. Div. of Design and Construction.
S. D. Koppula.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY7, p 867-878, July, 1981. 2 Fig, 5 Tab, 8 Ref.

Descriptors: *Water level fluctuations, *Flood forecasting, *Lakes, Rainfall-runoff relationships, Model studies, Mathematical models, *Lesser Slave Lake, *Alberta, Planning, Prediction, Storm water, Water resources management, Flood plain management, Water level, Forecasting.

Future water levels of Lesser Slave Lake, Alberta, were estimated using the forecasting technique, Exponentially Weighted Moving Average (EWMA). These predictions are crucial for storm water management and land use in a lake district. Since monthly statistics on the levels of Lesser Slave Lake were available for 1913-1977, the first 720 observations were used to develop initial values for mean level in a given period, seasonal factor in a given period, and trend factor in a given period. The next 60 observations (1973-77) were used to test the forecasting model. Comparisons of the predicted vs. the observed values for 1973-77 showed a general agreement; largest deviations were 1.5 ft. The Box-Jenkins technique, harmonic analysis, and a combination of the two methods were compared with the EWMA model. The EWMA was consistently superior in its predictive value. The composite model was the most satisfactory of the other three methods; harmonic analysis, the least. (Cassar-FRC)
W82-00118

CHARACTERIZING SHORT DURATION RAINFALL INTENSITIES FOR RUNOFF CALCULATION,
Science and Education Administration, Beltsville, MD. Hydrology Lab.
E. T. Engman, and D. M. Hershfield.
Transactions of the ASAE, Vol 24, No 2, p 347-352, March-April, 1981. 13 Fig, 9 Ref.

Descriptors: *Runoff forecasting, *Rainfall distribution, Rainfall-runoff relationships, Hydrographs, Infiltration, Nonpoint pollution sources, Error analysis.

The error inherent in calculating peak runoff from hourly rainfall data is demonstrated by applying a model to actual rainfall events. As the actual rainfall distribution approaches the average hourly depth, the error approaches zero. Errors of over 50% occur when intensities are averaged over the hour so that no precipitation excess is calculated. A procedure was developed for simulating five-min rainfall increments from published hourly data. Using the corrected values gives runoff hydrographs much closer to the measured rainfall. At Colorado Springs, Colorado, 3.15 cm was measured, 3.02 cm simulated; and at Tyler, Texas, 2.58 cm measured and 2.36 cm simulated. The method is limited to storms of two hours or less duration. (Cassar-FRC)
W82-00142

MODELING THE FLUX OF ATMOSPHERIC POLYCHLORINATED BIPHENYLS ACROSS THE AIR/WATER INTERFACE,
Wisconsin Univ.-Madison.
For primary bibliographic entry see Field 5B.
W82-00193

MODELING THE RELATIONSHIP BETWEEN DEVELOPMENT AND STORM WATER AND NUTRIENT RUNOFF,
Louisiana State Univ., Baton Rouge. Coastal Ecology Lab.
C. S. Hopkinson, Jr., and J. W. Day, Jr.
Environmental Management, Vol 4, No 4, p 315-324, July, 1980. 5 Fig, 5 Tab, 15 Ref.

Descriptors: *Storm water, *Urban runoff, *Nutrients, Eutrophication, Model studies, Simulation analysis, Runoff, Rainfall-runoff relationships, Agricultural land, Urbanization, Storm Water Management Model, Nonpoint pollution sources, Louisiana, Mississippi, Rivers, Swamps, Land use, Nitrogen compounds, Phosphorus compounds, Infiltration, Wetlands.

The EPA Storm Water Management Model was applied to the des Allemands swamp forest system in the headwaters of the Barataria Basin, Louisiana. The effects of changing land use patterns on storm water runoff were modeled. By 1995 urban land on the uplands will increase by 321%, primarily at the expense of agricultural land. This urbanization will cause storm water runoff rates to increase by 4.2 fold. Nutrient runoff will increase 28% for N and 16% for P. Lake eutrophication will be a problem unless corrective actions are taken. (Cassar-FRC)
W82-00260

THE CONSERVATIVE EFFECT OF RAINFALL VARIATION ON FERTILISER RESPONSE IN A HUMID ENVIRONMENT,
New South Wales Dept. of Agriculture, Wollongbar (Australia).
G. J. Murtagh.
Search, Vol 11, No 1/2, p 35-36, January/February, 1980. 1 Fig, 2 Tab, 8 Ref.

Descriptors: *Rainfall-runoff relationships, *Fertilizers, *Pastures, Humic areas, Runoff, Soil water, New South Wales, *Australia, Effects, Rainfall rate.

Increased rainfall associated with cyclonic activity was relatively unimportant in maintaining soil water supplies and response to fertilizer in pasture in the subtropical coastal areas of New South Wales, Australia. Since 1946 annual rainfall has increased significantly in the two study areas. Most of the excess rain fell when soil was wettest in February-April. After adjusting for runoff, fertilizer responses increased by only small amounts. This is not true in drier inland areas where runoff losses are less. (Cassar-FRC)
W82-00316

EFFECTS OF TILLAGE AND GYPSUM INCORPORATION ON RAIN RUNOFF AND CRUST STRENGTH IN FIELD SOILS IRRIGATED WITH SALINE-SODIC WATER,
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Inst. of Soil and Water.
H. Frenkel, and A. Hadas.
Soil Science Society of America Journal, Vol 45, No 1, p 156-158, 1981. 2 Tab, 16 Ref.

Descriptors: *Irrigation effects, *Rainfall-runoff relationships, *Soil strength, Irrigation, Runoff, Rainfall, *Gypsum, Erosion control, Infiltration, Cropland, *Saline water, Infiltration rate, Permeability, *Negev Desert, Israel.

The northwestern part of the Negev Desert of Israel is increasingly irrigated with saline-sodic waters, introducing sodium into the exchange complex of the soil and possibly reducing infiltration rates and water permeability of the soil. The addition of gypsum in the fall to prevent dispersion and crust formation during the rainy season is recommended. The effects of each of two methods for incorporating gypsum on rain runoff and crust strength were investigated in two fields irrigated with saline-sodic water (electrical conductivity: 5.8 mmhos per centimeter; sodium adsorption rate (SAR): 18) and with fresh water (electrical conductivity: 0.95; SAR: 2.6). The first method involves spreading gypsum on the soil surface after tillage operations and disking it into the top 5 centimeters on ridges that are being built. The second method involves plowing a large amount of gypsum into the soil once every few years, after which the area is left in a very rough state. Runoff was reduced to a minimum (3%) when the soil surface was left in a rough state. When ridging patterns were used, up to 40% of the rainfall per storm was lost, regardless of the direction of the ridge with respect to the area gradient or to gypsum application. These results were obtained from adjacent fields having a general slope of 1% and an annual mean rainfall of 371 mm. The results indicate that surface roughness is far more important than amendments in reducing rainfall runoff. (Carroll-FRC)
W82-00327

GROUND-WATER RESOURCES OF THE WHITE RIVER BASIN, MADISON COUNTY, INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
W. W. Lapham.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-109844, Price codes: A06 in paper copy, A01 in microfiche.
Geological Survey Water-Resources Investigations 81-35, June 1981. 112 p, 42 Fig, 9 Tab, 16 Ref.

Descriptors: Groundwater, *Aquifer characteristics, *Groundwater movement, Glacial drift, Groundwater recharge, Water level fluctuations, Estimating, Hydraulic properties, Seepage, Hydrologic budget, *Model studies, Simulations, Groundwater availability, *Groundwater potential, Water yield, Pumping, Observation wells, Surface-groundwater relations, *Indiana, Madison County, *White River basin.

The ground-water resources of the White River basin in and near Madison County, Ind., were investigated by mapping the aquifers, estimating their hydraulic properties, determining the distribution of potentiometric head in the aquifers, and estimating some of the components of the groundwater budget from data collected in the field. This information was used to construct and calibrate a five-layer digital groundwater flow model. The model was used to provide estimates of the ground-water potential in terms of yield, drawdown, and streamflow depletion. Four confined sand and gravel aquifers interbedded in the glacial drift, a bedrock aquifer, and an unconfined outwash aquifer are the three most important aquifer systems in the study area. Model analysis of eight pumping plans provide a general assessment of the water-yielding potential of the three major aquifer systems in the study area. Model results indicate that, at some locations, yields of as much as 2.5 million gallons per day can be developed. Model simulations also indicate that only pumping near the small streams will reduce streamflow by more than a few percent. In developing the ground-water system in the area, use of many small, scattered well fields that produce less than about 3 million gallons per day, may be more favorable hydrologically than a few, heavily pumped well fields, like the well field northwest of Anderson. (USGS)
W82-00412

WATER IN THE ELIZABETHTOWN AREA - A STUDY OF LIMESTONE TERRANE IN NORTH-CENTRAL KENTUCKY,
Geological Survey, Louisville, KY. Water Resources Div.
For primary bibliographic entry see Field 5B.
W82-00413

PREDICTED EFFECTS ON GROUND WATER OF CONSTRUCTION OF DIVIDE CUT SECTION, TENNESSEE-TOMBIGBEE WATERWAY, NORTHEASTERN MISSISSIPPI USING A DIGITAL MODEL,
Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 2F.
W82-00428

2B. Precipitation

RAINWATER GAUGE,
A. C. Abele.

HENRY S. GR... L URBANA CHAMPAIGN

Group 2B—Precipitation

U.S. Patent No. 4,233,841, 7 p, 9 Fig, 4 Ref; Official Gazette of the United States Patent Office, Vol 1000, No 3, p 909, November 18, 1980.

Descriptors: *Patents, *Instrumentation, *Rain gages, Weather, Protection, Housing.

A weather instrumentation station includes a louvered instrument housing containing the weather instruments. An exterior double-walled housing radiation shield is placed over the instrument housing to shield the instrument housing from the sun. A double-walled auxiliary shield may be positioned over at least one side of the housing shield to shield sun rays from the instrument housing on the open side. The housing shield and the auxiliary shield inner walls are formed of thermoplastic or aluminized asbestos material, and the outer walls of stainless steel. The housing shield roof is peaked to forestall accumulation of water and snow. There is also provided a rainwater gauge including a receiving flask with a funnel to channel the rainwater. The ratio of the area of the funnel top inlet opening to its lower outlet opening is preferably ten to one. An elongated, hollow, open-ended, stainless steel cylinder of minimal length may be connected to the perimeter of the funnel upper inlet opening to channel rainwater to the funnel lower outlet opening. The cylinder upper edge is a knife edge to ensure collecting a precise are of rainwater. (Sinha-OEIS)
W82-00068

SOME LIMITING FORMS OF THE POISSON DISTRIBUTION OF ANNUAL STATION PRECIPITATION,
Massachusetts Inst. of Tech., Cambridge.
P. S. Eagleson.
Water Resources Research, Vol 17, No 3, p 752-757, June, 1981. 7 Fig, 10 Ref.

Descriptors: *Storms, *Rainfall, Variability, Precipitation, Poisson ratio, Arid climates, Humid climates, Comparison studies.

Annual station precipitation is represented as a seasonally stationary Poisson arrival process in terms of three random variables: season length, number of storms, and storm depth. The contribution of each factor to variance of the annual total precipitation is determined, and the limiting distribution of the total precipitation derived by letting each variable vanish separately. Three cases are studied using data from Boston, Massachusetts; Pasadena, California; and Riyadh, Saudi Arabia. In humid climates the storm depth variability is the predominant contributor to variance in annual rainfall. In arid climates the variability of number of storms per rainy season is the controlling factor; distribution is highly skewed. These findings are useful in studies of extreme climates, where data is often scarce. (Cassar-FRC)
W82-00132

REPORT ON THE SUMMER MONEX FIELD PHASE,
National Science Foundation, Washington, DC.
J. S. Fein, and J. P. Kuettner.
Bulletin of the American Meteorological Society, Vol 61, No 5, p 461-474, May, 1980. 3 Fig, 1 Tab, 7 Ref.

Descriptors: *Monsoons, *Precipitation, *Rainfall, Weather, India, Satellite technology, Air circulation, Seasonal variation, Wet seasons, Winds, Cyclones, Meteorology, Data collections, Heat budget, Heat, Temperature, Asia, Foreign countries, Floods, Global Weather Experiment, MONEX, Indian Ocean.

The 1979 Summer Monsoon Experiment (MONEX) was designed to study the monsoon in the Indian Ocean and adjacent land areas using satellite and land-based measurements. The Indian monsoon of 1979 was substantially subnormal in precipitation over some inland areas, two weeks late in arriving, and early to break up. The southwest monsoon established fully over the Arabian Sea in July. The Bay of Bengal branch developed on schedule in late May, but later weakened, strengthening again on July 7. Break monsoon conditions developed after July 13. A cyclone in early August caused floods, crop damage, and loss of lives. After this event, the monsoon rains declined. Over Saudi Arabia and in the Arabian Sea, where differential heating of sea and land masses initiates the monsoon, differential heating, total heat budgets, and the structure of an intense heat low and its diurnal changes were studied. During this period soil temperatures as high as 70C were measured. Sea surface temperatures were 28C near shore and 30-34C off shore. The role of planetary-scale variation in controlling the monsoon was striking. The low-level Central Indian Ocean branch of the Somali jet was believed responsible for bringing the monsoon into southern India. Surges from the Southern Hemisphere were observed. Personnel from many U.S. and foreign educational and research institutions participated in the project. Combined MONEX and Global Weather Experiment data should provide unprecedented data for a basic study of monsoons. (Cassar-FRC)
W82-00265

RECENT VARIATIONS IN WINTER EXTRATROPICAL CYCLONE ACTIVITY FOR THE AUSTRALIAN REGION,
Adelaide Univ. (Australia). Dept. of Geography.
A. M. Carleton.
Search, Vol 11, No 1/2, p 37-39, January/February, 1980. 3 Fig, 4 Ref.

Descriptors: *Cyclones, *Precipitation, *Weather patterns, *Australia, Satellite technology, Indian Ocean, Tasman Sea.

Satellite infrared imagery for the winters of 1973-1977 in southern Australia was analyzed using the vortex classification system for extratropical cyclonic cloud vortices. The 1975 winter was nearest to the average in precipitation; 1973 and 1974 had above average precipitation and 1975-1976, below average precipitation. These precipitation trends were related to the longitudinal and latitudinal variations in satellite-observed activity. The longitudinal and latitudinal distribution of cyclogenesis was more critical in explaining the anomalies than its frequency. Fluctuations in the intensity of location of the Indian Ocean trough appeared to be the key circulation factor, with the cyclogenetic zone in the Tasman Sea another important factor. (Cassar-FRC)
W82-00315

HISTORICAL NILE FLOODS AND THEIR IMPLICATIONS FOR CLIMATIC CHANGE,
Washington State Univ., Pullman. Dept. of Anthropology.
For primary bibliographic entry see Field 2E.
W82-00326

2C. Snow, Ice, and Frost

EFFECTS OF VOLCANISM ON THE GLACIERS OF MOUNT ST. HELENS,
Geological Survey, Tacoma, WA. Water Resources Div.
M. M. Brugman, and A. Post.
Available from the Branch of Dist., USGS, 604 Pickett St. Alexandria, VA 22304. Geological Survey Circular 850-D, 1981. 11 p, 8 Fig, 2 Tab.

Descriptors: *Volcanoes, *Glaciers, *Snow, *Ice, Snowmelt, Snow cover, Firn, Runoff, Craters, Mountains, *Washington, *Mount St. Helens, Volcanic ash, Pyroclastic flows, Effects.

The cataclysmic May 18, 1980, eruption of Mount St. Helens removed 2.9 square kilometers of glacier snow and ice including a large part of Shoestring, Forsyth, Wishbone, Ape, Nelson, and all of Loowit and Leschi Glaciers. Minor eruptions and bulging of the volcano from March 27 to May 17 shattered glaciers which were on the deforming rock and deposited ash on other glaciers. Thick ash layers persisted after the May 18 eruption through the summer on most of the remaining snow and ice, and protected winter snow from melting on Swift and Dryer Glaciers. Melting and recrystallization of snow and ice surviving on Mount St. Helens could cause lubricate mudflows and generate outburst floods. Study of glaciers that remain on this active volcano may assist in recognizing potential hazards on other volcanoes and lead to new contributions to knowledge of the transient response of glaciers to changes in mass balance or geometry. (USGS)
W82-00007

ON THE ESTIMATION OF ANTARCTIC ICEBERG MELT RATE,
Oregon State Univ., Corvallis. School of Oceanography.
S. Neshyba, and E. G. Josberger.
Journal of Physical Oceanography, Vol 10, No 10, p 1681-1685, October, 1980. 2 Fig, 17 Ref.

Descriptors: *Antarctic Ocean, *Icebergs, *Melting, Ice, Sea ice, Water quantity, Water supply, Water supply development, Iceberg towing.

Minimum sidewall melt rate of Antarctic icebergs, of possible interest to engineers towing icebergs, was determined after evaluating errors of various methods--field observations, iceberg distribution statistics, laboratory experiments, and theoretical studies. This evaluation permits quantitative first-order correction for the effect of bubbles released from the melting ice on the convective heat transfer and the effect of other forms of iceberg deterioration, besides sidewall melting. At temperatures of 2, 3, 4, 8, and 12C best estimates of melt rates were 5, 10, 17, 55, and 100 meters per year, respectively. (Cassar-FRC)
W82-00166

AERIAL BIOMASS DISTRIBUTION IN AN UNDISTURBED AND DISTURBED SUBARCTIC BOG,
Great Lakes Forestry Research Center, Sault Ste. Marie (Ontario).
R. A. Sims, and J. M. Stewart.
Canadian Journal of Botany, Vol 59, No 5, p 782-786, May, 1981. 1 Fig, 1 Tab, 17 Ref.

Descriptors: *Bogs, *Clear-cutting, Peat bogs, *Biomass, Distribution, Vegetation, Ice, Revegetation, Erosion, Frozen ground, Permafrost, *Subarctic zone.

The differences in aerial biomass between an uncleared and cleared portion of a subarctic treed peat plateau at a single site were measured. A portion of a wooded peat plateau in northern Manitoba was stripped of surface vegetation during powerline construction. Seven years after the clearing of the land, the aerial biomass of the plants growing on the disturbed surface was estimated to be 2098 kg/ha. This figure is only 26.4% of the undisturbed portion's biomass. Surface erosion of the peat was visible. Disturbance of the surface does accelerate erosion and may initiate thawing and deterioration of the ice core. In the study area, tree biomass represented 28.7% of the aboveground biomass. Photosynthetic biomass was 17% in the wooded area and 53% in the disturbed area. Major ericaceous species increased after the clearing of the area. The permafrost persisted at the same depth under the disturbed part as under the adjacent forested part. (Small-FRC)
W82-00211

ICE PROBLEMS AT A COOLING WATER INTAKE IN A TIDAL ESTUARY AT LINGAN, N.S.,
Albery, Pullerits, Dickenson and Associates Ltd., Don Mills (Ontario).
For primary bibliographic entry see Field 8A.
W82-00230

ILLUSTRATION OF THE ROLES OF SNOW IN THE EVOLUTION OF THE WINTER COVER OF A LAKE,
Trent Univ., Peterborough (Ontario). Dept. of Geography.
W. P. Adams, and N. T. Roulet.
Arctic, Vol 33, No 1, p 100-116, March, 1980. 14 Fig, 12 Ref.

Descriptors: *Slush, *Lake ice, *Snow cover, Cycles, Ice cover, Temperature, Fluctuations, Lakes, Snow, Iced lakes, Ice, Melting, *Spatial distribution, Lentic environment, Winter, Elizabeth Lake, Labrador.

A survey of spatial patterns of snow and ice cover on Elizabeth Lake, Labrador, was conducted in February of 1979. Relationships between snow cover, black ice and white ice (produced by slushing) were examined by SPSS and SYMAP computer maps and programs. Snow cover had two general effects on the patterns of ice cover; it produced an insulating effect which slowed the growth of the underlying ice cover, and it also depressed the sheet of ice below the hydrostatic water level, allowing slushing to occur and thus promoting the growth of white ice. Data from Lake Elizabeth showed agreement with these general patterns upon computer analysis. Areas of lower snow cover represented areas where slushing had occurred due to snow depression of the ice surface and incorporation of snow into slush ice formation. Distributions of white ice on the lake's surface were also found to correspond to snow drifting trends controlled by a west-northwest prevailing wind. Black ice thickness generally decreased towards lake margins, while white ice thickness generally increased in these same areas. The cyclic nature of ice growth illustrated on Lake Elizabeth has great bearing on the nature of peak ice which occurs on the lake. (Geiger-FRC)
W82-00267

SHALLOW CORE SNOW CHEMISTRY OF ATHABASCA GLACIER, ALBERTA,
New Hampshire Univ., Durham. Dept. of Earth Sciences.
D. Butler, W. B. Lyons, J. Hassinger, and P. A. Mayewski.
Canadian Journal of Earth Sciences, Vol 17, No 2, p 278-281, 1980. 3 Fig, 2 Tab, 15 Ref.

Descriptors: *Glaciers, *Chemical composition, Chemical analysis, Ice, Glacier mass balance, Glacier balance, Glacial sediments, Nitrates, Phosphates, Snow, Chemistry of precipitation, *Athabasca Glacier.

Samples were taken from the Athabasca Glacier on August 24, 1978, in the accumulation zone close to the 1978 summer equilibrium line altitude and just above the third icefall at an elevation of 2694 meters. The NO3(-) and PO4(3-) values from Athabasca Glacier ice are much lower than those reported for snow samples from central Alberta. The increased reactive SiO2 values in the central Alberta snows suggest that reactive SiO2 can be introduced into the atmosphere and incorporated into snow and ice by man's activities. The mean Si/Fe ratio from the Athabasca ice is low when compared to those of atmospheric aerosols and the central Alberta snow samples. The mean NO3(-)/PO4(3-) ratio is about twice that of the central Alberta snows, suggesting that anthropogenically diluted aerosols may contain higher concentrations of PO4(3-) relative to NO3(-) than unpolluted air. The NO3(-)/PO4(3-) and SiO2/Fe ratios proceed through maxima at 2.5 and 6-6.5 meters depth in the sample pit. The glacier's yearly net mass balance for the sample area was 1.5 and 2.4-2.7 meters water equivalent for the 1976-1977 and 1977-1978 mass balance years. (Baker-FRC)
W82-00320

2D. Evaporation and Transpiration

A PROPOSED TECHNIQUE TO MEASURE EVAPOTRANSPIRATION USING MICROMETEOROLOGICAL METHODS,
Orange Free State Univ., Bloemfontein (South Africa). Dept. of Agrometeorology.
K. L. Bristow, and J. M. De Jager.
Water SA, Vol 7, No 1, p 49-53, January, 1981. 3 Fig, 1 Tab, 8 Ref.

Descriptors: *Measuring instruments, *Mathematical equations, *Evapotranspiration, Anemometers, Radiometry, Evaporation, Evaporation gauges, Irrigation requirements, Transpiration, Water loss, Energy, Plant-water relationships.

Accurate measurements of crop evapotranspiration are vital to irrigation project managers and researchers in the field of plant-water relationships. A method is described for estimating evapotranspiration using two sets of recording wet- and dry-bulb thermometers and an anemometer. In initial field work on wheat crops conducted over a six day period, a net radiometer was employed, which could be replaced by a sunshine duration recorder. Crop evaporation was compared to pan evaporation, and computed surface temperatures gave good agreement with temperatures measured at the momentum exchange surface. Collected data was plugged into the surface energy budget equation, while a reiterative technique was used to calculate a surface temperature to balance this expression. Through conversion of the latent heat flux term in the balanced equation to a volumetric evaporation, the amount of evapotranspiration was determined. The necessary mathematical data may be computed on a programmable calculator, and the durable equipment can be installed and maintained by untrained personnel. (Geiger-FRC)
W82-00183

FIELD TEST OF AN IRRIGATION SCHEDULING COMPUTER MODEL,
Soil and Irrigation Research Inst., Pretoria (South Africa). Dept. of Agriculture and Fisheries.
For primary bibliographic entry see Field 3F.
W82-00184

REDUCED TRANSPIRATION AND INCREASED WATER EFFICIENCY BY DIURON IN CORN (ZEA MAYS),
Guelph Univ. (Ontario). Dept. of Environmental Biology.
S. Ahmed, and R. A. Fletcher.
Weed Science, Vol 28, No 2, p 180-185, March, 1980. 5 Fig, 5 Tab, 16 Ref.

Descriptors: *Transpiration control, *Diuron, *Herbicides, *Corn, Water use efficiency, Drought resistance, Drought, Crop production, Agriculture.

The effectiveness of low concentrations of a representative phenoxy, triazine, and urea herbicide were evaluated in reducing transpiration and increasing water efficiency in corn production. Diuron (3-(3,4-dichlorophenyl)-1,1-dimethylurea) was the most effective herbicide on both monocotyledon and dicotyledon species. A 40% reduction in transpiration occurred. At all stages of corn growth, foliar applications of low concentrations (0.035 to 0.56 kg/ha) effectively reduced transpiration. For 16 days after treatment, the lower leaves of the corn plants did not wilt and become senescent. Diuron increased water efficiency and this effect was more pronounced when water was limiting. Treated plants used 68% less water than controls for each gram of shoot dry weight produced. Diuron may reduce transpiration and maintain yields in drought periods under field conditions. (Small-FRC)
W82-00196

2E. Streamflow and Runoff

CHANNEL CONDITIONS IN THE LOWER TOUTLE AND COWLITZ RIVERS RESULTING FROM THE MUDFLOWS OF MAY 18, 1980,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W82-00004

REPORT OF THE ANNUAL YIELD OF THE ARKANSAS RIVER BASIN FOR THE ARKANSAS RIVER BASIN COMPACT, ARKANSAS--OKLAHOMA, 1980 WATER YEAR,
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 6E.
W82-00012

FLOOD DATA FOR THE SACRAMENTO RIVER AND BUTTE BASIN 1875 TO 1978, SACRAMENTO VALLEY, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
J. C. Blodgett.
Available from the OFSS, USGS Box 25425 Fed. Ctr., Denver, CO 80225, Price: $26.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 80-971, June 1981. 193 p, 10 Fig, 17 Tab, 17 Ref.

Descriptors: *Flood data, *Historic floods, *Flood stages, *Flood profiles, Flow duration, Streamflow, Flood peak, Overflow, Flood discharge, Discharge measurement, Gaging stations, Cross sections, *California, *Sacramento River, *Butte Basin.

Streamflow data at various locations were assembled for the Sacramento River between Red Bluff and Meridian, Calif., and for Butte Basin, which serves as an overflow basin during periods of flooding. Data were obtained from various Federal and State agencies and private sources to document the magnitude of flooding from 1875 to 1978. The assembled data include annual maximum flood stages and discharges for the period of record at gaging stations, and flood stages at numerous staff gages, crest-stage gages, and high-water mark sites throughout the study area. Tabulations of floodflow measurements made at or near gaging stations, including the cross-sectional area of the channel and velocities, are presented. Cross sections of the Sacramento River near Chico Landing surveyed in 1978 and earlier surveys to show the size of Butte Basin have been included. A detailed list of references is presented giving the sources of the data included in this report. Many of these sources present detailed descriptions of flooding at various sites. (USGS)
W82-00019

THE INFLUENCE OF STREAM ORDER AND SELECTED STREAM BED PARAMETERS ON FISH DIVERSITY IN RAYSTOWN BRANCH, SUSQUEHANNA RIVER DRAINAGE, PENNSYLVANIA,
Maryland Univ., Frostburg. Appalachian Environmental Lab.
T. Y. Barila, R. D. Williams, and J. R. Stauffer, Jr.
Journal of Applied Ecology, Vol 18, No 1, p 125-131, April, 1981. 1 Fig, 3 Tab, 19 Ref.

Descriptors: *Stream order, *Diversity indices, *Fish populations, Species diversity, Raystown Branch, Susquehanna River, *Pennsylvania, Stream biota, Aquatic animals.

Stream order proved a satisfactory composite index for correlation with fish diversity in a study of Raystown Branch of the Susquehanna River, Pennsylvania. The following parameters were studied in August and October, 1978, at each of 36 stations along the 165 km length: diversity index, stream order, gradient, maximum width, narrowest width, mean width, mean depth, maximum depth, altitude, total species, total individuals, and 6 most commonly occurring species. Diversity was most highly correlated with stream order, increasing with first through fourth order streams. Fifth order streams had a slightly lower mean diversity index, possibly caused by migration into lower order streams for spawning or problems with sampling. Other physical variables showed predictable relationships with diversity and stream order. (Cassar-FRC)
W82-00109

CHARACTERIZING SHORT DURATION RAINFALL INTENSITIES FOR RUNOFF CALCULATION,
Science and Education Administration, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 2A.
W82-00142

FLOW RESISTANCE IN VEGETATED WATERWAYS,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
N. Kouwen, R-M. Li, and D. B. Simons.
Transactions of the ASAE, Vol 24, No 3, p 684-690, 698, May/June, 1981. 8 Fig, 2 Tab, 29 Ref.

Descriptors: *Flow resistance, *Vegetation effects, Streamflow, Plant growth, *Channel flow, Model studies.

A new method to determine the flow capacity of a vegetated channel is presented. The method uses the vegetation's length and stiffness as parameters. Graphs of field data of Manning's coefficient versus the product VR (velocity times hydraulic radius) can be accurately reproduced. A table of stiffness values for various types of vegetation for which flow data were available is included. It is shown that the n-VR method of channel design currently in use is based on the correct premise that n is a function of VR regardless of the relative values of V and R. The limitations of the n-VR method are stated. The advantage of the new method is that it is a numerical method which can be easily incorporated in computer programs for other purposes such as backwater or routing models. (Baker-FRC)
W82-00152

AMOUNTS AND RELATIVE SIGNIFICANCE OF RUNOFF TYPES IN THE TRANSPORT OF NITROGEN INTO A STREAM DRAINING AN AGRICULTURAL WATERSHED,
Massey Univ., Palmerston North (New Zealand). Dept. of Soil Science.
For primary bibliographic entry see Field 5B.
W82-00173

POLLUTION FROM LAND RUNOFF,
Great Lakes Basin Commission, Ann Arbor, MI.
For primary bibliographic entry see Field 5B.
W82-00253

HISTORICAL NILE FLOODS AND THEIR IMPLICATIONS FOR CLIMATIC CHANGE,
Washington State Univ., Pullman. Dept. of Anthropology.
F. A. Hassan.
Science, Vol 212, No 4499, p 1142-1145, June 5, 1981. 2 Fig, 1 Tab, 32 Ref.

Descriptors: *Flooding, *Climatology, *Weather patterns, *Nile floods, Africa, Flood stages, History, Rainfall-runoff relationships, Flood stages.

Although records of Nile flood stages are available for the period from the 7th century A.D. to the present, past attempts to understand the implications of variations in Nile floods for climatic change have been unsatisfactory. This study used three different analytic techniques to detect episodic variations in flood stages, following which an attempt was made to determine the cause of the variations and to relate flood episodes to climate in Africa and Europe. Major episodes of low Nile discharge were noted during the years 930 to 1070 and 1180 to 1350. Major episodes of high Nile floods occurred from 1070 to 1180 and from 1350 to 1470. Short-term fluctuations in Nile flood maxima appear to reflect variations in the contributions from the White Nile, which drains a large area of equatorial Africa, and to match variations in water levels of Lake Chad, which are associated with the poleward movement of the intertropical convergence zone. Therefore, it is concluded that the episodic variations in Nile flood discharge are probably the result of climatic changes that influence precipitation in equatorial Africa. Comparison of data on Nile flood stages, including those for scattered periods prior to the 7th century A.D., indicate that there is also a correlation between low Nile discharge and cold climate in Europe. (Carroll-FRC)
W82-00326

USE OF FLOW-DURATION CURVES TO EVALUATE EFFECTS OF URBANIZATION ON STREAMFLOW PATTERNS ON LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 4C.
W82-00416

2F. Groundwater

GROUND-WATER DATA FOR MICHIGAN, 1979,
Geological Survey, Lansing, MI. Water Resources Div.
G. C. Huffman.
Geological Survey Open-File Report 80-1212, 1980. 56 p, 4 Fig, 3 Tab, 120 Ref.

Descriptors: *Groundwater resources, *Michigan, *Water levels, *Aquifers, *Water quality, Water wells, Water yield, Water utilization, Well data, Hydrogeology, Hydrographs, Water level fluctuations, Water analysis, Chemical analysis, Data collections.

This report summarizes data on water levels in 138 observation wells in Michigan and provides information on well locations, depths, altitudes, and aquifers that they tap. Tabulated data include extremes of water levels for 1979 and for the period of record. Also tabulated is the pumpage of most major ground-water users in the State and quality data on selected wells sampled during 1979. In most areas, ground-water levels followed precipitation trends. In areas where precipitation was above normal, such as in the northern part of the State, ground-water levels were generally above average. Elsewhere levels were below average. (USGS)
W82-00014

JANUARY 1980 WATER LEVELS, AND DATA RELATED TO WATER-LEVEL CHANGES, WESTERN AND SOUTH-CENTRAL KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
M. E. Pabst.
Geological Survey Open-File Report 80-958, August 1980. 100 p, 2 Tab.

Descriptors: *Groundwater, *Water level, *Observation wells, *Water level fluctuations, *Irrigation, Groundwater recharge, Aquifers, Hydrologic data, *Kansas, Western Kansas, South-central Kansas.

Water-level measurements were made, mostly in January 1980, in about 1,240 observation wells in western and south-central Kansas. The measurements were made in mid-winter when pumping was minimal and water levels had recovered from the effects of pumping during the previous irrigation season. Annual hydrologic data are provided for relating water-level changes from a 'base-reference year' (predevelopment year), a year of abnormally high rainfall and minimum pumpage (1966), and the previous year (1979). The 'base-reference year' is designated at 1950 for the northwestern and westcentral areas, 1940 for the southwestern area, and 1944 for the south-central area. Water level data in the south-central area also are compared with data for 1974. 'Base-reference-year' water levels are based on measurements made during that year and on interpretation of water-table maps. Data also are provided for relating the average annual water-level changes, saturated thicknesses of the deposits, and percentage changes in saturated thicknesses. (USGS)
W82-00016

GROUNDWATER AVAILABILITY IN ACADIA NATIONAL PARK AND VICINITY, HANCOCK AND KNOX COUNTIES, MAINE,
Geological Survey, Boston, MA. Water Resources Div.
B. P. Hansen.
Geological Survey Open-File Report 80-1980. 8 p, 3 Fig, 12 Ref.

Descriptors: *Groundwater availability, *Water yield, *Wells, *Aquifer characteristics, Geohydrology, Water quality, Saline-freshwater interfaces, Bedrock, Geologic fractures, *Maine, Arcadia National Park, Hancock County, Knox County.

This report presents the results of a preliminary investigation of grund-water availability in Acadia National Park and vicinity, Hancock and Knox Counties, Maine. In general, yield of water from individual wells in unconsolidated surficial deposits is low (0-10 gallons per minute). Several small, unconsolidated deposits may yield moderate quantities (50-100 gallons per minute) but these have not been adequately tested. Yields from 160 wells in the crystalline bedrock range from 0.5 to 100 gallons per minute, with a median yield of 10 gallons per minute. Wells in zones of extensive fracturing or faulting generally have higher than average yields. Zones of fracturing may correspond to lineations which have been mapped by interpretation from topographic maps and aerial photographs. In general, ground water is of suitable chemical quality for public supply. Most ground water is low in dissolved solids and is soft. Iron exceeds 0.3 milligram per liter and manganese exceeds 0.5 milligram per liter in water from some wells. Brackish (salty) water is present in only a few wells at the coast or adjacent to saltwater bodies. Elevated concentrations of Radon-222 have been reported from wells in the granite aquifer. (USGS)
W82-00017

EVALUATION OF GROUND-WATER MONITORING NETWORK, SANTA CRUZ COUNTY, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 7A.
W82-00023

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER IN THE SUWANNEE RIVER WATER MANAGEMENT DISTRICT, FLORIDA, MAY 1980,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-00024

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER IN THE NORTHWEST FLORIDA WATER MANAGEMENT DISTRICT, MAY 1980,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-00025

AQUIFER PARAMETER IDENTIFICATION WITH OPTIMUM DIMENSION IN PARAMETERIZATION,
California Univ., Los Angeles. School of Engineering and Applied Science.
W. W-G. Yeh, and Y. S. Yoon.
Water Resources Research, Vol 17, No 3, p 664-672, June, 1981. 11 Fig, 4 Tab, 16 Ref.

Descriptors: *Aquifer characteristics, *Transmissivity, *Parametric hydrology, Hydrology, Optimization, Unsteady flow, Groundwater movement.

A method has been developed for parameter identification in a 2-dimensional, unsteady state groundwater flow. The optimum trade-off between the modeling error and the error associated with the parameter uncertainty may be directly determined without relying on prior geologic information on the aquifer. The coefficients to be identified are transmissivities which vary spatially. Finite elements are used to represent the unknown transmissivity function parametrically as nodal values over a suitable discretization of a flow region. A modified Gauss-Newton algorithm is used for parameter optimization. Covariance analysis estimates the reliability of the estimated parameters. Modeling errors, as represented by a least squares criterion, generally decrease with increases in dimension of the unknown parameter, but errors in data are propagated to a greater degree into the estimated parameters, reducing the reliability of the estimations. This method is shown to be more reliable than the pure zonation method. Two cases illustrate the method for determining the optimum dimension in parameterization. (Cassar-FRC)
W82-00131

HYDRAULIC PROPERTIES OF COAL AND RELATED MATERIALS, NORTHERN GREAT PLAINS,
North Dakota Univ., Grand Forks. Engineering Experiment Station.
B. W. Rehm, G. H. Groenewold, and K. A. Morin.
Ground Water, Vol 18, No 6, p 551-561, November-December, 1980. 5 Fig, 3 Tab, 29 Ref.

Descriptors: *Coal, *Hydraulic properties, *Groundwater, *Mining engineering, *Monitoring, Aquifers, Porosity, Flow, Coal mining, Permeability, Geologic fractures, Drawdown, Water level, *Strip mine wastes, Sand aquifers, Hydraulic conductivity, Coal aquifers.

Data from five study areas where coal and sand beds form important aquifers in the northern Great Plains Region have been summarized. Both sand and coal have similar hydraulic conductivities and specific storage values. Aquitards in the region consist of clay and silt, fractured to varying degrees and with a wide range of conductivities. The hydraulic conductivity of strip mine spoils has a six order of magnitude range, with a mean of 8 x 10 to the minus seventh power meters per second. Variability is related to contouring, seasonal variations, and spatial variation of spoil lithology. The hydraulic properties of coal bearing units vary both within and between mines. Disregard for the heterogeneities of a coal aquifer can result in problems in the development of a dewatering plan and in the prediction of the effect of the mine on local water supply wells. (Titus-FRC)
W82-00278

GROUND-WATER MODELING: RECENT DEVELOPMENTS,
GeoTrans, Inc., Reston, VA.
C. R. Faust, and J. W. Mercer.
Ground Water, Vol 18, No 6, p 569-577, November-December, 1980. 2 Fig, 2 Tab, 40 Ref.

Descriptors: *Groundwater, *Computer programs, *Model studies, *Hydrogeology, *Calibrations, Mathematical models, Technology, Computer models, Computer applications, Flow, Data interpretation, Mathematical analysis.

Recent developments in groundwater modeling are reviewed. Current research in this field is influenced by two factors, the state of model evolution and computer capabilities. Groundwater flow in saturated porous media is an area for which models are well-developed because confidence in the results is high. The problem of data adequacy is being addressed in research on parameter estimation. In addition, transport modeling and the boundary integral method, a new solution technique, are the focus of current research efforts. The need to develop accessible models and convenient computer techniques is growing as more uses are found for these tools in hydrology and in administrative professions. (Titus-FRC)
W82-00281

GROUND-WATER FLOW AND URANIUM IN COLORADO PLATEAU,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
N. V. Ortiz, J. A. Ferentchak, F. G. Ethridge, H. C. Granger, and D. K. Sunada.
Ground Water, Vol 18, No 6, p 596-606, November-December, 1980. 17 Fig, 2 Tab, 19 Ref.

Descriptors: *Flow, *Porosity, *Uranium, *Geochemistry, *Groundwater, Hydrogeology, Aquifers, Finite difference methods, Piezometers, Flumes, Pumps, Data interpretation, Permeability, Precipitate, *Colorado Plateau, Ore deposits.

The precipitation of humates at the interface between a humic acid solution and an aluminum potassium sulfate solution was studied in porous media models to gain some insight into the deposition of Colorado Plateau type uranium deposits. The effects of variable flow rates, porous-media layering, mudstone lenses, fluid density differences, and geochemical reactions on the flow phenomenon and the resulting precipitate were evaluated. A numerical model was developed to predict the shape and location of the interface where precipitation occurs. The precipitate of the humic material was found to occur both parallel and perpendicular to the general flow path, at the interface between two solutions. Results also indicate that the precipitate deposits are larger when the contact time between the two fluids is large. Any variation in flow rate can significantly influence the location of the precipitate. The association of precipitate bands with modeled sedimentary features and the similarities between these precipitate bands and actual deposits in the Colorado Plateau suggest that these model studies provide data useful both in understanding and predicting the relations between tabular ore deposits and groundwater flow patterns. (Titus-FRC)
W82-00282

GROUND-WATER INFORMATION: NWWA PROVIDES THE RESOURCES,
National Water Well Association, Worthington, OH.
J. Poland.
Ground Water, Vol 18, No 6, p 541-543, November-December, 1980.

Descriptors: *Literature review, *Publications, *Information exchange, *Libraries, Groundwater, Reviews, Technology, Documentation, Information retrieval, Information systems, Rural areas, Developing countries.

The National Water Well Association's library and information center is developing a bibliographic data base of hydrogeological references. Resources of the library include over 9000 volumes of books, journals, reports, and newsletters. Information on developing countries as well as on rural America is available. In addition, computer searching and retrieval and manual searching services are offered. (Titus-FRC)
W82-00301

POSSIBILITIES OF USING HELIUM AND TRITIUM SURVEYS FOR STUDYING RECHARGE CONDITIONS OF SUBSURFACE WATERS,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 7B.
W82-00302

GARRETT COUNTY WATER-WELL RECORDS, CHEMICAL-QUALITY DATA GROUND-WATER USE, COAL TEST-HOLE DATA AND SURFACE-WATER DATA.
Geological Survey, Towson, MD. Water Resources Div.
Maryland Geological Survey Water Resources Basic Data Report No 11, 1980. 102 p, 5 Fig, 2 Plates, 10 Tab, 21 Ref. (Compiled by Nutter, L. J., Smigaj, M. J., and Knobel, L. L.).

Descriptors: *Groundwater, *Hydrologic data, *Water quality, *Chemical analysis, Wells, Groundwater availability, Geologic units, Water use, Surface water, Flow measurement, Low flow, Flood frequency, *Maryland, Garrett County.

This report is a compilation of selected water-well records, selected spring records, gas-well records, chemical-quality data, water-use data, coal test-hole records, and surface-water data for Garrett County, Maryland. Included are records of about 1,100 water wells, 120 springs, 210 gas wells, 70 coal test holes, 56 chemical analyses of ground water, surface-water data from 8 continuous-record sites, and miscellaneous measurements from 11 sites. (USGS)
W82-00395

ALTITUDE OF WATER TABLE, BISCAYNE AQUIFER, DADE COUNTY, FLORIDA, MAY 1980,
Geological Survey, Miami, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-00409

ALTITUDE OF WATER TABLE, BISCAYNE AQUIFER, DADE COUNTY, FLORIDA, OCTOBER 1979,
Geological Survey, Miami, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-00410

ALTITUDE OF WATER TABLE, BISCAYNE AQUIFER, DADE COUNTY, FLORIDA, MARCH 1979,
Geological Survey, Miami, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-00411

GROUND-WATER RESOURCES OF THE WHITE RIVER BASIN, MADISON COUNTY, INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 2A.
W82-00412

WATER-LEVEL RECORDS FOR THE NORTHERN HIGH PLAINS OF COLORADO, 1977-81,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-00422

HYDROGEOLOGIC DATA FROM TEST DRILLING NEAR VERNA BEACH, FLORIDA, 1978,
Geological Survey, Tallahassee, FL. Water Resources Div.
M. Barker, G. Bowman, and H. Sutcliffe, Jr.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $3.75 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-634, 1981. 26 p, 7 Fig, 3 Tab, 5 Ref.

Descriptors: *Water quality, *Observation wells, *Rotary drilling, *On-site data collections, *Geohydrology, Lithologic logs, Water sampling, Chemical analysis, Pumping, Drawdown, *Florida, *Verna, Well fields.

Four test wells were drilled in the vicinity of the city of Sarasota well field near Verna, Fla., to provide hydrologic and geologic information. An expedient and economical method of air lifting water samples from isolated water-producing zones while drilling was utilized. Lithologic logs of drill cuttings and geophysical logs, including point resistance and spontaneous potential electric logs, gamma-ray logs, and caliper logs, were made. Chemical quality of water was determined for principal producing zones at each well. Dissolved solids from composite water samples ranged from 313 milligrams per liter in test well 0-1 north of the well field to 728 milligrams per liter in test well 0-3 within the well field. Each test well was pumped to determine maximum discharge, water-level drawdown, and recovery time. A leaking pump column on test well 0-1 prevented accurate measurement of drawdown on the well. Test well 0-2, located east of the well field, had a pumping rate of 376 gallons per minute and 13.11 feet of drawdown after 3 hours and 50 minutes; test well 0-3 had a maximum yield of 320 gallons per minute, a drawdown of 31.91 feet after 2 hours and 35 minutes of pumping, had a recovery time of 20 minutes; and test well 0-4, south of the well field, had a pumping rate of 200 gallons per minute with 63.34 feet of drawdown after 2 hours and 35 minutes. (USGS)
W82-00424

PREDICTED EFFECTS ON GROUND WATER OF CONSTRUCTION OF DIVIDE CUT SECTION, TENNESSEE-TOMBIGBEE WATERWAY, NORTHEASTERN MISSISSIPPI USING A DIGITAL MODEL,
Geological Survey, Jackson, MS. Water Resources Div.
M. S. McBride.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $7.00 in paper

copy, $3.50 in microfiche. Geological Survey Open-File Report 81-649, 1981. 50 p, 25 Fig, 1 Tab, 52 Ref.

Descriptors: *Groundwater, *Waterways, Navigation, *Drawdown, *Forecasting, Model studies, Simulation, Geology, Channeling, Artifical lakes, Dams, Groundwater movement, Wells, Water level, Drawdown, Hydrographs, *Mississippi, *Tennessee-Tombigbee Waterway, Tennessee River, Tombigbee River, *Canal construction.

The Tennessee-Tombigbee Waterway, connecting the Tennessee River in northeastern Mississippi with the Gulf of Mexico, is currently (1980) under construction. The Divide Section, the northernmost 39 miles of the Waterway, will consist, from north to south, of (1) a dredged channel, (2) the Divide Cut, and (3) an artifical lake impounded by the Bay Springs Dam. In all three, water will be at Tennessee River level. A three-dimensional digital model covering 3,273 square miles was constructed to simulate ground-water flow in the Gordo and Eutaw Formations and the Coffee Sand in the vicinity of the Divide Section. The model was calibrated to preconstruction water levels, then used to simulate the effects of stresses imposed by the construction of the Divide Section. The model indicates that the system stabilizes after major changes in conditions within a few months. The Divide Cut acts as a drain, lowering water levels as much as 55 feet. Drawdowns of 5 feet occur as much as 8 miles from the Cut. The 80-foot-high Bay Springs Dam raises ground-water levels by 5 feet as far as 6 miles from its impoundment. Drawdown is not likely to affect public water supplies significantly, but probably will adversely affect a relatively small number of private wells. (USGS)
W82-00428

2G. Water In Soils

MODELING GRAIN SORGHUM RATOON CROPPING AND ASSOCIATED RUNOFF AND SEDIMENT LOSSES,
Science and Education Administration, Temple, TX. Blackland Conservation Research Center.
D. L. Stinson, G. F. Arkin, T. A. Howell, C. W. Richardson, and J. R. Williams.
Transactions of the ASAE, Vol 24, No 3, p 631-635, 642, May/June, 1981. 6 Fig, 2 Tab, 7 Ref.

Descriptors: *Sorghum, *Mathematical models, *Crop yield, Runoff, Crop production, Sediments, Soil erosion, Water quality, Soil water, Growth, Agriculture, Ratoon cropping.

A practical method was developed to quantitatively describe the effects of ratoon cropping (producing a new crop without replanting) grain sorghum on water quality and quantity parameters and on crop growth and yield. Simulation was used to evaluate the effects of ratoon cropping grain sorghum on volume and sediment load of runoff water. Also, simulation was used to evaluate the effects on availability of soil moisture as it related to crop growth and yield. A growth crop model and a hydrologic model were combined. In only 9 of the 40 years simulated would a ratoon (second) crop have yielded 1500 kg/ha or more. Runoff, evapotranspiration, seepage, sediment yields, total crop yields, and plant crop yields for ratoon cropping were significantly different at the 5% level from those for single cropping for the 9 years with acceptable ratoon crops. The probability of producing a 1500 kg/ha ratoon grain crop yield starting with a fully recharged soil water profile at the plant (initial) crop harvest time was 70%. (Small-FRC)
W82-00113

SOIL HYDRAULIC STABILITY IN A SUBSURFACE DRAINAGE SYSTEM,
Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.
Z. A. Samani, and L. S. Willardson.
Transactions of the ASAE, Vol 24, No 3, p 666-669, May/June, 1981. 3 Fig, 2 Tab, 6 Ref.

Descriptors: *Hydraulic gradient, *Soil stability, *Soil saturation, Erosion, Drainage systems, Permeability coefficient, Plasticity, Mathematical equations, Estimating equations, Soil water.

An indirect way was developed to evaluate the hydraulic stability of saturated soils in the immediate vicinity of a subsurface drain. Six soils from Utah, one from Ohio, and five from Michigan were tested to identify their hydraulic failure gradients. Plasticity index and hydraulic conductivity were correlated with hydraulic failure. Thus, soil stability and density can be used to estimate the internal water flow gradient at which hydraulic failure of the soil structure will occur. An equation was developed which can be used to estimate the hydraulic failure of soils. An increase in soil density or compaction will increase the value of the gradient of hydraulic failure. Data on hydraulic failure can be used with drainage design information to determine whether a drain envelope is needed. It is also possible to calculate the thickness of the envelope or drain diameter. (Small-FRC)
W82-00115

TRANSIENT SOIL MOISTURE MOVEMENT THROUGH LAYERED SOILS USING A FINITE ELEMENT APPROACH,
Pennsylvania State Univ., University Park. Dept. of Agricultural Engineering.
R. Pall, A. R. Jarrett, and C. T. Morrow.
Transactions of the ASAE, Vol 24, No 3, p 678-683, May/June, 1981. 13 Fig, 1 Tab, 21 Ref.

Descriptors: *Mathematical models, *Fluid flow, *Soil water, Porous media, Flow, Mathematical studies, Finite element method, Darcys law, Soil environment, *Soil water movement.

A numerical model to study transient vertical moisture flow through homogeneous and layered soils under isothermal conditions was developed, which uses a finite element approach. The principles of Darcy law flow and mass balance were applied to each element of a flow system to obtain the soil moisture conditions at each time. The model gave results comparable to the numerical method of Hanks and Bowers (1962). One advantage of the new model is that it can be easily programmed. The model is efficient because it does not use the partial differential equation of unsaturated flow which saves computer time. There is physical meaning to the steps in computation because the physical laws of flow through porous media and mass conservation appear explicitly in the model. Unlike other models, the procedure is straight forward, flexible in application, and does not require complex algebraic manipulation. The model can handle both heterogeneous soil and non-uniform initial moisture conditions. (Small-FRC)
W82-00133

AN INFILTRATION MODEL: DEVELOPMENT AND EVALUATION OF ITS PARAMETERS,
Kentucky Univ., Lexington. Dept. of Agricultural Engineering.
B. N. Wilson, D. C. Slack, and C. L. Larson.
Transactions of the ASAE, Vol 24, No 3, p 670-677, 683, May/June, 1981. 7 Fig, 4 Tab, 21 Ref.

Descriptors: *Mathematical models, *Rainfall infiltration, *Ponding, *Soil water, Infiltration, Mathematical studies, Air-water interfaces, Porous media, Flow, Gravity flow.

An infiltration model, called ART, was developed which considers air viscous forces and models a Buckley-Leverett profile at ponding and subsequent infiltration events. It is based on a constant rainfall rate prior to surface ponding and on the assumption that the surface remains at field saturation for the remainder of the event. It also assumes a deep homogeneous soil profile at a uniform initial moisture content. Gravity and resistance flow components are evaluated by associating them with similar flow components in a modified Green-Ampt-Mein-Larson model. The model is efficient and uses less computer time than other approaches, and explicity demonstrates the physical laws of flow through porous media and mass conservation. The procedure is straight forward, flexible in application, and does not require complex algebraic manipulations. It was developed to handle both heterogeneous soil and non-uniform initial moisture conditions. (Small-FRC)
W82-00137

A MORE VERSATILE SOIL WATER SAMPLER,
North Central Forest Experimental Station, Grand Rapids, MN.
For primary bibliographic entry see Field 7B.
W82-00191

VARIATION IN MICROBIAL ACTIVITY IN HISTOSOLS AND ITS RELATIONSHIP TO SOIL MOISTURE,
Agricultural Research and Education Center, Belle Glade, FL.
R. L. Tate, III, and R. E. Terry.
Applied and Environmental Microbiology, Vol 40, No 2, p 313-317, August, 1980. 3 Fig, 5 Tab, 11 Ref.

Descriptors: *Microbial degradation, *Soil moisture, Organic soil, *Cropland, Sugarcane, Soil water, Dehydrogenase, Enzymes, Bacteria, Oxidation, Aerobic bacteria, Anaerobic conditions.

Dehydrogenase activity and microbial biomass were examined to further elucidate the factors limiting the oxidation of soil organic matter in drained, cultivated histosols. Biomass provided an indication of the overall variation in microbial populations, whereas dehydrogenase reflected the respiratory rate of the microbial community. The variation of these activities, aerobic carbon metabolism, and aerobic bacterial populations with soil moisture were studied to determine the effects of moisture on overall soil microbial activity and to elucidate the relationship between aerobic and anaerobic catabolism of soil organic matter in Pahokee muck. Dehydrogenase activity was 2- to 7-fold greater in soil cropped to St. Augustinegrass compared with uncropped soil. Biomass ranged from equivalence in the two soils to a 3-fold stimulation in the cropped soil. Biomass in soil cropped to sugarcane approximated that from the grass field, whereas dehydrogenase activities of the cane soil were nearly equivalent to those of the fallow soil. Microbial biomass, dehydrogenase activity, aerobic bacterial populations, and salicylate oxidation rates all correlated with soil moisture levels. These data suggest that within the moisture ranges detected in the surface soils, increased moisture stimulated microbial activity, whereas within the soil profile where moisture ranges reached saturation, increased moisture inhibited aerobic activities and stimulated anaerobic processes.
W82-00244

A COMPARATIVE STUDY OF THREE FORMS OF THE RICHARD EQUATION USED FOR PREDICTING ONE-DIMENSIONAL INFILTRATION IN UNSATURATED SOIL,
Universite Scientifique et Medicale de Grenoble (France). Inst. de Mecanique.
R. Haverkamp, and M. Vauclin.
Soil Science Society of America Journal, Vol 45, No 1, p 13-20, 1981. 9 Fig, 22 Ref.

Descriptors: *Mathematical equations, *Unsaturated flow, *Infiltration, Mathematical analysis, Mathematical models, Finite difference methods, *Soil water, Feasibility studies, Comparison studies.

The performance of three finite difference models, each of which is based on a different means of expressing the Richard transient water transfer equation, is compared with respect to precision, time consumption, and economic feasibility. The three models were tested on both a quasi-analytical solution and on experimental results for two different types of soil and for two upper boundary conditions (Dirichlet and Neumann). The best results were obtained with the Kirchhoff model, which was not affected by weighting problems. The model based on the local balance form of the Richard equation was slightly influenced by weighting errors, but was less time consuming than the model based on the Kirchhoff integral transfor-

mation. The model based on the nonconservative decomposed form of the Richard equation was highly influenced by weighting errors and gave the worst results. The range of operation of the decomposed model is also limited with respect to the choice of mesh ratios. The performances of the three models were independent of the chosen upper boundary condition. Nomograms can be evaluated for the three models, relating as a function of the chosen space and time step the performances of the models in terms of precision, amounts of water infiltrated, and computer time. These nomograms can help the user select the correct discretization scheme for the problem under consideration. Since the tests, which were conducted on two types of soil with totally different hydrodynamic properties, led to qualitatively identical results, it is reasonable to expect similar results on other types of soil. (Carroll-FRC)
W82-00328

AREAL PREDICTIONS OF WATER AND SOLUTE FLUX IN THE UNSATURATED ZONE,
Arizona Univ., Tucson. Dept. of Soils, Water, and Engineering.
For primary bibliographic entry see Field 6A.
W82-00381

TWO-DIMENSIONAL LINEARIZED MOISTURE FLOW WITH WATER EXTRACTION,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
For primary bibliographic entry see Field 2I.
W82-00405

EFFECTS OF TOPSOIL AND SUBSOIL THICKNESS ON SOIL WATER CONTENT AND CROP PRODUCTION ON A DISTURBED SOIL,
Science and Education Administration, Mandan, ND. Northern Great Plains Research Center.
J. F. Power, F. M. Sandoval, R. E. Ries, and S. D. Merrill.
Soil Science Society of America Journal, Vol 45, No 1, p 124-129, 1981. 2 Fig, 7 Tab, 9 Ref.

Descriptors: *Soil water, *Crop production, *Soil profiles, Topsoil, Subsoil, Soil horizons, Land reclamation, Spoil banks, Mine wastes, Crop yields.

There is very little quantitative data on the effects of soil thickness upon crop production in semiarid regions. Soil thickness may affect plant rooting depth and the quantity of soil water available for plant growth. This will affect crop growth potentials, especially when the underlying material is a poor medium for plant root activity, as are sodic mine spoils. The research reported in this paper, which was conducted in connection with mined land reclamation research, involved reconstruction of soil by building a wedge ranging from 0 to 210 cm thick with productive subsoil on top of leveled sodic mine spoils derived from shale. This subsoil wedge was then covered with 0, 20, or 60 cm of topsoil. A fourth treatment involving mixing subsoil and topsoil within the wedge in a 3 to 1 ratio. Alfalfa, crested wheat grass, native grasses, and spring wheat were grown on the plots for five years. Yields of all crops increased as total soil thickness increased to the 90 to 150 cm range. All crops except wheat produced at least 90% of the maximum yield with at least 90 cm of mixed topsoil and subsoil spread over the spoils. Water was extracted from the upper 30 to 90 cm of spoils when the soil-spoil interface was within 90 cm of the soil surface. Thickness of the topsoil had no effect on depth of water extraction. Alfalfa extracted water to about 135 cm if sodic spoils were within 90 cm of the surface and to about 175 cm where spoils were covered with at least 150 cm of soil materials. Depth of water extraction under these two situations was about 120 and 150 cm, respectively, for crested wheatgrass, 80 and 120 cm for native grasses, and 75 and 90 cm for spring wheat. There was no evidence of any accumulation of soil water just above the soil-spoil interface under any situation. (Carroll-FRC)
W82-00465

UNSATURATED WATER FLOW THROUGH A SIMULATED WHEEL TRACK,
Science and Education Administration, Morris, MN.
D. C. Reicosky, W. B. Voorhees, and J. K. Radke.
Soil Science Society of America Journal, Vol 45, No 1, p 3-8, 1981. 10 Fig, 1 Tab, 14 Ref.

Descriptors: *Soil physical properties, *Flow characteristics, *Soil compaction, Soil water potential, Compaction, Tensiometers, Conductivity, Cropland, Hydraulic gradient, Soil moisture retention, Soil porosity, Plant growth.

Soil physical properties which affect plant growth can be altered by wheel-track compaction. This study investigated the effect of a simulated wheel track on water movement and soil matric potential distribution under laboratory conditions. The 2 millimeter fraction of the surface layer of a Barnes loam was packed into a soil container large enough to permit a 40-centimeter wide wheel track to be simulated midway between two plant rows spaced 75 centimeters apart. The simulated wheel track was imposed using a compaction tool attached to a penetrometer proving ring that compacted the soil in 25 square centimeter segments at a pressure of 3.25 kilograms per square centimeter. Miniature spring-loaded tensiometers installed at 5 centimeter grid spacings in the wall of the soil container were used to measure hydraulic head. Water content, bulk density, and penetrometer resistance were measured in experimental runs with soil packed wet and packed dry. The change in the pore size distribution that resulted from increased bulk density significantly affected water flow properties of the soil. There were marked reductions in both saturated and unsaturated conductivity with increase in soil bulk density. The water retention curves were also significantly altered by increasing the bulk density. Lower hydraulic heads and larger hydraulic gradients were found under simulated wheel-tracked compaction than under the non-wheel-tracked area. Two-dimensional plots of hydraulic head at selected times showed that isopotential lines curved around the wheel-tracked area. The data suggest that there is less water flow in the wheel track than in surrounding soil. (Carroll-FRC)
W82-00473

2H. Lakes

EFFECTS OF MOUNT ST. HELENS ERUPTION ON SELECTED LAKES IN WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
N. P. Dion, and S. S. Embrey.
Available from the Branch of Distr., USGS, 604 Pickett St. Alexandria, VA 22304. Geological Survey Circular 850-G, 1981. 25 p, 11 Fig, 10 Tab, 11 Ref.

Descriptors: *Lakes, *Volcanoes, *Limnology, *Water quality, Chemical property, Physical property, Ecosystems, *Washington, *Mount St. Helens, Spirit Lake, St. Helens Lake, Fawn Lake, Venus Lake, Walupt Lake, Warden Lake, Sprague Lake, Amber Lake, *Volcanic ash.

The cataclysmic eruption of Mount St. Helens altered the physical, chemical, and biological characteristics of numerous Washington lakes. As would be expected, those lakes closest to the volcano were the ones affected most by the eruption. Spirit Lake can now be considered a completely different lake because of its higher altitude, larger area, shallower depth, and changed hydrology, biology, and water chemistry. Water-quality changes were observed only in the lakes situated in the blast zone of the volcano. The changes included increases in most chemical constituents and reductions in transparency. Productivity levels in these lakes, as estimated by chlorophyll a concentrations, probably increased. No chemical or biological changes were observed in lakes that received only ashfall. (USGS)
W82-00006

PREDICTING LAKE LEVELS BY EXPONENTIAL SMOOTHING,
Department of the Environment, Edmonton. Div. of Design and Construction.
For primary bibliographic entry see Field 2A.
W82-00118

NITROGEN FIXATION AND THE NITROGEN BUDGET OF A EUTROPHIC IMPOUNDMENT,
National Inst. for Water Research, Pretoria (South Africa).
P. J. Ashton.
Water Research, Vol 15, No 7, p 823-833, July, 1981. 12 Fig, 4 Tab, 29 Ref.

Descriptors: *Nitrogen fixation, *Reservoirs, *Eutrophication, Nutrients, Eutrophic lakes, Lakes, Phosphorus, Nitrification, Ammonification, Anabaena circinalis, Rietvlei Dam, *South Africa.

At Rietvlei Dam, South Africa, eutrophic and N-limited, three summer blooms (1975-77) of Anabaena circinalis produced between 1.1 and 24.5 tons of nitrogen by fixation. This represented 1.4%-46.5% of the total annual inflow of combined N. Soluble organic N is a major part of the N pool in the impoundment, and ammonification and nitrification produce large quantities of inorganic N from organic material. High water temperatures, low concentrations of combined N, and low flow promote the fixation process. The N:P ratios in the outflow show sharp peaks (4, 10, and 18) during summer algal blooms, whereas the inflow N:P ratios remain relatively constant throughout the year, about 1-2. (Cassar-FRC)
W82-00127

ANAEROBIC METHANE OXIDATION: OCCURRENCE AND ECOLOGY,
Wisconsin Univ.-Madison. Dept. of Bacteriology.
A. J. B. Zehnder, and T. D. Brock.
Applied and Environmental Microbiology, Vol 39, No 1, p 194-204, January, 1980. 8 Fig, 6 Tab, 33 Ref.

Descriptors: *Oxidation, *Methane, *Sediments, Sludge, *Anaerobic conditions, Lakes, Lake Mendota, Wastewater, Iron, Sulfates, Sulfides, Lake sediments, Mud, Wisconsin.

Freshwater sediments were taken from Lake Mendota, a hard-water eutrophic dimictic lake with a mud bottom. The water overlying the sediments is anoxic and contains hydrogen sulfide. The sediments actively produce methane during the entire year. Samples were taken in the deepest section of the lake with a water column depth of 23 meters. Anoxic sediments and digested sewage sludge anaerobically oxidized methane to carbon dioxide while producing methane. This strictly anaerobic process showed a temperature optimum between 25 and 37 degrees C, indicating an active microbial participation in this reaction. Methane oxidation in these anaerobic habitats was inhibited by oxygen. The rate of the oxidation followed the rate of methane production. The observed anoxic methane oxidation in Lake Mendota and digested sewage sludge was more sensitive to 2-bromoethanesulfonic acid than the simultaneous methane formation. Sulfate diminished methane formation as well as methane oxidation. However, in the presence of iron and sulfate the ratio of methane oxidized to methane formed increased markedly. Manganese dioxide and higher partial pressures of methane also stimulated the oxidation. The rate of methane oxidation in untreated samples was about two percent of the methane production rate in Lake Mendota sediments and eight percent of that in digested sludge. This percentage could be increased up to 90% in sludge in the presence of 10 mM ferrous sulfate and at a methane partial pressure of 20 atmospheres. (Baker-FRC)
W82-00218

IMPACT OF CONSTRUCTION OF A HYDROELECTRIC PROJECT ON THE WATER QUALITY OF FIVE LAKES IN NOVA SCOTIA,
Department of the Environment, Halifax (Nova Scotia).

For primary bibliographic entry see Field 5C.
W82-00227

RESONATOR STUDIES FOR KINCARDINE HARBOUR, LAKE HURON,
McMaster Univ., Hamilton (Ontario). Dept. of Civil Engineering and Engineering Mechanics.
For primary bibliographic entry see Field 8B.
W82-00228

ARE SIERRA LAKES BECOMING ACID,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 5C.
W82-00231

DISTRIBUTION AND TRANSPORT OF HEAVY METALS IN THE SEDIMENTS OF A SMALL NORTHERN EUTROPHIC LAKE,
Alberta Environmental Center, Vegreville.
For primary bibliographic entry see Field 5B.
W82-00235

EXPERIMENTAL STUDIES ON THE EFFECT OF ARSENIC ON MICROBIAL DEGRADATION OF ORGANIC MATTER AND ALGAL GROWTH,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
G. J. Brunskill, B. W. Graham, and J. W. M. Rudd.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 3, p 415-423, March, 1980. 7 Fig, 4 Tab, 41 Ref.

Descriptors: *Eutrophication, *Wastewater disposal, *Arsenic, Water pollution effects, Lakes, Nutrients, Phosphorus compounds, Nitrogen compounds, Phytoplankton, Algae, Organic matter, Bacteria, *Microbial degradation, Degradation, Particulate matter, Chemical reactions, Ontario.

The effects of arsenate and arsenite on microbial degradation of organic matter in lake water were studied in experimental tubes in Lake 303 at the Experimental Lakes Area, Northern Ontario. Results on this lake suggested that addition of domestic sewage to Kam Lake, Northwest Territories, containing 30-50 micromoles per liter of arsenic from gold mine tailing pond water, would restrain eutrophication. Summer degradation of organic matter was not inhibited by As, and dissolved P remained high, making more P available for outflow downstream. Arsenic depressed the rates of formation of particulate P and planktonic uptake of dissolved P. Summer blooms are not expected to be as extensive due to As inhibition of P uptake by the plankton. Under winter ice 40 micromoles per liter arsenate or arsenite inhibited microbial degradation by 50%. Under aerobic conditions, arsenite was oxidized at the rate of two micromoles per liter per day. Summer rates were similar. Under anaerobic conditions arsenate was reduced at the rate of one micromole per liter per day. (Cassar-FRC)
W82-00237

SULFHYDROLASE ACTIVITY IN SEDIMENTS OF WINTERGREEN LAKE, KALAMAZOO COUNTY, MICHIGAN,
Michigan State Univ., Hickory Corners. W. K. Kellogg Biological Station.
G. M. King, and M. J. Klug.
Applied and Environmental Microbiology, Vol 39, No 5, p 950-956, May, 1980. 4 Fig, 3 Tab, 17 Ref.

Descriptors: Sediments, Lakes, *Sulfates, Enzymes, *Wintergreen Lake, *Michigan, Hypolimnion, Sulfides, Oxidation, *Lake sediments.

An initial characterization of the ester sulfate cycle in anoxic sediments of Wintergreen Lake, Michigan, is presented. Significant levels of sulfhydrolase activity were found in littoral, transition, and profundal sediment samples. Rates of sulfate formation suggest that the sulfhydrolase system would represent a major source of sulfate within these sediments. Sulfate formed by ester sulfate hydrolysis can support dissimilatory sulfate reduction as indicated by the incorporation of S-35 from labeled sodium dodecyl sulfate into S-35 labeled hydrogen sulfide. Sulfhydrolase activity varied with sediment depth, was greatest in the littoral zone, and was sensitive to the presence of oxygen. Estimations of ester sulfate concentrations in sediments revealed large quantities of ester sulfate. Both total sulfur and ester sulfate concentrations varied with the sediment type and were two to three orders of magnitude greater than the inorganic sulfur concentration. (Baker-FRC)
W82-00241

COMPARISON OF IN SITU AND IN VITRO RATES OF METHANE RELEASE IN FRESHWATER SEDIMENTS,
Michigan Univ., Ann Arbor. Dept. of Environmental and Industrial Health.
C. A. Kelly, and D. P. Chynoweth.
Applied and Environmental Microbiology, Vol 40, No 2, p 287-293, August, 1980. 2 Fig, 4 Tab, 26 Ref.

Descriptors: *Sediments, *Methane, Lakes, Microbial degradation, Natural waters, Seasonal variations, Lake sediments, Comparison studies.

A study was made of anaerobic lake sediment incubated in vitro for its ability to mimic natural in situ sediment activities, using rate of methane production for the comparison. Two lakes with different rates and seasonal patterns of methanogenic activity were compared. During the study 82 cores were taken and 200 individual sections were incubated. There was good agreement between rates of in situ methane release and initial rates of production measured in vitro in surface sediment. The evidence indicated that it is the in situ surface sediment methane production which is primarily responsible for maintaining in situ methane release, and thus the above agreement was what was expected if surface in situ activity was maintained in vitro. When deeper sediment was investigated, the sum of in vitro rates from 0 to 20 cm was much higher than in situ release rates and would have resulted in an impossibly high volume of gas. The extra gas could not have been stored within the sediments. It was concluded that the in situ methanogenic activity of the 0 to 3 cm anaerobic surface sediments could be preserved during removal and laboratory incubation. However, similar treatment of deeper sediment appeared to stimulate methanogenic activity. (Baker-FRC)
W82-00245

FACTORS AFFECTING PHOSPHORUS RELEASE FROM INTACT LAKE SEDIMENT CORES,
Wisconsin Univ.-Madison. Water Chemistry Lab.
G. C. Holdren, Jr., and D. E. Armstrong.
Environmental Science and Technology, Vol 14, No 1, p 79-87, January, 1980. 7 Fig, 6 Tab, 37 Ref.

Descriptors: *Sediments, *Phosphorus, *Lakes, *Lake sediments, Limnology, Lake morphology, Lake stages, Epilimnion, Temperature effects, Eutrophication, Wisconsin, Oxidation-reduction potential.

This investigation considered the effects of mixing, redox potential, temperature, bioturbation, and sediment type in lakes on phosphorus release. Since phosphorus release into anoxic hypolimnetic waters can be approximated by diffusion models, only epilimnetic sediments were investigated. Intact sediment cores from epilimnetic areas of four Wisconsin lakes were incubated in the laboratory to determine the effects of various environmental parameters on sediment phosphorus release. Bioturbation was found to have the greatest effect on phosphorus release rates. Raising the temperature or lowering oxygen concentrations in the overlying water also led to increased release rates, while suspension of sediment and lowering the temperature removed phosphorus from the water column. Sediment type affected the relative importance of differing incubation conditions, with redox potential having more effect on noncalcareous sediments and temperature having greater effect on calcareous sediments. The results indicate that epilimnetic sediments could contribute significant amounts of inorganic phosphorus to the overlying water in some lakes. (Baker-FRC)
W82-00251

LIGNOCELLULOSE MINERALIZATION BY ARCTIC LAKE SEDIMENTS IN RESPONSE TO NUTRIENT MANIPULATION,
Cincinnati Univ., OH. Dept. of Biological Sciences.
T. W. Federle, and J. R. Vestal.
Applied and Environmental Microbiology, Vol 40, No 1, p 32-39, July, 1980. 6 Fig, 2 Tab, 22 Ref.

Descriptors: *Mineralization, *Arctic zone, *Lake sediments, Lignocellulose, Decomposition, Decomposing organic matter, Deterioration, Degradation, *Nutrients, Nitrogen, Phosphorus, Cellulose, Lignin.

Mineralization of specifically labeled C-14-lignocelluloses by sediments from a remote arctic lake was examined with regard to nutrient concentration and other environmental factors. The mineralizations of the cellulose and lignin components of lignocellulose were found to respond differently to manipulation of nitrogen and phosphorus levels. This suggests that nutrient concentrations, in addition to the relative recalcitrance of the two compounds, may be important in explaining the increased proportion of lignin to cellulose in decomposing litter. Mineralization was measured by quantifying the amount of labeled carbon dioxide released from the substrates. Nitrogen, and to a greater degree, phosphorus additions enhanced the mineralization of white pine cellulose during the summer of 1978. Nitrogen and phosphorus together had no cumulative effect. During the summer of 1979 nitrogen or phosphorus alone had only a slight stimulatory effect on the mineralization of a sedge cellulose, but together they had a dramatic effect. These differences were attributed to yearly variations in the nutrient availability within the lake. (Baker-FRC)
W82-00270

OCCURRENCE OF APHANOMYCES OVIDESTRUENS, A FUNGUS PARASITIC ON COPEPODS, IN TWO EUTROPHIC LAKES,
Otago Univ., Dunedin (New Zealand). Dept. of Zoology.
C. W. Burns.
New Zealand Journal of Marine and Freshwater Research, Vol 14, No 1, p 23-29, 1980. 3 Fig, 1 Tab, 13 Ref.

Descriptors: *Trophic level, *Lakes, *Distribution patterns, Fungi, *Aquatic fungi, Eutrophication, Animal parasites, Parasitism, Predation, Copepods, Aquatic life, Animal diseases, Reproduction, Population dynamics, *Eutrophic lakes, *New Zealand.

The occurrence of Aphanomyces ovidestruens on a freshwater calanoid copepod, Boeckella dilatata Sars, from two lakes in New Zealand is reported. The location and form of the asexual zoospores, oogonia, antheridia, and infection hyphae of the fungus on B. dilatata demonstrated some differences from the description of Aphanomyces ovidestruens. The infection hyphae on B. dilatata did not swell distally into bulbous appressoria, but rather tapered, sometimes accompanied by small constrictions, before branching into fine hyphae in the eggs of the host. The oogonia and oospores were typically larger in the fungus on B. dilatata than in that of Diaptomus gracilis. The oogonial walls of A. ovidestruens on B. dilatata were usually conspicuously roughened, often to the extent of being ornamented with tubercles or spines up to 5 micrometers long. The incidence of infection in the populations of B. dilatata was different in the two lakes and varied throughout the study. (Baker-FRC)
W82-00304

BIOLOGICAL CONSEQUENCES OF TREATING A LAKE WITH HYDROGEN PEROXIDE ON THE PLANKTON BIOCENOSIS (BIOLOGIQUES DU TRAITEMENT D'UN LAC AVEC DU PEROXYDE D'HYDROGENE SUR LA BIOCENOSE PLANCTONIQUE),

Institut National de la Recherche Agronomique, Thonon-les-Bains (France).
G. Balvay.
Water Research, Vol 15, No 6, p 691-696, 1981. 2 Fig, 3 Tab, 8 Ref.

Descriptors: *Plankton, *Hydrogen peroxide, *Toxicity, Rotifers, Biomass, Chlorphyll a, Water treatment, *Dissolved oxygen, Oxidation, Lakes, Phytoplankton, Aquatic life, Ecological effects, Lake Morillon, *France.

In an effort to improve dissolved oxygen conditions in Lake Morillon, France (volume 11,800 cu meters), hydrogen peroxide was added in September 13, 1978--280 kg at 1.5 meters depth and 175 kg at 4 meters depth. There was a decrease in chlorophyll a, phytoplankton biomass, rotifers, and primary producers immediately after addition of the hydrogen peroxide. Recovery began within a week. It was concluded that use of hydrogen peroxide did not endanger the continuity of the plankton biocenosis. (Cassar-FRC)
W82-00305

THE PREDICTION OF LACUSTRINE PHYTOPLANKTON DIVERSITY,
McGill Univ., Montreal (Quebec). Dept. of Biology.
B. D. LaZerte, and S. Watson.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 5, p 524-534, May, 1981. 7 Fig, 4 Tab, 37 Ref.

Descriptors: *Phytoplankton, *Species diversity, *Biomass, Lakes, *Lake Memphremagog, Quebec, Algae, Species composition, *Taxonomy, Prediction, Sampling.

Lake Memphremagog, Quebec, was the site of a two year study performed to test the hypothesis that total phytoplankton biomass can predict phytoplankton community structure independent of its taxonomic composition. A range of diversity numbers, based on proportional biomass, was calculated for each of 133 samples. Biomass was a good predictor of species evenness (relative distribution of biomass) but not species richness (number of species present) provided that counts were rarefied to a fixed and ideally large size. The method is not applicable to under-ice communities and to the extremely low biomass communities immediately after ice-out. Species richness is mainly dependent on season and changes in taxonomic composition. (Cassar-FRC)
W82-00319

HYDROCHEMISTRY OF A DOLOMITE KARST: THE BRUCE PENINSULA OF ONTARIO,
Department of the Environment, Burlington (Ontario). Lands Directorate.
For primary bibliographic entry see Field 2K.
W82-00321

ANALYSIS OF CAPACITY REQUIREMENTS FOR STORAGE RESERVOIRS: A CASE STUDY,
Calgary Univ. (Alberta). Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W82-00341

PREDICTION OF TOTAL PHOSPHORUS CONCENTRATIONS, CHLOROPHYLL A, AND SECCHI DEPTHS IN NATURAL AND ARTIFICIAL LAKES,
Iowa State Univ., Ames. Dept. of Animal Ecology.
D. E. Canfield, Jr., and R. W. Bachmann.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 4, p 414-423, April, 1981. 4 Fig, 5 Tab, 27 Ref. OWRT-A-063-IA(2).

Descriptors: *Lakes, *Phosphorus compounds, *Prediction, Model studies, Nutrients, Chlorophyll a, Secchi disks, Algae, Transparency, Eutrophication, Sediments, Lake sediments, Sedimentation rates, Artificial lakes, Natural waters.

A model for predicting total phosphorus was developed and tested using data on 704 natural and artificial lakes. It estimates P concentrations over a wide range of lake types at a 95% confidence interval of 31-288% of the calculated total P concentration. Total P concentrations are predicted equally well in natural and artificial lakes, but predictions of algal density as measured by Secchi disc and chlorophyll a concentrations are more reliable for natural lakes than for artificial lakes. This may be a result of non-algal turbidity. This model should be applicable to most lakes within the temperature region of the U.S. and southern Canada except for lakes in closed basins or bays within lakes. (Cassar-FRC)
W82-00400

POSTDEPOSITIONAL MOBILITY OF PHOSPHORUS IN LAKE SEDIMENTS,
McGill University, Montreal (Quebec). Dept. of Biology.
R. Carignan, and R. J. Flett.
Limnology and Oceanography, Vol 26, No 2, p 361-366, March, 1981. 7 Fig, 25 Ref.

Descriptors: *Phosphorus, *Lake sediments, *Migration, Lakes, Sediments, Path of pollutants, Sedimentation, Nutrients, Lake Memphremagog, Quebec, Sediment-water interfaces, Deposition.

Phosphorus in sediments of Lake Memphremagog, Quebec, migrated upward and accumulated near the sediment-water interface in the 2-6 cm layer, as defined by constant Pb210 activity. In this layer, total phosphorus ranged from 2700 to 3300 micrograms per g, whereas the upper 2 cm contained about 2200 micrograms per g and the 7-18 cm layers 1300-1900 micrograms per g. In a 5-week experiment, homogenized sediment was placed in water in an aquarium with aeration and homogeneous mixing. Core samples showed that the total P concentration of the top 1 cm section was 1400 micrograms per g; the 1-2 cm layer was slightly depleted in P, 1100 micrograms per g; and the remainder of the column, 1200 micrograms per g. Interstitial P decreased to 0 at the surface from 1250-1350 micrograms per g in the rest of the profile. Soluble reactive P concentrations were fairly constant, near 200-300 micrograms per g throughout most of the profile, with a sudden increase in the top 1 cm and a slight decrease in the 1-2 cm layer. Iron concentrations behaved in a similar manner. This strongly suggests that upward P and Fe movements were induced by diffusion of interstitial P and Fe along a concentration gradient generated by precipitation in the oxidized surface layer of the sediments. Similar gradients were seen in nondisturbed sediments, indicating that this upward migration operates also under natural conditions. The remobilized P appears to be isotopically exchangeable (or mobile) under anaerobic conditions. Therefore, the total P levels in surface sediments have no relation to the currently sedimenting material, and P levels in the sediment layers may give a false historical P loading profile or P sedimentation rates. (Cassar-FRC)
W82-00474

THE IMPORTANCE OF REGENERATED NITROGEN TO PHYTOPLANKTON PRODUCTIVITY IN A SUBALPINE LAKE,
California Univ., Davis. Div. of Environmental Studies.
R. P. Axler, G. W. Redfield, and C. R. Goldman.
Ecology, Vol 62, No 2, p 345-354, April, 1981. 3 Fig, 4 Tab, 45 Ref.

Descriptors: *Nitrogen, *Phytoplankton, Mineralization, California, Alpine regions, Cold regions, Lakes, Nutrients.

The rate of ammonium regeneration due to zooplankton excretion and microbial mineralization processes were studied in relation to the rate of inorganic nitrogen assimilation by phytoplankton in epilimnetic water. The euphotic zone of dimictic, meso-oligotrophic Castle Lake is characterized by a rapid depletion of both nitrate and ammonium soon after spring thaw. External inputs of nitrogen are minimal during this period of time, and levels of inorganic nitrogen remain low until fall overturn. The rate of ammonium assimilation was high relative to nitrate assimilation, and was significantly correlated with the rate of ammonium regeneration. The importance of this rapid turnover of nitrogen to phytoplankton growth is consistent with the results of previous Castle Lake studies and with the current conceptual model of primary production in the mixed layer of nitrogen-deficient marine ecosystems. (Baker-FRC)
W82-00476

SEASONAL PARTICLE-SIZE SELECTION BY DIAPTOMUS SICILIS IN OFFSHORE LAKE MICHIGAN,
National Atmospheric and Oceanic Administration, Ann Arbor, Mich. Great Lakes Environmental Research Lab.
H. A. Vanderploeg.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 5, p 504-517, May, 1981. 3 Fig, 2 Tab, 52 Ref.

Descriptors: *Food habits, *Copepods, *Particle size, Lakes, Invertebrates, Aquatic animals, *Lake Michigan, Particle shape, Zooplankton, Diaptomus, Seston.

Diaptomus sicilis, a copepod abundant in the Laurentian Great Lakes, showed a relatively invariant pattern of particle-size selection in 23 separate feeding experiments conducted from spring through fall over a 2-year period. This pattern persisted for different feeding rates under varying conditions of particle-size spectrum shape, abundance and food quality of particles, and temperature. In one case, where the curve of filtering efficiency vs. particle size differed from the other curves, grazer-produced particles and/or elongated particles dominated the seston. The invariant selection is not inconsistent with both filtering and raptorial modes of feeding operating simultaneously. Evidence indicates that these organisms feed in a strong passive-mechanical filtering mode that may be supplemented by a raptorial mode that selects large particles of high food quality. (Cassar-FRC)
W82-00485

REDUCTION OF SULFUR COMPOUNDS IN THE SEDIMENTS OF A EUTROPHIC LAKE BASIN,
Michigan State Univ., Hickory Corners. W. K. Kellogg Biological Station.
R. L. Smith, and M. J. Klug.
Applied and Environmental Microbiology, Vol 41, No 5, p 1230-1237, May, 1981. 8 Fig, 1 Tab, 22 Ref.

Descriptors: *Sulfur compounds, *Eutrophic lakes, *Lake sediments, Lakes, Sediments, Lake basins, Chemical reduction, Metabolism, Nutrients, Sulfur, Sulfates, Isotopic tracers.

The significance of sulfate reduction in sediments of inland waters, and especially of fresh water lakes, has not been as extensively characterized as that of marine systems. The distribution of natural sulfur substances (SO4 (2-), H2S, S(0), acid-volatile sulfide, and total sulfur) in the sediments and overlying water column of a eutrophic fresh water lake and the occurrence of significant rates of sulfate reduction in this environment were investigated. Low concentrations of sulfate relative to those of acid-volatile sulfide and total sulfur and a decrease in total sulfur with sediment depth implied that the contribution of dissimilatory sulfur reduction to H2S production was relatively minor. Kinetic experiments with 35S demonstrated an apparent Km of 0.068 mmol of SO4(2-) reduced per liter of sediment per day. Tracer experiments with 35S indicated an average turnover time of the sediment sulfate pool of 1.5 hours. A sediment depth profile to 15 centimeters demonstrated a total sulfate reduction of 15.3 mmol of sulfate reduced per square meter per day, corresponding to a mineralization of 30% of the particulate organic matter entering the sediment. Reduction of 35S(0) occurred at a slower rate. Although these sediments contained low concentrations of oxidized inorganic compounds, the rates of sulfate reduction were high. These results indicate that this reduction can be

important in the anaerobic mineralization of organic carbon. (Carroll-FRC)
W82-00488

2I. Water In Plants

MODELING GRAIN SORGHUM RATOON CROPPING AND ASSOCIATED RUNOFF AND SEDIMENT LOSSES,
Science and Education Administration, Temple, TX. Blackland Conservation Research Center.
For primary bibliographic entry see Field 2G.
W82-00113

SOYROOT - A DYNAMIC MODEL OF SOYBEAN ROOT GROWTH AND WATER UPTAKE,
Punjab Agricultural Univ., Ludiana (India). Dept. of Soil and Water Engineering.
N. K. Narda, and R. B. Curry.
Transactions of the ASAE, Vol 24, No 3, p 651-656, 662, May/June, 1981. 5 Fig, 2 Tab, 31 Ref.

Descriptors: *Soybeans, *Mathematical models, *Growth, Growth rates, Roots, *Root development, *Moisture uptake, Soil-water-plant relationships, Carbohydrates.

SOYROOT, a dynamic model of soybean root growth, was developed from root growth attributes measured in laboratory and field studies, combined with simulated carbohydrate available for root growth. The model was based on evidence that root length provides a better correlation with water uptake by the plant root system than does root weight or number of roots. It consists of a root growth submodel and a macroscopic model of water uptake. Three simulation runs of the model were made using 1978 climatological data for Wooster, Ohio. The SOYMOD/OARDC model when coupled with the SOYROOT model responded to changes in soil moisture content predicted by the macroscopic model. The macroscopic model predicted soil moisture content reasonably well. The SOYROOT model is a first approximation and must be further reviewed and validated. (Small-FRC)
W82-00114

PERFORMANCE OF BEARING CHERRY AND PRUNE TREES UNDER VERY LOW IRRIGATION RATES,
S & E Irrigated Agriculture Research and Extension Center, Prosser, WA.
For primary bibliographic entry see Field 3F.
W82-00119

EFFECT OF IRRIGATION AND TREE DENSITY ON PEACH PRODUCTION,
Department of Agriculture, Harrow (Ontario).
R. E. C. Layne, C. S. Tan, and J. M. Fulton.
Journal of the American Society for Horticultural Science, Vol 106, No 2, p 151-156, March, 1981. 2 Fig, 2 Tab, 22 Ref.

Descriptors: *Crop yield, *Irrigation effects, *Peaches, Orchards, Plant growth, Fruit crops, Trees, Harrow, Ontario, Water stress.

Three irrigation regimes (no irrigation, 25% and 50% available soil moisture, ASM) and three tree planting densities (266, 358, and 536 trees per hectare) were studied in a peach (Prunus persica L. Batsch cv. Harken/Siberian C) orchard planted near Harrow, Ontario, in 1973. The 25% ASM plots were irrigated about four times yearly and the 50% plots, about 12 times per year. The best treatment was the highest tree density and 50% ASM, which increased fruit yields up to 99.5%. Irrigation at 50% ASM increased yields in the first five years of production up to 9.7%. No irrigation and the highest tree density increased yields up to 74.6%. Tree growth in irrigated plots was significantly greater than in unirrigated plots during the early years, 1974 and 1975, when the tree roots were near the surface. From 1976 to 1979 there was no significant difference. Tree growth was reduced by increasing tree density with the exception of 50% ASM and the highest tree density. Fruit size (proportion of marketable fruit) was increased by irrigation and little affected by tree density. There was no significant effect of irrigation or tree density on disease susceptibility or raw product fruit quality. (Cassar-FRC)
W82-00120

EFFECTS OF SOIL WATER REGIME AND NITROGEN FORM ON BLOSSOM-END ROT, YIELD, WATER RELATIONS, AND ELEMENTAL COMPOSITION OF TOMATO,
Missouri Univ., Columbia.
W. G. Pill, and V. N. Lambeth.
Journal of the American Society for Horticultural Science, Vol 105, No 5, p 730-734, September, 1980. 8 Tab, 29 Ref.

Descriptors: *Plants, *Water stress, Water demand, Nutrients, Calcium, Soil water, Potassium, Magnesium, Fertilization, *Nitrogen, *Soil-water-plant relationships, *Blossom-end rot.

A study was conducted to elucidate the interactive effects of soil water regime with NO3-N and NH4-N fertilization on blossom-end rot (BER) incidence and on plant ion concentrations and water stress. Seeds of Missouri breeding line 76-1-60-8 tomato, a relatively BER-susceptible line, were sown in vermiculite. Thirty-six 3-week-old seedlings were transplanted into individual 20 cm clay pots. Eight applications of NO3-N or NH4-N at 28 meq per pot were made at 5 day intervals. Under the two wettest soil water regimes, NH4-N compared to NO3-N fertilization reduced total and mean fruit number, whereas no difference was found under the driest regime. Incidence and severity of BER were increased by NH4 nutrition and by decreasing soil water potential. Decreasing soil water potential did not influence leaf Ca, Mg, or K concentrations, but it did decrease fruit concentration of these ions. At any soil water regime, NH4 fertilization decreased leaf Ca and Mg concentration, but generally increased leaf K and fruit Ca, Mg, and K concentrations. Since leaf diffusive resistance values increased with decreasing soil water potential, but were unaffected by N form, the lower overall transpiration and areal transpiration rates under NH4-N might be explained by increased non-leaf resistances to water flux and/or by reduced soil-plant water potential gradients. (Baker-FRC)
W82-00162

ENVIRONMENTAL RESOURCES AND RESTRAINTS TO AGRICULTURAL PRODUCTION IN A MEDITERRANEAN-TYPE ENVIRONMENT,
University of New England, Armidale (Australia). Dept. of Agronomy and Soil Science.
R. C. G. Smith, and H. C. Harris.
Plant and Soil, Vol 58, No 1-3, p 31-57, 1981. 17 Fig, 3 Tab, 37 Ref.

Descriptors: *Crop production, *Rainfall impact, *Soil water, Rainfall intensity, Rainfall rate, Precipitation, Agriculture, *Mediterranean, Semiarid climates, Arid climates, Soil-water-plant relationships, Crop yield, Model studies.

A dynamic model of a wheat crop was developed to analyze climatic data from a Mediterranean type environment in an effort to assess the relative importance of various environmental constraints. The environmental variables considered included day length, temperature, frost, solar radiation, wind, humidity, rainfall, and soil. This study used climatic data from a typical lowland site at Aleppo, Syria, where sowing generally is accomplished between mid-November and mid-December. The potential growing season, which is the time between the point at which continuous growth begins and the time it must cease because of the shortage of soil water, is determined by the interaction between climate, crop water use, and stored soil water. Annual rainfall during the growing season at Aleppo over a 14-year period varied from 113 millimeters to 453 millimeters and was positively correlated with potential growing season. Soil depth and texture are the major factors affecting the storage of water. The daily soil water balance for 12 years was simulated in order to analyze the variability of the distribution of soil water with depth and over time. Fallowing can be used to even out the availability of soil water from year to year. An evaluation of the crop water use and of the longer term effects of any increase in water use on the soil water carryover and variability of the system should be conducted prior to any change in the crops used in rotations. The ideal wheat variety for this climate would be one which would give modest yields in dry years but which would be yield-responsive in wetter years. (Carroll-FRC)
W82-00329

EFFECTS OF WATER REGIME ON GROWTH, YIELD, AND NITROGEN UPTAKE OF RICE,
International Rice Research Inst. Los Banos (Philippines).
C. S. Khind, and F. N. Ponnamperuma.
Plant and Soil, Vol 59, No 2, p 287-298, 1981. 6 Fig, 3 Tab, 14 Ref.

Descriptors: *Flood irrigation, *Rice, *Denitrification, Crop production, *Crop yield, *Wetlands, Nitrogen removal, Irrigation practices, Irrigation.

About 40% of the world's wetland rice area is rainfed and therefore is not assured of a water supply for continuous soil submergence, often resulting in alternate flooding and drying during the crop season. Since severe nitrogen losses through nitrification-denitrification are caused by alternate wetting and drying of soils, this process is believed to be an important pathway of nitrogen loss in rainfed wetland rice fields. A greenhouse experiment and two field experiments were conducted to investigate the effects of water regime on the performance of rice. The greenhouse experiment involved four water regimes (continuous flooding and soil drying for 16 days followed by reflooding, with drying beginning 2, 5, and 8 weeks after transplanting), four soils, and 0 and 100 milligrams of nitrogen per kilogram. The redox potentials of all soils were raised above the aerobic threshold by soil drying. While none of the soil drying regimes adversely affected soil high in nitrogen, adverse effects in the soil low in nitrogen were noted when soil drying occurred 2 and 5 weeks after transplanting. The field experiments tested the effects of three water regimes (continuous flooding, alternate drying and flooding every 2 weeks, and soil drying for 2 weeks at 6 weeks after transplanting followed by reflooding) and nitrogen concentrations of 1, 50, 100, and 150 kilograms per hectare on a nearly neutral clay soil during two growing seasons. None of the soil drying treatments resulted in decreased growth, yield, or nitrogen uptake by rice at any level of nitrogen in either growing season. Denitrification was not possible on reflooding since nitrate was absent after soil drying. These results indicate that loss of nitrogen due to alternate flooding and drying of soils carrying an established rice crop may not be appreciable, especially if the soil is high in nitrogen. (Carroll-FRC)
W82-00330

A MODEL OF NATURAL AND MAN-INDUCED CHANGES IN OPEN FRESHWATER WETLANDS ON THE MASSACHUSETTS COASTAL PLAIN,
Massachusetts Univ., Amherst. Dept. of Forestry and Wildlife Management.
J. S. Larson, A. J. Mueller, and W. P. MacConnell.
Journal of Applied Ecology, Vol 17, No 3, p 667-673, December, 1980. 1 Fig, 2 Tab, 10 Ref. OWRT-A-121-MASS.(2), 14-34-0001-9023.

Descriptors: *Wetlands, *Succession, *Vegetation, Marshes, Water policy, *Massachusetts, Bogs, Freshwater marshes, Agriculture, Shallow water, Construction, Road construction, Aquatic plants, Land use, Bristol, Environmental effects.

Aerial photography and cover maps were used to measure changes in open freshwater wetlands (not including wooded wetlands) in Bristol, Massachusetts, between 1951 and 1971. Nearly half of the 3958.9 hectare area showed changes in vegetation class. Over 900 hectares of wetlands were lost during the 20-year period. Natural succession pro-

duced more changes in vegetation (1485.2 hectares) than man-induced causes (total 560.0 hectares). Agriculture (82.9 hectares), cranberry culture (82.9 hectares), highway construction (84.5 hectares), and reservoirs and impoundments (103.1 hectares) were the leading man-induced causes of wetland changes. Although northeast U.S. wetlands are considered relatively stable, this data suggests a dynamic process. The main sequence moves from open water, through vegetated open water, deep marsh, shallow marsh, shrub swamp, to wooded wetland. Branches from this main sequence include dead woody deep marsh, cranberry bog, seasonally flooded flat, and meadow. (Cassar-FRC)
W82-00397

TWO-DIMENSIONAL LINEARIZED MOISTURE FLOW WITH WATER EXTRACTION,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
A. W. Warrick, and D. O. Lomen.
Journal of Hydrology, Vol 49, No 3/4, p 235-246, 1981. 4 Fig, 12 Ref. OWRT-B-064-ARIZ(6).

Descriptors: *Moisture, *Sinks, Flow velocity, Fluctuations, Plant water potential, Hydrology, Soil-water-plant relationships, Soil water.

Analytical solutions for two-dimensional sources are presented, with the flow into the system balanced by space-distributed sink functions and flow out from the boundaries. The generalized solutions are presented for three types of surface boundary conditions: specified flux, specified matrix flux potential and flux proportional to the matrix flux potential. The first case is appropriate for trickle irrigation, the second for specified surface moisture or pressure head conditions, and the last analogous to evaporative conditions. Additional sub-surface line-sources can be combined with any of these solutions. The specific numerical results obtained all show similarities to line-sources of the same net strength, suggesting that a good first approximation can be found by assuming a source only equal to the net addition of water. The maximum error due to the approximation would be in the region close to the source, with the error damped out over relatively short distances. (Baker-FRC)
W82-00405

EFFECTS OF TOPSOIL AND SUBSOIL THICKNESS ON SOIL WATER CONTENT AND CROP PRODUCTION ON A DISTURBED SOIL,
Science and Education Administration, Mandan, ND. Northern Great Plains Research Center.
For primary bibliographic entry see Field 2G.
W82-00465

SODIUM-POTASSIUM RATIOS IN SOIL SOLUTION AND PLANT RESPONSE UNDER SALINE CONDITIONS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 3C.
W82-00469

VEGETATION AND NUTRIENT STATUS OF NORTHERN MICHIGAN BOGS AND CONIFER SWAMPS WITH A COMPARISON TO FENS,
Michigan Univ., Pellston. Biological Station.
C. R. Schwintzer.
Canadian Journal of Botany, Vol 59, No 5, p 842-853, May, 1981. 5 Tab, 53 Ref.

Descriptors: *Bogs, *Fens, *Swamps, Peat bogs, *Nutrients, Wetlands, Vegetation, Succession, Hydrogen ion concentration, Water chemistry, Classification, *Michigan.

Information was obtained about the vegetation and telluric nutrient status of bogs and conifer swamps, comparable to that already available for fens. Also, bogs, fens, and conifer swamps were compared with respect to these features. The six bogs studied were characterized by well-developed field and bryophyte layers and strongly acid waters with very low Ca and Mg. The most prevalent plants were Chamaedaphne calyculata and Carex oligosperma of the field-layer plants and Sphagnum of the bryophyte layer. The four conifer swamps studied were characterized by well-developed tree and field layers and circumneutral waters of pH 7 to 7.4 with moderate to high Ca, Mg and alkalinity. The tree layer was dominated by Thuja occidentalis, while the most prevalent field plants were Mitella nuda, Abies balsamea, and Maianthemum canadense. Bogs, conifer swamps, and fens were related successionally but had different floristics, species density, proportion of evergreen species, role of symbiotic nitrogen fixing species, role of Sphagnum, and water chemistry. Bogs can be differentiated from conifer swamps and fens on the basis of nutrient status, which is dependent upon the degree of telluric water influence in rooting zones. Thus, these three types of wetlands should not be lumped together in the general category of bogs but should be considered separately. (Small-FRC)
W82-00484

2J. Erosion and Sedimentation

EROSION AND SEDIMENTATION IN THE KENAI RIVER, ALASKA,
Geological Survey, Laguna Niguel, CA. Water Resources Div.
K. M. Scott.
Geological Survey Open-File Report 81-219, 1981. 116 p, 19 Fig, 5 Tab, 53 Ref.

Descriptors: *Streams, *Channel erosion, *Bank erosion, *Sedimentation, Watersheds, Flow characteristics, Snowmelt, Floods, Bed load, Gravel, Vegetation effects, Fisheries, Salmon, Hydrographs, Aerial photography, *Alaska, *Kenai River.

The Kenai River is the most important freshwater fishery in Alaska. The flow regime is characterized by high summer flow of glacial meltwater and periodic flooding caused by sudden releases of glacier-dammed lakes in the headwaters. Every part of the stream is a known or potential salmon-spawning site. The stream channel is underfit, attributed to regional glacial recession and drainage changes, and locally is entrenched in response to geologically recent changes in base level. Throughout the central section of the river the channel is armored, a condition with implications for the ability of this section of channel to support the spawning and rearing of salmon. The entrenched section of the channel has been stable since 1951. Bank erosion is active both upstream and downstream from the entrenched channel, however. Although erosion rates have been generally constant since 1951, evidence suggests a possible recent decrease in bank stability that may be related to changes in river use. As population and recreation use increases, development can pose a hazard to the productivity of the stream through increased suspended-sediment concentration resulting directly from construction and, with greater potential for long-term impact, indirectly from bank erosion. A short-term hazard to both stream and developments is the cutoff of meander loops, the risk of which is increased by canals and boat slips cut in the surface layer of cohesive, erosion-resistant sediment on the flood plain within nonentrenched meander loops. A long-term hazard is an increase in bank erosion rates resulting from loss of vegetation on the high (up to 70 feet) cutbanks of entrenched and partially entrenched sections. (USGS)
W82-00015

DEPOSITION OF RIVERBORNE ORGANIC CARBON IN FLOODPLAIN WETLANDS AND DELTAS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
P. J. Mulholland.
Available from the National Technical Information Service, Springfield, VA as CONF-8009140, Price codes: A18 in paper copy, A01 in microfiche. In: Flux of Organic Carbon by Rivers to the Oceans, Report of a Workshop, Woods Hole, MA, Sept 21-25, 1980, Dept. of Energy Report CONF-8009140, April 1981. p 142-172, 3 Fig, 2 Tab, 32 Ref.

Descriptors: *Organic carbon, *Flood plains, *Sediment distribution, *Deposition, Sedimentation, *Wetlands, Deltas, Sediment transport, Oxidation, Particulate matter, Reservoirs, Drainage, Channeling.

Interaction between rivers and floodplain wetlands generally results in a net annual deposition of riverborne sediment and particulate organic carbon of up to 100 g C per sq m over large wetland areas. Some of this material is certainly oxidized, but a large part of it probably escapes complete oxidation because of the lack of available oxygen. Global deposition of riverborne organic carbon in floodplain wetlands is at least 6% of total river flux, and probably higher. Some of man's activities, such as channelization and wetland drainage, are reducing the total area of floodplain wetland receiving river inputs. However, this reduction may be offset by increased erosion and subsequent floodplain deposition of organic carbon in less-developed regions. Increased construction of impoundments is increasing deposition and preservation of organic carbon in inland sediments. Land disturbance and agriculture increase soil erosion and result in large amounts of sediment deposition in the channels and floodplains of smaller streams and rivers. Assuming that the rates of formation of the world's major river deltas have been uniform over the past 12,000 years, organic carbon accumulation in these systems has been about 0.6 X 10 to the 15th power gC/yr. (Moore-SRC)
W82-00034

PHYSICAL EFFECTS OF VEHICULAR DISTURBANCES ON ARID LANDSCAPES,
Stanford Univ., CA. Dept. of Applied Earth Sciences.
For primary bibliographic entry see Field 4C.
W82-00111

SOIL HYDRAULIC STABILITY IN A SUBSURFACE DRAINAGE SYSTEM,
Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.
For primary bibliographic entry see Field 2G.
W82-00115

SECONDARY FLOW, SHEAR STRESS AND SEDIMENT TRANSPORT,
Pittsburgh Univ., PA. Dept. of Civil Engineering.
C-L. Chiu, and D. E. Hsiung.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY7, p 879-898, July, 1981. 9 Fig, 8 Ref.

Descriptors: *Open channel flow, *Shear stress, *Sediment transport, Model studies, Channel flow, Flow characteristics, Flow velocity, Flow pattern, Water conveyance, Alluvial channels.

Explicit links were established among interacting variables in open channel flows, such as the distribution of primary flow velocity, channel cross section, discharge rate, secondary flow, shear stress distribution, and sediment concentration. Data from the Rio Grande Conveyance, Bernardo, New Mexico, were used in the development of the relationships. A shear formula calculates the shear stress in the flow and along the bottom and side walls of alluvial channels. The geometric shape of boundary shear distribution computed along the channel bottom was similar to that of measured channel bottom, indicating a direct correlation between the boundary shear and the scour on the channel bed. The secondary flow affects sediment transport directly (convection) and indirectly (diffusion). The main parts of the mechanism governing sediment concentration are gravity, diffusion, and secondary flow. (Cassar-FRC)
W82-00117

SEDIMENT AND NUTRIENT MOVEMENT FROM THE BLACK CREEK WATERSHED,
Purdue Univ., Lafayette, IN. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W82-00135

UNIV. OF ILL. URBANA-CHAMPAIGN

ERODIBILITY OF STREAMBANK MATERIALS OF LOW COHESION,
Science and Education Administration, Oxford, MS. Sedimentation Lab.
E. H. Grissinger, W. C. Little, and J. B. Murphey.
Transactions of the ASAE, Vol 24, No 3, p 624-630, May/June, 1981. 6 Fig, 2 Tab, 9 Ref.

Descriptors: *Stream banks, *Soil erosion, *Cohesion, Soil types, Clays, Erosion, Wetting, Shear stress, Erosion rates, Particle size, Flumes.

The stability of fine grained streambank materials was evaluated for materials with plasticity index values of less than 15. Erosion rates of undisturbed channel bank materials were determined in the field with a portable flume. Measured erosion rates were sizable, and two erosive forces were identified. Excessive erosion occurred in samples that were relatively dry before testing, probably as a result of the detaching effect of wetting. Erosion in wet samples was dependent upon bed shear stress. Clay content was correlated significantly with the shear stress-dependent erosion rates, while maximum noneroding pinhole velocities correlated significantly with the same erosion rates for samples that had no limiting morphological characteristics. The significance of sample morphology was scale dependent and varied with the size of the test sample in relation to the size of the morphological components. (Small-FRC)
W82-00136

EFFECT OF CROP RESIDUE ON SOIL LOSS FROM CONTINUOUS ROW CROPPING,
Science and Education Administration, Ames, IA. Agriculture and Home Economics Experimental Station.
J. M. Laflen, and T. S. Colvin.
Transactions of the ASAE, Vol 24, No 3, p 605-609, May/June, 1981. 3 Fig, 3 Tab, 13 Ref.

Descriptors: *Soil erosion, *Crop production, *Cultivated lands, Agriculture, Farms, Soil types, Slopes, Rainfall simulators, *Experimental farms.

Relative soil losses as affected by crop residue were evaluated using a rainfall simulator for several combinations of crop rotations, tillage systems, and canopy levels at two Iowa locations. Tillage treatments were conventional, reduced, and no-till, and the statistical design was a randomized complete block with two replicates. Crop canopy, kind of residue, and crop rotations had little effect on derived mulch factor-crop residue relationships, though this relationship was different at the two sites. The locational differences were apparently due to differences in slopes and/or soils. They can be explained on the basis of sediment transport, sedimentation theory, and size distributions of eroded material. Thus, presently used soil erosion prediction methods for conservation tillage systems could be improved by including the interaction effects of crop residue, soil, and slope. (Small-FRC)
W82-00145

SEDIMENT TRANSPORT IN NORTON SOUND, ALASKA,
Geological Survey, Menlo Park, CA.
D. E. Drake, D. A. Cacchione, R. D. Muench, and C. H. Nelson.
Marine Geology, Vol 36, No 1/2, p 97-126, May, 1980. 16 Fig, 1 Tab, 20 Ref.

Descriptors: *Sediment transport, *Sounds, Tractive forces, Bays, Bights, *Yukon River, Rivers, Sand, Silt, Sediments, Silting, Norton Sound, *Alaska.

Temporal variations were monitored in bottom currents, pressure, and suspended matter concentrations within the major transport pathway of Yukon River suspended matter. The most significant transport occurs within advective currents flowing north across the outer part of the sound. The thickest accumulations of modern Yukon silt and very fine sand occur beneath this persistent current. Monitoring took place for 80 days during the summer of 1977 using a Geological Processes Bottom Environmental tripod system. Two distinctive periods of bottom flow and sediment transport were noted: an initial 59 days of fair-weather conditions, characterized by tidally dominated currents and relatively low, stable suspended-matter conditions; and a 21 day period during which several storms traversed the Northern Bering Sea, mean suspended-matter concentrations near the bottom increased by a factor of five, and the earlier tidal dominance was overshadowed by wind-driven and oscillatory wave-generated currents. Friction velocities at the monitoring site were generally subcritical during the fair-weather period. The data suggest that very fine sand constituting about 50% of the sediment on the outer part of the Yukon prodelta is transported during a few late-summer and fall storms each year. Suspended-matter transport during the storms in September 1977 was equal to four months of fair-weather transport. (Baker-FRC)
W82-00151

ESTIMATING THE PHYSICAL CARRYING CAPACITY OF RECREATION AREAS: A RATIONALE FOR APPLICATION OF THE UNIVERSAL SOIL LOSS EQUATION,
Maryland Univ., College Park. Dept. of Recreation.
F. R. Kuss, and J. M. Morgan, III.
Journal of Soil and Water Conservation, Vol 35, No 2, p 87-89, March/April, 1980. 2 Tab, 21 Ref.

Descriptors: *Recreation facilities, *Soil management, Vegetation, Planning, Erosion, Soil conservation, Universal Soil Loss Equation, Land use, Soil erosion.

The Universal Soil Loss Equation was used to predict the physical carrying capacity of recreational areas. The soil loss tolerance factor (T) was substituted for the average annual soil loss per unit area (A). T represents the maximum rate of soil erosion that will permit the land's productivity to be sustained. Thus, T divided by the soil loss index becomes the maximum value of C (the vegetative cover and management factor) that an area can tolerate. Three picnic sites in the Patapsco Valley State Park, Maryland, were examined using the equation. The C values for the 3 sites were 0.009, 0.019, and 0.043, indicating that the first was a relatively sensitive area and should be zoned for limited use or scheduled for additional maintenance. Site 3 was relatively tolerant of recreational use. (Cassar-FRC)
W82-00274

SOLAR CYCLES AND EROSIONAL EVENTS ON THE NEW SOUTH WALES CENTRAL AND SOUTH COASTS,
Sydney Univ. (Australia).
B. Stevenson.
Search, Vol 11, No 4, p 117-118, April, 1980. 2 Fig, 12 Ref.

Descriptors: *Beach erosion, *Sunspots, *Weather patterns, Solar radiation, Erosion, Jetstreams, *New South Wales, Australia, Storms, Coasts.

Erosional events on Australia's New South Wales coast were related to periods of low sunspot activity in 1857, 1876, 1889, 1912, 1944-45, 1966-67, and 1974-75. A high pressure anomaly occurs in the southern Tasman region during July at the sunspot minima and ascending phase of the sunspot cycle. This condition represents enhanced blocking with a resulting increase in storm activity and coastal erosion. A likely intermediate agent is variation in jetstream activity over the east Australian continent, weaker jetstreams being associated with low sunspot activity. (Cassar-FRC)
W82-00318

RAINFALL INTENSITY-KINETIC ENERGY RELATIONSHIPS FOR SOIL LOSS PREDICTION,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Inst. of Earth Resources.
P. I. A. Kinnell.
Soil Science Society of America Journal, Vol 45, No 1, p 153-155, 1981. 2 Fig, 1 Tab, 11 Ref.

Descriptors: *Soil erosion, *Rainfall intensity, *Mathematical equations, Prediction, Erosion, Rainfall impact, Kinetic energy, Mathematical studies.

Soil erosion involves an expenditure of energy to detach soil material from the soil surface and to transport this detached material away from the eroding area. The kinetic energy expended by raindrops impacting with the soil surface accounts for a proportion of the energy required in the rainfall erosion process. Since the calculation of rainfall kinetic energies from drop-size data has demonstrated a high correlation between the rate of expenditure of rainfall kinetic energy and rainfall intensity when raindrops are traveling at or close to their terminal velocities, this relationship provides a means for the estimation of variations in rainfall kinetic energy in time and space. Application of three equations used to describe rainfall intensity-kinetic energy relations to data for Miami, Florida, and Zimbabwe (Rhodesia) demonstrated the limitations of these equations. The relationships between kinetic energy per unit quantity of rain (E sub RA) and rainfall intensity (I) at these two locations are best expressed by the equation E sub RA equals z (1 minus pe(-hI), where e is the base of natural logarithms and z, p, and h are empirical constants. It is suggested that this equation may provide the means by which reasonable estimates of rainfall kinetic energy can be derived in other geographic areas. (Carroll-FRC)
W82-00466

EFFECT OF MULCH RATE ON SOIL LOSS BY RAINDROP SPLASH,
California Univ., Davis. Dept. of Land, Air, and Water Resources.
M. J. Singer, Y. Matsuda, and J. Blackard.
Soil Science Society of America Journal, Vol 45, No 1, p 107-110, 1981. 3 Fig, 2 Tab, 14 Ref.

Descriptors: *Soil erosion, *Mulching, *Rain, Erosion control, Erosion, Rills, Rainfall simulators, Mathematical studies, Kinetic energy, Rain splash, Sediment transport.

Previous studies by the present authors had investigated the relationship between percent cover by oat straw, blue oak leaves, and redwood litter and soil loss under simulated rainfall. A likely explanation for the finding of a parabolic relationship rather than the expected linear relationship is the lack of splash measurements as part of the experiment. A total of 50 rainfall simulator events of 76 millimeters per hour intensity for 30 minutes were run to investigate the effect of oat straw on splash detachment and transport of soil. Soil available for transport by interrill flow is a function of soil detached by interrill flow, direct splash impact, and secondary splash impact. Soil transported by interrill flow and soil transported by rain splash were measured separately. Increases in straw mulch rate resulted in significant decreases in both soil transported by rain splash and soil transported by interrill flow. When straw mulch cover reached 96%, rain splash sediment transport was reduced to less than 8% of the bare soil rain splash transport and interrill flow transport was reduced to 24% of the bare soil rain-flow transport amount. Since there was no reduction in the interril flow, the reduction in interrill flow transport was entirely due to a reduction in raindrop splash detachment. A linear correlation was found between cover level and sediment transport by rain splash and interrill flow when both processes were considered. The effectiveness of cover as an erosion control technique results from reductions in both direct rain splash detachment and indirect rain splash effects. (Carroll-FRC)
W82-00468

EFFECTS OF SMALL AMOUNTS OF RESIDUE ON FURROW EROSION,
Science and Education Administration, Prosser, WA.
J. S. Aarstad, and D. E. Miller.
Soil Science Society of America Journal, Vol 45, No 1, p 116-118, 1981. 4 Tab, 9 Ref.

Descriptors: *Erosion control, *Soil erosion, *Organic matter, Erosion, Decomposing organic

matter, Turbidity, Agricultural runoff, Irrigation ditches, Sedimentation, Runoff, Furrow drainage.

Previous studies have demonstrated that preserving residue through reduced tillage may effectively control furrow erosion from irrigation. However, some tillage is desirable to incorporate fertilizers and herbicides and to prepare the seedbed. Since tillage destroys plant residues, this study was designed to determine whether or not small amounts of plant residue placed in irrigation furrows would decrease furrow erosion to tolerable levels. Studies conducted on a medium-textured soil with a 3% slope demonstrated that even the lowest residue rate, which consisted of a clump of straw placed every 2 meters down the furrow and was equivalent to about 60 kilograms per hectare on a total area basis, greatly reduced the sediment in and the turbidity of the runoff water. When 2.2 metric tons of straw per hectare was placed along the furrow, equivalent to about 0.4 metric tons per hectare on a total area basis, virtually all erosion was eliminated. Infiltration rates generally increased as the amount of residue in the furrow increased, causing a decrease in runoff velocity and sediment suspension. The highest residue rate reduced the turbidities of runoff water to less than those of the inflow water. These results indicate that limited tillage for herbicide incorporation and seedbed preparation can be performed while still leaving enough surface residue to control erosion. However, techniques and equipment for manipulation and placement of the residue after limited tillage need to be developed. (Carroll-FRC)
W82-00470

THE EFFECTS OF SURFACE SLATY FRAGMENTS ON SOIL EROSION BY WATER,
Southern Piedmont Conservation Research Center, Watkinsville, GA.
J. E. Box, Jr.
Soil Science Society of America Journal, Vol 45, No 1, p 111-116, 1981. 9 Fig, 5 Tab, 12 Ref.

Descriptors: *Surface runoff, *Soil erosion, *Soil properties, Rainfall, Slate, Erosion, Runoff, Rocks, Rainstorms, Mathematical studies, Mathematical equations, Soil types, Rainfall-runoff relationships, Mulching, *Slate Belt, *Southern Piedmont.

The Carolina Slate Belt, which extends from southern Virginia across the Carolinas and into Georgia, has shallow slaty soils in which slaty fragments make up between 5 and 40% of the surface soil weight. The effects of various amounts of slaty fragments on the surface on soil erosion and runoff were studied using Golston very slaty silt loam, Badin slaty silt loam, Georgeville silty clay loam, and a Georgeville loam. A rainulator was used to measure erosion and runoff from a 120-minute storm of 6.35 centimeters per hour. Photographs were used to determine the percent soil surface coverage by slaty fragments after each storm, which was found to range from 2.5 to 97%. Lots on which the soil had been sieved experienced soil loss rates which were about three to six times greater than the loss rates on natural plots. Doubling of the slaty fragments in the top 15 centimeters caused a soil loss rate lower than that of either the natural or the sieved plots. The relationship between soil loss ratio and percent coverage by slaty fragments was identical to that previously determined for plant residue mulching effects on soil loss ratio. An interim solution for predicting erosion on Slate Belt soils of the southern Piedmont which are subject to armoring by slaty fragments is proposed for use until sufficient data are available to adjust the K sub m factor or to add an armoring factor to the universal soil loss equation (USLE). Results from this study indicate that it may be possible to determine surface armoring after 30 minutes of intensive rainfall. (Carroll-FRC)
W82-00471

GULLY DEVELOPMENT IN THE DEEP LOESS HILLS REGION OF CENTRAL MISSOURI,
Missouri Univ., Columbia.
G. Roloff, J. M. Bradford, and C. L. Scrivner.
Soil Science Society of America Journal, Vol 45, No 1, p 119-123, 1981. 5 Fig, 3 Tab, 24 Ref.

Descriptors: *Gully erosion, *Loess, *Missouri, Soil strength, Soil erosion, Erosion, Overland flow, Slope stability, Geomorphology, Gullies, Stratigraphy, Soil properties.

Gullying is a frequent erosion phenomenon in the deep loess hills region of central Missouri, causing degradation of valuable farmland and increased sediment loadings in local streams. This study involved instrumentation of a small gully in a headslope position in loess over glacial till designed to monitor the downslope flow of water within the soil profile (throughflow) and sampling to identify soil properties related to the process of gully development. Throughflow was found to be controlled by the buried paleosol surface in this upper landscape position. The convergence of throughflow to the gully lower headwall was the predominant factor in lessening soil strength and in precipitating gully failure events. Although the exact mechanics of the failure events are not clear, failure planes follow cleavage planes within the soil mass caused by freezing-thawing and wetting-drying cycles. These cycles reduce soil stability by providing a greater number of cleavage planes. Failure debris is deposited against the gully wall, increasing gully stability. Overland flow was responsible for the removal of failure debris but not for bank erosion. Gully development at upper landscape positions such as this is very slow and probably depends on infrequent but intense rainfall events which carry the failure debris downstream and permit new failures. (Carroll-FRC)
W82-00472

2K. Chemical Processes

EFFECT OF CATIONS ON COPPER ADSORPTION BY KAOLIN,
Maryland Univ. Eastern Shore, Princess Anne. Dept. of Natural Sciences.
G. C. Gupta, and F. L. Harrison.
Water, Air, and Soil Pollution, Vol 15, No 3, p 323-327, April, 1981. 2 Fig, 15 Ref.

Descriptors: *Copper, *Adsorption, Estuarine environment, Metals, Heavy metals, Calcium, Cations, Magnesium, Ions, Rivers, Kaolinite, Soil types, Desorption, Path of pollutants, Clay, *Kaolin.

The effect of cations on the adsorption of copper by kaolin was studied in pure systems. Kaolin powder was sieved to obtain the less than 62 micrometer fraction, treated with hydrogen peroxide to remove organic material, and equilibrated overnight with 0.5N HCl. After further treatment a dilute suspension of H-kaolin was added to clay to obtain a final concentration of 27 ppm in each of several test bottles. To each test bottle either calcium chloride or magnesium chloride was added to give a final concentration of 20, 40, 100, 200 mg/liter and distilled water to give a final volume of 10 ml. The samples were then spiked with high activity radioactive copper-64. After filtration the amounts of radioactivity on the filter and in the filtrate were measured separately, using a gamma ray well counter. Copper adsorption was plotted against calcium or magnesium concentrations. No appreciable change was noted in the distribution coefficient of adsorption in clay suspensions equilibrated with the chlorides in the concentration range of 90 to 200 mg/liter. These results support the findings of others that an increase in the concentration of calcium ions reduces the copper binding capacity of the bottom oozes in water bottles. This indicates that electrostatically bound heavy metals will enter the solution phases as calcuim ions and magnesium ions increase in the water, as may happen in a change from river to estuarine and marine systems. In dilute freshwater copper can compete with other divalent cations, but in seawater desorption of copper will occur because of the overabundance of other cations. (Baker-FRC)
W82-00172

SORPTION OF TRACE CADMIUM ON CLAY MINERALS AND RIVER SEDIMENTS: EFFECTS OF PH AND CD(II) CONCENTRATIONS IN A SYNTHETIC RIVER WATER MEDIUM,
State Univ. of New York at Binghamton. Dept. of Chemistry.
J. D. Reid, and B. McDuffie.
Water, Air, and Soil Pollution, Vol 15, No 3, p 375-386, April, 1981. 7 Fig, 33 Ref.

Descriptors: *Cadmium, *Sorption, Clays, Minerals, *Sediments, Fluvial sediments, Rivers, Acidity, Chemical properties, Hydrogen ion concentration.

Cadmium (II) sorption was studied at initial cadmium concentrations ranging from 1 to 1000 micrograms/liter with a constant solid phase concentration of 0.5 g/liter. The percentage sorbed at equilibrium increased sharply from pH 6.5 to 9.0, with a shift toward increased adsorption at lower initial concentrations, indicating specific, non-equivalent sites. Freundlich log-log plots were linear, with a slope of 0.83. Susquehanna River sediments (silt/clay fraction) showed similar behavior, sorbing cadmium somewhat more strongly than illite, as did montmorillonite, while kaolinite sorbed cadmium less strongly. Sorption on illite was not altered appreciably by removing the iron or manganese oxide coating with dithionite, by removing organic matter with hydrogen peroxide, or by using a carbonate-free medium. Equilibration time, desorption at lower pH, and the effect of citrate in shifting the sorption to higher pH were also studied. The data are presented in terms of cadmium speciation equilibria and possible sorption mechanisms. (Baker-FRC)
W82-00174

CHEMISTRY OF PRECIPITATION AT GAINESVILLE, FLORIDA,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
C. D. Hendry, and P. L. Brezonik.
Environmental Science and Technology, Vol 14, No 7, p 843-849, July, 1980. 7 Fig, 2 Tab, 36 Ref.

Descriptors: *Precipitation, *Chemical analysis, *Acid rain, Acidic water, Sulfuric acid, Nitric acid, Nitrogen, Phosphorus, Nutrients, Eutrophication, Lakes, Plankton, Magnesium, Potassium, Sodium, Chlorides, Calcium, Rainwater analysis, *Florida.

Wet-only precipitation was collected manually from June 1976 to July 1977 on the University of Florida campus. Bulk precipitation was collected about 8 km northwest of Gainesville at a cypress swamp site located on a large pine plantation. Chemical analyses were performed on both types of samples. The rain was shown to be the predominant deposition mechanism for SO4(2-), NH4(+), NO3(-), Mg(2+), and K(+). Dry fallout is of comparable importance to rainfall for deposition of Na(+), Cl(-), and Ca(2+). Heavy metal levels were highly variable in both types of samples. The average concentrations of total nitrogen, NH4(+), and NO3(-) in bulk precipitation were 0.82, 0.12, and 0.23 mg nitrogen/liter, respectively. Averages for ortho and total phosphate were 24 and 85 micrograms phosphate/liter, respectively, in bulk precipitation and 19 and 34 micrograms/liter in wet-only samples. Highest nutrient concentrations occurred in spring and early summer. Total loadings of nitrogen and phosphate from bulk precipitation are above permissible rates, relative to eutrophication, for shallow lakes. The volume-weighted mean pH of wet-only precipitation was 4.53; bulk precipitation had a slightly higher pH. Lowest pH values occurred in spring and summer. Acidity titrations and ionic balances indicate that rainfall acidity resulted mainly from sulfuric acid (69%) and nitric acid (23%). (Baker-FRC)
W82-00185

WATER-ROCK PARTITION COEFFICIENTS AND THE COMPOSITION OF NATURAL WATERS - A REASSESSMENT,
Marine Biological Association of the United Kingdom, Plymouth (England).
D. R. Turner, A. G. Dickson, and M. Whitfield.
Marine Chemistry, Vol 9, No 3, p 211-218, June, 1980. 3 Fig, 2 Tab, 12 Ref.

LIBRARY OF THE URBANA-CHAMPAIGN

Descriptors: *Statistical analysis, *Rocks, *Chemical composition, *Seawater, Mathematical studies, Water analysis, Correlation analysis, Correlation coefficients.

The concept of a chemical steady state in the world ocean system is reevaluated on the basis of recent data on world average river composition and global mean composition of crustal rocks. The initial statistical analyses have been modified to reflect the new data. Improved correlations were found between mean oceanic residence times and water-rock partition coefficients. Also, improved correlations were found between water-rock partition coefficients and the electronegativity function. Such correlations give support to the idea that the average composition of seawater can be estimated using the electronegativities of the elements and the rate of input of dissolved components. Thus, a simple dynamic model is possible. Further, a detailed study of the scavenging of Th, Pb, Cu, Ni, and Cd in the marine environment suggests rapid rates of reaction which would favor the maintenance of a chemical steady state in the world oceans. (Small-FRC)
W82-00284

BASIN LANDSCAPE-HALOGEOCHEMICAL METHOD OF EVALUATING THE NATURAL AND RECLAMATION CONDITIONS OF IRRIGATED TERRITORIES,
Akademiya Nauk SSSR, Moscow. Inst. of Soil Chemistry and Soil Science.
I. N. Stepanov, M. N. Brynskikh, O. S. Matveeva, N. I. Savitova, and E. I. Chembarisov.
Water Resources (English Translation), Vol 7, No 1, p 77-81, January/February, 1980. 3 Tab, 11 Ref. Translated from Vodnye Resursy, No 1, p 171-176, 1980.

Descriptors: *River basin development, *Chemical composition, Salts, Rivers, Mineralization, Minerals, Syr Darya Basin, Kura River Basin, Colorado River Basin, River water.

A new method for regional evaluation of the reclamation condition of irrigated territories is proposed. The method is based on using data from observations by the USSR Hydrometerological Service Administration on the hydrological and hydrochemical regime of river, irrigation and collector-drain waters. The method has the advantage that it uses long-term series of observations from 40 to 100 years, which are expanding with each additional year. The basin method is based on concepts concerning the effect of the soil cover on the chemical nature of river waters. The sequence of removal of ions from soils to river water and the change in their composition have a certain regularity which gives grounds to assume the opposite, that is, on the basis of the mineral content and chemical relationships of water from a flow draining a particular irrigated tract, its natural and reclamation condition can be judged. Use of the method to study the Syr Darya basin, the Kura basin and the Colorado River basin suggests that under various conditions, a relationship is noted between the water-management development of territories and the mineralization (chemical composition) of the waters of rivers draining them. (Baker-FRC)
W82-00303

HYDROCHEMISTRY OF A DOLOMITE KARST: THE BRUCE PENINSULA OF ONTARIO,
Department of the Environment, Burlington (Ontario). Lands Directorate.
D. W. Cowell, and D. C. Ford.
Canadian Journal of Earth Sciences, Vol 17, No 4, p 520-526, 1980. 5 Fig, 2 Tab, 20 Ref.

Descriptors: *Hydrology, *Karst, Dolomite, *Chemical composition, Calcium, Magnesium, Carbonates, Seasonal variations, Georgian Bay, Lake Huron, Lakes, Bays, Canada, Bruce Peninsula, Peninsulas, Chemical analysis, Water analysis, *Chemical properties, Hardness, Rivers, Wetlands, Surface waters.

The characteristics of waters of the Bruce Peninsula, a low-lying, karstified dolomite surface at latitude 45 N, were investigated. A total of 250 samples representing six hydrochemical environments were collected. These environments included: Georgian Bay and Lake Huron; inland lakes; rivers and streams; wetlands; conduit-flow springs; and diffuse-flow springs. The seasonal behavior and chemical separation of these waters are examined. Except for Georgian Bay and Lake Huron, the waters of the peninsula were very hard, ranging from 180-320 ppm Ca(2+) plus Mg(2+) (as CaCO3), and displayed increasing hardness as the summer season progressed. Surface recharge and conduit-flow springs were generally saturated with respect to calcite and dolomite. Only diffuse-flow springs, which are among the hardest of waters, are commonly undersaturated. These waters are also the easiest to distinguish chemically, and results of a linear discriminant function analysis suggest that other waters of the peninsula represent a single class. (Baker-FRC)
W82-00321

NITROGEN FIXATION AND METHANE METABOLISM IN A STREAM SEDIMENT-WATER SYSTEM AMENDED WITH LEAF MATERIAL,
Waterloo Univ. (Ontario). Dept. of Biology.
T-Y. Tam, C. I. Mayfield, and W. E. Inniss.
Canadian Journal of Microbiology, Vol 27, No 5, p 511-516, May, 1981. 4 Fig, 1 Tab, 25 Ref.

Descriptors: *Methane, *Nitrogen fixation, *Sediments, Streams, Leaves, Bacteria, Nitrification, Oxidation, Aerobic conditions, Anaerobic conditions, Ecosystems.

Although studies have been performed on the effect of allochthonous input of leaf materials on the energy budget in running water energy systems, there have been no previous studies of the effects of leaf material on the nitrogen cycle in streams. The present investigation focused on the reduction of acetylene and the production and oxidation of methane in a stream sediment-water system amended with either fresh leaves or autumn shed leaves incubated in the presence and absence of air. There was no net methane production in the sediment-water system except when leaf material was added. The addition of fresh leaves resulted in 2.2 times the methane accumulation found when autumn-shed leaves were added. Net methane production was not significantly affected by static incubation in the presence of air, with such production being about the same as anaerobic rates with fresh leaves or 79% of the anaerobic rates with autumn-shed leaves. The addition of leaf material readily supported acetylene reduction under aerobic conditions in the sediment-water system, while significantly less reduction of acetylene occurred under anaerobic gas phase incubation conditions. Fresh leaves were also more stimulatory of acetylene reduction than were autumn-shed leaves. (Carroll-FRC)
W82-00486

MEASUREMENTS OF HYDROGEN PEROXIDE IN RAINWATER,
Harvey Mudd Coll. Claremont, CA. Dept. of Chemistry.
G. L. Kok.
Atmospheric Environment, Vol 14, No 6, p 653-656, 1980. 2 Fig, 1 Tab, 10 Ref.

Descriptors: *Hydrogen peroxide, *Rain, *Oxidation, Chemical reactions, Precipitation, Claremont, California, *Rainwater.

Levels of hydrogen peroxide (H2O2), an important component of the polluted and clean troposhere, were measured in rainwater at Claremont, California, during rainfall events in 1978 and 1979. Concentrations were typically 1-160 ppb, but on three occasions levels in excess of 1 ppm were obtained: (1) September 5, 1978, a very intense evening shower, 1.59 ppm during the first three hours of rain, (2) July 17, 1979, an early morning shower, 1.14 ppm, and (3) January 31, 1979, during electrical storm activity, 1.09 ppm. H2O2 levels generally decreased with time during a storm. Measured values of H2O2 were lower than those predicted from the uptake of gas phase H2O2 into clouds. Possible mechanisms of loss are destruction during evaporation and reaction with SO2 or other acidic species. The predominant mechanism for uptake of H2O2 into rainwater is washout. (Cassar-FRC)
W82-00497

2L. Estuaries

CARBON ISOTOPES AS INDICATORS OF THE SOURCE AND FATE OF CARBON IN RIVERS AND ESTUARIES,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 5B.
W82-00033

NEAP-SPRING TIDE SEQUENCES OF INTERTIDAL SHOAL DEPOSITS IN A MESOTIDAL ESTUARY,
Utrecht Rijksuniversiteit (Netherlands). Dept. of Sedimentology.
J. R. Boersma, and J. H. J. Terwindt.
Sedimentology, Vol 28, No 2, p 151-170, April, 1981. 13 Fig, 1 Tab, 20 Ref.

Descriptors: *Intertidal areas, *Tidal effects, *Sediment deposition, *Estuaries, Neap tides, Spring tides, Shoals, Sand waves, Dunes, Erosion, Westerschelde estuary, *Netherlands.

The hydrographic properties, the distribution and response pattern of various types of bedforms, and the sedimentary structures produced were observed in the mesotidal Westerschelde estuary, the Netherlands. Ebb and flood tides generally differed in strength; the resulting dominance changed over the neap-spring tide period. Parallel, long-crested sand waves and irregular short-crested dunes responded differently to the neap-spring variation in current velocity. The internal structure largely consisted of unidirectional cross-bedding, separated into a succession of tidal bundles, each formed during one tide. These tidal bundles were arranged in a lateral sequence reflecting neap-spring tide periods and differed in character with location. Within the tidal bundle, reactivation, full vortex and slackening structures reflected acceleration, full stage, and deceleration of flow, respectively, in the dominant tide, usually the flood tide. The full vortex structures tended to be well developed around spring tide and disappear towards neap tide. The subordinate tide carved pause planes which enclose the tidal bundles. These pause planes can be either erosional or depositional. (Cassar-FRC)
W82-00112

GEOCHEMISTRY OF A SUBARCTIC SALT MARSH ENVIRONMENT,
National Water Research Inst., Burlington (Ontario). Process Research Div.
W. A. Glooschenko, and J. A. Capobianco.
Marine Geology, Vol 37, No 3/4, p 231-240, September, 1980. 1 Fig, 3 Tab, 31 Ref.

Descriptors: *Salt marshes, *Chemical composition, Trace elements, Marshes, Geochemistry, Tidal marshes, Magnesium, Calcium, Potassium, Iron, Manganese, Silicon, Aluminum, Phosphorus, Sulfur, Titanium, Copper, Lead, Nickel, Cobalt, Cadmium, Chromium, Mercury, Zinc, North Point, *Ontario.

Samples were taken from a coastal salt marsh located at North Point, Ontario, on the southwestern shore of James Bay. The climate of the area is subarctic, with a dominant upland vegetation of northern boreal forest and large inland areas of bog and fen peatlands. The area is underlain by Paleozoic rocks of Ordovician, Silurian, and Devonian age. Extensive silty tidal flats are present, which are reworked by ice scouring during periods of thaw. The elements Ti, Mg, Ca, K, Na, Fe, Mn, Si, Al, P, and S were determined in the samples by x-ray fluorescence. Trace elements Cu, Pb, Ni, Co, Cd, Cr, and Zn were determined by digesting 2.5 g of sediment with a mixture of HCl/HNO3 and using atomic absorption spectrophotometry. The studies indicated that the parent material from which the sediments were derived, i.e., is Paleozo-

ic carbonates rather than Canadian Shield igneous and metamorphic rocks, is the major controlling factor determining elemental composition of these materials. Other factors such as acidic or basic nature of aluminosilicates, hydrated iron oxides, clay and sand content, sulfides, and organic matter influence sediment composition within the salt marsh in terms of total elemental compositon. However, since the marsh sediments and soil represent a system changing through time, with exposure to saline and fresh water, and thus varying redox potential, it would be expected that sediments would change in terms of soluble and exchangeable cations and anions. (Baker-FRC)
W82-00148

PERPETUAL SHOALS AT THE ENTRANCE TO CHESAPEAKE BAY: FLOW-SUBSTRATE INTERACTIONS AND MUTUALLY EVASIVE NET CURRENTS,
Waterways Experimental Station, Stevenville, MD.
M. A. Granat, and J. C. Ludwick.
Marine Geology, Vol 36, No 3/4, p 307-323, July, 1980. 5 Fig, 1 Tab, 27 Ref.

Descriptors: *Water currents, *Bays, Bights, Sounds, Estuaries, *Chesapeake Bay, *Substrates, Shoals, Sandbars, Mud flats, Sediment, Tidal currents, Wave action.

Shoals in coastal plain estuaries are sites of greater-than-average net sediment accumulation which exist in a state of quasi-equilibrium with tidal currents and wave action. Studies of the Inner Middle Ground Nine Foot Shoal, a compound parabolic shoal in the entrance to the Chesapeake Bay, indicate that it is in dynamic interaction with mutually evasive ebb and flood tidal currents. This interaction is perpetuated through a close relationship between flow and substrate. A modest change in one attribute as a result of natural or man-induced variation causes a change in the other in an attempt to maintain a pseudo-balanced system. Comparisons among six bathymetric surveys taken during the past 127 years trace development of the shoal from two linear sediment bodies to its present double parabolic morphology. The existing particle size distributions of the surface sediments are systematically related to the present morphology and seem to be in adjustment with the ambient currents. Tidal currents of the area were sufficient in velocity to easily erode the surface sediments of the shoal. Various flow asymmetries or inequalities were examined from eight current meter stations to determine the dominant directions and to summarize the hydraulic regime. Different flow dominance was indicated depending on the attribute considered. Bathymetric influence on the flow direction of near-bottom currents is illustrated by diverted currents and shielding. Sediment circulation cell was a manifestation of the mutual evasion of ebb and flood tidal currents. Feedback exists between flow and substrate and results in a system in quasi-equilibrium. (Baker-FRC)
W82-00149

GEOMORPHIC AND HYDRAULIC EVOLUTION OF TIDAL CREEKS ON A SUBSIDING BEACH RIDGE PLAIN, NORTH INLET, S.C.,
South Carolina Univ., Columbia. Dept. of Geology.
L. R. Gardner, and M. Bohn.
Marine Geology, Vol 34, No 3/4, p M91-M97, February, 1980. 3 Fig, 14 Ref.

Descriptors: *Tidal marshes, *Evolution, Beaches, Erosion, Shores, *Submergence, Drowning, Submerged lands, Tide lands, North Inlet, South Carolina.

Stratigraphic and geomorphic features of a small marsh basin near Noth Inlet, South Carolina, are described. The basin is in an early stage of evolution under conditions of slow submergence. These features suggest that the tidal creek draining this basin was originally a small fresh-water stream which has gradually adjusted its hydraulic geometry to an increasing volume of tidal flow imposed by submergence. A generalized model of the evolution ofhydraulic geometry in response to submergence is presented as a complement to the Mudge-Davis model of marsh evolution. The dominant sediment of the interridge area of marsh was shown to be sand. Mud and silt were confined to a relatively narrow zone along the main tidal channel. That the area was originally a coastal forest much like that landward of the present marsh is evidenced by the presence of stumps and roots in the sandy sediment of the marsh along with occasional relic cat eye ponds on the surface of the sandy marsh. In the early stages of its adjustment to tidal influence the stream apparently eroded a considerable volume of sand, which subsequently was partly replaced by mud. Eventually the entire watershed of the original stream will be subject to tidal inundation, and further growth in the volume of tidal flow will subside. The stream will then achieve a condition of mature stability, in which the meanders have little tendency to migrate. (Baker-FRC)
W82-00150

EFFECT OF CATIONS ON COPPER ADSORPTION BY KAOLIN,
Maryland Univ. Eastern Shore, Princess Anne. Dept. of Natural Sciences.
For primary bibliographic entry see Field 2K.
W82-00172

INFLUENCE OF ESTUARINE SEDIMENT ON VIRUS SURVIVAL UNDER FIELD CONDITIONS,
Baylor College of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
For primary bibliographic entry see Field 5A.
W82-00199

ENRICHMENT AND ASSOCIATION OF BACTERIA AND PARTICULATES IN SALT MARSH SURFACE WATER,
Stanford Univ., CA. Dept. of Civil Engineering.
R. W. Harvey, and L. Y. Young.
Applied and Environmental Microbiology, Vol 39, No 4, p 894-899, April, 1980. 3 Fig, 1 Tab, 31 Ref.

Descriptors: *Bacteria, *Salt marshes, *Particulate matter, Tidal effects, Population dynamics, Tidal marshes, Surface water, Sippewissett salt marsh, Massachusetts, Palo Alto salt marsh, California.

The relationship between particulate material and populations of surface layer bacteria was investigated in a salt marsh. At two sampling sites, Sippewissett salt marsh in Falmouth, Massachusetts, and Palo Alto salt marsh in Palo Alto, California, elevated counts of bacteria were found during outgoing tides in surface microlayers. The degrees by which bacteria were concentrated into the surface microlayer were linearly dependent upon surface concentration of particulate matter. Bacterial populations in the subsurface water were largely planktonic, but a significant percentage of the bacteria in the microlayer were attached to particulate material. Both bacterial populations were grown on seawater nutrient agar, and the microlayer bacteria grew more successfully than did the bacteria from subsurface waters. Successful growth was positively correlated with the fraction of bacteria attached to particulate matter. It seems that the particulates in the microlayer waters of the salt marsh influenced the observed increase in both the readily grown and the total numbers of bacteria. (Small-FRC)
W82-00201

POPULATIONS OF METHANE-PRODUCING BACTERIA AND IN VITRO METHANOGENESIS IN SALT MARSH AND ESTUARINE SEDIMENTS,
Clemson Univ., SC. Dept. of Microbiology.
W. J. Jones, and M. J. B. Paynter.
Applied and Environmental Microbiology, Vol 39, No 4, p 864-871, April, 1980. 6 Tab, 29 Ref.

Descriptors: *Methane bacteria, *Marine sediments, *Salt marshes, Methane, Estuaries, Spartina, Sediments, Sapelo Island, Georgia.

The methanogenic populations of various marine sediments, particularly salt marsh sediments, were quantified, and the in vitro rates of sediment methanogenesis were measured. Most probable numbers of methanogens were determined using an anaerobic, habitat-simulating culture medium with 80% H2 plus 20% CO2 as substrate. Methane producing organisms were found at all depths tested (0 to 36 cm) in salt water and salt marsh sediments. For the short Spartina marsh sediments of Sapelo Island, Georgia, populations were maximal at the 5 to 7 cm depth, while in the tall Spartina marsh, populations were maximal in the upper 0 to 2 cm zone. In vitro rates of methanogenesis with short Spartina sediments incubated under 80% H2-20% CO2 indicated that the 5 to 7 cm region exhibited maximal activity. When incubated under 100% N2 rates of methanogenesis were similar to rates with 80% H2-20% CO2. Replacing the N2 with H2 resulted in an eight-fold decrease in the rate of methanogenesis. (Small-FRC)
W82-00202

SPECIFIC INHIBITION OF NITRITE OXIDATION BY CHLORATE AND ITS USE IN ASSESSING NITRIFICATION IN SOILS AND SEDIMENTS,
Cawthron Inst., Nelson (New Zealand).
L. W. Belser, and E. L. Mays.
Applied and Environmental Microbiology, Vol 39, No 3, p 505-510, March, 1980. 5 Fig, 4 Tab, 11 Ref.

Descriptors: *Nitrification, *Intertidal areas, Sediments, Soils, Nitrates, Oxidation, Ammonium, Chlorates, Natural waters, New Zealand.

The selectivity of chlorate inhibition on the oxidation of nitrite, with respect to possible inhibition of ammonium oxidation, was investigated. The purpose was to develop a method for measuring ammonium oxidizer activity in which only nitrite need be measured. Initial work was carried out with intertidal sediments collected at the Delaware Inlet, Nelson, New Zealand. Two pasture soils were also used, one a Wakapuaka sandy loam and the other a Ronga silty loam. Both soils were in permanent clover grass pastures grazed by either sheep or cattle. The application of chlorate to the samples prevented nitrite from being oxidized to nitrate. The effectiveness and specificity of chlorate were then tested with pure cultures of nitrite and ammonium oxidizers, as well as in soil and sediment slurries. It was concluded that chlorate had relatively little inhibitory effect on ammonium oxidation. However, under some conditions chlorate was not completely effective in blocking nitrite oxidation, and the causes of this were investigated. The technique was designed to check for incomplete blockage. The technique as developed had two advantages over methods where both nitrite and nitrate are measured. First, when automated methods are not available, nitrite is much simpler to measure and requires a smaller sample size. Second, in soils with high nitrate background, this method will be much more sensitive, as nitrite will normally be undetectable at the beginning of the incubation. (Baker-FRC)
W82-00242

EFFECT OF ESTUARINE SEDIMENT PH AND OXIDATION-REDUCTION POTENTIAL ON MICROBIAL HYDROCARBON DEGRADATION,
Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.
G. A. Hambrick, III, R. D. DeLaune, and W. H. Patrick, Jr.
Applied and Environmental Microbiology, Vol 40, No 2, p 365-369, August, 1980. 5 Fig, 19 Ref.

Descriptors: *Sediments, *Hydrocarbons, Mineralization, *Estuarine environment, Estuaries, Coasts, Acidity, Oxidation, *Microbial degradation, Microorganisms, Degradation, Bottom sediments.

The objective of this study was to determine and compare the relative rates of mineralization in estuarine sediment of two C-14 labeled petroleum hydrocarbons, octadecane and naphthalene, as affected by different pH levels and redox potentials. Three sets of sediment-water suspensions were used, incubated at one of three pH levels, 5.0, 6.5, or 8.0. Hydrocarbon mineralization rates were in-

UNIV. OF ILL. URBANA-CHAMPAIGN

ferred from the activity of respired carbon dioxide. Sediment pH and oxidation-reduction potential were important factors governing the population of hydrocarbon-degrading microorganisms in the sediment and subsequent mineralization rates. Highest mineralization rates occurred at pH 8.0, and the lowest occurred at pH 5.0. At all pH levels mineralization decreased with decreasing oxidation-reduction potential, that is, increasing sediment anaerobiosis. In general, mineralization rates for octadecane were greater than those for naphthalene. Aerobic microorganisms in the oxidized sediment were more capable of degrading hydrocarbons than anaerobic microorganisms in reduced sediment of the same pH. (Baker-FRC)
W82-00243

ENUMERATION AND RELATIVE IMPORTANCE OF ACETYLENE-REDUCING (NITROGEN-FIXING) BACTERIA IN A DELAWARE SALT MARSH,
Delaware Univ., Newark. Coll. of Marine Studies.
H. J. Dicker, and D. W. Smith.
Applied and Environmental Microbiology, Vol 39, No 5, p 1019-1025, May, 1980. 2 Fig, 2 Tab, 42 Ref.

Descriptors: *Bacteria, *Salt marshes, Marshes, Bacterial analysis, Nitrification, Tidal marshes, Nitrogen, Seasonal variations, Temperature effects, Clostridium, Azotobacter, Desulfovibrio, *Delaware, *Nitrogen fixation.

Four sites were selected for study in the Canary Creek marsh adjacent to the University of Delaware Marine Station facilities in Lewes, Delaware. The stations were located in four different vegetational areas of the marsh. Three groups of N2-fixing bacteria were enumerated from the top centimeter of the surface in the four areas. The results over a period of sampling for nine months showed that there were no discernible seasonal patterns for any of the groups enumerated (Azotobacter sp., Clostridium sp., and Desulfovibrio sp). Azotobacter sp. were present in numbers of 10 to the seventh power per g of dry mud, whereas the two anaerobic fixers were present in much lower numbers, 10 to the third power to 10 to the fourth power per gram of dried mud. There were no differences in the numbers of each group among the different vegetational areas, thus indicating that there was a heterogeneous population of N2 fixers present. Additional studies indicate that the activity of sulfate reducers (Desulfovibrio sp.) may account for as much as 50% of the total observed acetylene reduction activity. Oxygen was found to exert little effect on the observed acetylene reduction activity, indicating that stable aerobic and anaerobic microenvironments exist in the surface layer of marsh sediments. (Baker-FRC)
W82-00248

DOES SALT MARSH FERTILIZATION ENHANCE SHELLFISH PRODUCTION. AN APPLICATION OF FLOW ANALYSIS,
Massachusetts Univ., Amherst. Dept. of Forestry and Wildlife Management.
J. T. Finn, and T. M. Leschine.
Environmental Management, Vol 4, No 3, p 193-203, May, 1980. 3 Fig, 2 Tab, 27 Ref.

Descriptors: *Fertilizers, *Shellfish, *Flow, *Nitrogen compounds, Nutrients, Marshes, Wetlands, Salt marshes, Ecosystems, Barataria Bay, Louisiana, Sippewissett Marsh, Massachusetts, Model studies, Wastewater disposal, Spartina, Aquatic plants.

Flow analysis was used to determine that adding nitrogen fertilizer to Spartina salt marsh sediment was not an efficient way to enhance shellfish growth. Nitrogen flow models for Barataria Bay salt marsh, Louisiana, and Sippewissett Marsh, Cape Cod, indicated that in both locations only 3% of added N reached the shellfish, despite the great physical differences and despite the inclusion of considerably more microbial processing of N in the Barataria Bay model. The most efficient N transfer would have to bypass Spartina growth, decomposition, and detrital feeding. (Cassar-FRC)
W82-00259

THERMOSTABILIZATION OF ENTEROVIRUSES BY ESTUARINE SEDIMENT,
Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
P-F. Liew, and C. P. Gerba.
Applied and Environmental Microbiology, Vol 40, No 2, p 305-308, August, 1980. 5 Fig, 17 Ref.

Descriptors: *Sediments, *Enteroviruses, *Estuarine environment, Temperature effects, Adsorption.

The protection of viral infectivity via adsorption to particulates was investigated. Particular attention was given to the possibility of an increased resistance to thermoinactivation resulting from the contact of the viruses with sediments. Dried estuarine sediment and artificial seawater were used in the study. The effect of sediment on enterovirus survival was assessed by comparing inactivation of a virus inoculum added to 40 ml of seawater in a 100-ml flint-glass bottle with inactivation of a similar virus inoculum in an identical volume of seawater containing sediment. The final concentration of virus in each bottle was 25,000 plaque-forming units per ml. Poliovirus survival was prolonged at 24 and 37C, but not at 4C in the presence of sediment over the time periods observed. Further inactivation studies were performed at 50 and 55C to maximize the thermal effects, and similar protection was noted. The supernatant fluid from a mixture of seawater and sediment lacked a protective effect against thermoinactivation, suggesting that prolonged virus survival in the presence of sediment was due to adsorption to particulates. From these observations it appears that the adsorption of enteroviruses to estuarine sediments may play a significant role in protecting them against thermoinactivation. (Baker-FRC)
W82-00263

THE ABUNDANCE OF ESTUARINE LARVAL AND JUVENILE FISH IN A SOUTH CAROLINA INTERTIDAL CREEK,
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
E. L. Bozeman, Jr., and J. M. Dean.
Estuaries, Vol 3, No 2, p 89-97, June, 1980. 5 Fig, 3 Tab, 26 Ref.

Descriptors: *Estuaries, *Fish populations, *Larvae, *Juvenile fish, *North Inlet Estuary, *South Carolina, Intertidal areas, Tides, Saline water fish, Marine fish, Aquatic environment, Aquatic animals, Wildlife, Immature growth stage, Eel, Atlantic menhaden, Creeks.

The population of larval and juvenile fish was measured in a small intertidal creek in the North Inlet Estuary, South Carolina, during October 1974 to May 1975. Five species accounted for 99.3% of the 573,739 individual fish captured: spot, Leiostomus xanthurus; pinfish, Lagodon rhomboides; Atlantic menhaden, Brevoortia tyrannus; Atlantic croaker, Micropogon undulatus; and speckled worm eel, Myrophis punctatus. A total of 16 species were represented. The collection method, blocking the channel at high tide and catching the fish in a quantitative sampling net as they left on the ebb tide, was reliable. Larvae were most abundant in February and March and moved to the open sea in the spring. (Cassar-FRC)
W82-00276

THE SIGNIFICANCE OF THE SUBMARINE GEOLOGY OF UPPER SPENCER GULF, SOUTH AUSTRALIA, TO ENVIRONMENTAL DECISION-MAKING,
Adelaide Univ. (Australia). Dept. of Geology.
J. R. Hails, V. A. Gostin, and G. E. Sargent.
Search, Vol 11, No 4, p 115-116, April, 1980. 2 Fig.

Descriptors: *Environmental effects, *Shore protection, Water pollution effects, Sediment transport, Aquatic plants, Ecological effects, Sea grasses, Mangrove swamps, Clays, Metals, Fate of pollutants, *Spencer Gulf, *Australia, Estuaries.

Study of more than 300 undisturbed vibrocores and box cores from the upper Spencer Gulf, South Australia, indicated that environmental damage could result from proposed industrial development in the coastal areas. Any damage to the extensive seagrass meadows or mangrove plants by pollutants or physical removal could interrupt shoreline equilibrium, releasing shell grit and sand to fill channels. Pollutants discharged into the water would be likely to remain in the nearshore environment because of poor water circulation and adsorption by the underlying stiff clays. (Cassar-FRC)
W82-00314

EFFECT OF SOLAR RADIATION AND PREDACIOUS MICROORGANISMS ON SURVIVAL OF FECAL AND OTHER BACTERIA,
Tasmania Univ., Hobart (Australia). Dept. of Agricultural Science.
J. McCambridge, and T. A. McMeekin.
Applied and Environmental Microbiology, Vol 41, No 5, p 1083-1087, May, 1981. 1 Fig, 3 Tab, 14 Ref.

Descriptors: *Sewage bacteria, *Estuarine environment, *Solar radiation, Seawater, Bacteria, Escherichia coli, Coliforms, Predation, Pathogens.

Although the effect of solar radiation on the survival of sewage bacteria in seawater has received considerable attention, little attention has been paid to pathogens and fecal matter other than coliforms or to the interaction between naturally occurring microbial predators and solar radiation. This study compared the survival of a range of bacteria associated with feces when exposed to solar radiation and examined the interrelationship between microbial predators and solar radiation in estuarine water samples. Significantly greater declines in the numbers of Escherichia coli cells were observed in estuarine samples exposed to both naturally occurring microbial predators and solar radiation than in samples exposed to only one of these factors. The effect of solar radiation on microbial predators was found to be negligible. However, sewage bacteria were susceptible to ligh-induced decay in varying decrees. Klebsiella pneumoniae had the lowest survival rate in estuarine water samples both in the dark and when exposed to solar radiation. The survival rates of the other sewage bacteria were next lowest for E. coli, followed in order of increasing survival levels by Salmonella typhimurium, Streptococcus faecium, Enterobacter aerogenes, and Erwinia herbicola. These results demonstrate that naturally occurring microbial predators and solar radiation interact to produce part of the observed decline of sewage bacteria in estuarine water samples and that different bacteria are affected by solar radiation to different degrees. (Carroll-FRC)
W82-00491

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3C. Use Of Water Of Impaired Quality

GROUND WATER ALTERNATIVES AND SOLUTIONS,
Los Alamos Scientific Lab., NM.
For primary bibliographic entry see Field 6D.
W82-00029

TREATMENT OF FLORIDA SURFACE WATERS FOR USE IN PHOSPHATE BENEFICIATION,
Bureau of Mines, University, AL. Tuscaloosa Research Center.
For primary bibliographic entry see Field 5D.
W82-00048

CROPPING SYSTEMS FOR TREATMENT AND UTILIZATION OF MUNICIPAL WASTEWATER AND SLUDGE,
Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences.
For primary bibliographic entry see Field 5E.
W82-00097

NITROGEN AVAILABILITY FROM SEWAGE SLUDGE,
Vermont Univ., Burlington. Dept. of Plant and Soil Science.
For primary bibliographic entry see Field 5E.
W82-00158

COASTAL BERMUDAGRASS YIELD AND SOIL PROPERTIES AS AFFECTED BY SURFACE-APPLIED DAIRY MANURE AND ITS RESIDUE,
Alabama Agriculture Experimental Station, Auburn.
Z. F. Lund, and B. D. Doss.
Journal of Environmental Quality, Vol 9, No 1, p 157-262, January-March, 1980. 9 Fig, 1 Tab, 6 Ref.

Descriptors: *Land disposal, *Manure, *Grasses, Crop yield, Farm wastes, *Fertilizers, *Bermudagrass, Dairy industry, Nitrogen, Acidity, Water pollution sources.

An experiment was performed to yield information on how manure affects soil properties and how long plants respond to residue from surface-applied manure. Dairy manure was applied for three years as a solid at rates of 45 and 90 metric tons/ha/yr and as a liquid at rates of 45, 90, and 135 metric tons/ha/yr on plots of Ditham loamy sand and Lucedale fine sandy loam. Mineral fertilizers were used on control plots. At the beginning of the residual phase of the study, residue from the manure three years after the final application was still producing considerably higher yields of coastal bermudagrass on both soils compared to the check plots. By the end of three cropping seasons, nitrogen was one of the most important limiting factors of production on both soils. Manure application increased levels of K and Mg and the pH of the subsoils. There was some downward movement of P. Thus, manure can be used to correct subsoil acidity in coarse-textured soils. However, the landspreading of manure may cause problems by polluting runoff and groundwater. (Small-FRC)
W82-00195

AMES' MUTAGENIC ACTIVITY IN RECYCLED WATER FROM AN ISRAELI WATER RECLAMATION PROJECT,
Johns Hopkins Univ., Baltimore, MD. Dept. of Environmental Health Sciences.
For primary bibliographic entry see Field 5D.
W82-00234

EFFECTS OF TILLAGE AND GYPSUM INCORPORATION ON RAIN RUNOFF AND CRUST STRENGTH IN FIELD SOILS IRRIGATED WITH SALINE-SODIC WATER,
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Inst. of Soil and Water.
For primary bibliographic entry see Field 2A.
W82-00327

IRRIGATION TAILWATER MANAGEMENT,
California Univ., Davis. Dept. of Land, Air, and Water Resources.
K. K. Tanji, J. W. Biggar, R. J. Miller, W. O. Pruitt, and G. L. Horner.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-196925, Price codes: A07 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-034a, July 1981. 5 p, 1 Fig, 2 Ref.

Descriptors: *Irrigation water, *Irrigation-return flow, *Tailwater, Water quality, Water supply, Water reuse, Dissolved solids, Suspended sediments, Pesticide residues, Agricultural chemicals, Water conservation, Cost analysis, *Impaired water use, *Central Valley, California.

Irrigation tailwater and other components of irrigation return flows were investigated in two representative sites in the Central Valley of California. Management of tailwater depends on the quantity and the quality of the water. When water is scarce tailwater is not discharged, or is used close to the site of production. Beneficial uses of tailwater include irrigation of crops and pasture, maintenance of wetland/waterfowl habitats, livestock water supply, groundwater recharge, maintenance of low flows in stream beds, repulsion of salinity in tidal estuaries, fish migration and spawning, warm water fish habitat, navigation, recreation and aesthetics, and municipal/industrial water supply. The use will depend on the quality of the water as well as the quantity. Poor quality of tailwater is caused by the presence of dissolved mineral salts, sediments, and agricultural chemicals. There is no single, universally-applicable control technology for irrigation tailwater, but low cost methods involve reducing the production of tailwater. This may be done by changing methods, use of variable interest and cost rates, and differential water costs. (Brambley-SRC)
W82-00392

RECLAIMING AND REUSING WASTEWATER,
California Univ., Berkeley.
For primary bibliographic entry see Field 5D.
W82-00402

THE HARVEST OF MICROALGAE FROM THE EFFLUENT OF A SEWAGE FED HIGH RATE STABILIZATION POND BY TILAPIA NILOTICA. PART 2: STUDIES OF THE FISH PONDS,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Agricultural and Food Engineering.
P. Edwards, O-A. Sinchumpasak, and M. Tabucanon.
Aquaculture, Vol 23, No 1-4, p 107-147, April, 1981. 6 Fig, 6 Tab, 25 Ref.

Descriptors: *Fish ponds, *Wastewater treatment, *Growth, Stabilization ponds, Algae, Phytoplankton, Effluent, Economic aspects, Tilapia, Fish stocking, Biomass, *Impaired water use.

Utilization of sewage-grown phytoplankton as in situ food for algae-feeding fish provides a potentially economic means of harvesting this protein source. The growth of Tilapia nilotica as a function of the concentration of phytoplankton in the water was investigated to acquire information needed for the design of fish culture systems involving the recycling of organic wastes. Phytoplankton concentration was varied by changing the flow rates and therefore the detention times of the fish ponds receiving wastes from a high rate stabilization pond. Tilapia nilotica grew well in the 4-cum concrete fish ponds, but ceased to grow after 3 months, regardless of stocking density or mean pond algal concentration. A fish stocking density of 10 per cubic meter may produce a high yield of small individual fish suitable for animal feed. Yields obtainable using a 4-cubic meter concrete pond system based on 3 month growing seasons may be similar to those for larger earth ponds with a single fish crop each year. A linear relationship exists between fish yields and mean phytoplankton concentration in the fish ponds. Good fish growth may be achieved with algal concentrations of 70 milligrams per liter. The dominance of phytoplankton in fish guts and the high crude food conversion ratios, based on phytoplankton added and retained in the fish ponds, demonstrated the high nutritional value of waste grown microalgae. Reductions of detention time, and therefore of mean pond phytoplankton concentrations, resulted in increases in the efficiency of fish production per unit phytoplankton biomass. Since fish growth was directly correlated with mean pond phytoplankton concentration, maximum efficiency would require large areas of land to obtain significant fish yields. (Carroll-FRC)
W82-00456

THE HARVEST OF MICROALGAE FROM THE EFFLUENT OF A SEWAGE FED HIGH RATE STABILIZATION POND BY TILAPIA NILOTICA. PART 3: MAIZE CULTIVATION EXPERIMENT, BACTERIOLOGICAL STUDIES, AND ECONOMIC ASSESSMENT,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Agricultural and Food Engineering.
P. Edwards, O-A. Sinchumpasak, V. K. Labhsetwar, and M. Tabucanon.
Aquaculture, Vol 23, No 1-4, p 149-170, April, 1981. 3 Fig, 5 Tab, 17 Ref.

Descriptors: *Land application, *Fish ponds, *Wastewater treatment, Effluents, Nitrogen, Crop yield, Irrigation, Coliforms, Algae, Phytoplankton, Economic aspects, Stabilization ponds, *Impaired water use.

The fertilization potential of effluent from a fish pond, which in turn received effluent from a sewage-fed high rate stabilization pond, for maize cultivation was investigated. Plots received composite fish pond effluent, raw sewage, or tap water and one of three levels of commercial nitrogen fertilizer. A linear relationship was found between maize yield and total nitrogen applied, regardless of the nitrogen source. However, differences in soil fertility prevented the development of an absolute relationship between maize yield and total nitrogen applied. Effluent from the fish ponds contained higher concentrations of fecal coliforms than are permitted under the World Health Organization standard for wastewater reuse for crops eaten cooked and for fish culture. Significant amounts of algae passed through the fish ponds when the phytoplankton concentration was high enough to produce good fish growth. As a result, a large land area was required for the maize crops irrigated with effluent from the ponds. About 63 hectares would be needed to treat and recycle domestic wastewater from a city of 100,000 people. The land area ratios were 1.86:1:10.25 for the high rate stabilization pond, the fish pond, and the maize plot, respectively. The study results suggest that there is little advantage in incorporation of a high rate pond in a fish-maize system, since fish do not harvest the phytoplankton as efficiently as they are produced in the high rate stabilization pond and since fecal coliform counts are high in the fish pond effluent. Use of a stabilization pond system composed entirely of earth ponds modified for fish and crop cultivation as well as for waste treatment probably would provide a more effective means of recycling sewage into fish. If a high rate stabilization pond is to be used, direct harvesting of the phytoplankton from the effluent for use as animal feed is probably the most practical means to exploit the system. (Carroll-FRC)
W82-00457

SODIUM-POTASSIUM RATIOS IN SOIL SOLUTION AND PLANT RESPONSE UNDER SALINE CONDITIONS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
D. Devitt, W. M. Jarrell, and K. L. Stevens.
Soil Science Society of America Journal, Vol 45, No 1, p 80-86, 1981. 3 Fig, 3 Tab, 23 Ref.

Descriptors: *Wastewater disposal, *Salinity, *Crop production, *Potassium, *Sodium, Land disposal, Soil solution, Effluents, Irrigation, Electric powerplants, Electrical conductivity, Nutrients, Soil-water-plant relationships, Chemical composition.

The use of cooling tower water from electrical generating plants to irrigate agricultural crops is being investigated. These effluents are quite saline and are usually high in sodium and comparatively low in potassium, resulting in a low potassium to sodium ratio. This study investigated the soil and plant factors that might affect the uptake and distribution of potassium by wheat plants irrigated with high-sodium, low-potassium water synthesized to represent cooling tower water. Lysimeters filled with either Holtville clay loam or San Emigdio sandy loam planted with wheat were irrigated with three concentrations of simulated cooling tower waters at electrical conductivities of 2.1, 4.2, or 7.1 mmho per centimeter. The concentrations of both sodium and potassium in the saturation extracts increased and the accumulation of sodium in leaves of the wheat plants greatly increased when the salinity of the irrigation water was increased. A significant inverse relationship was found between the potassium in plant leaves and the depth-weighted potassium in solution, as well as between sodium in leaves and potassium in leaves at harvest. The product of potassium/sodium in soil solution and the root length density, summated over

UNIV. OF ILL. URBANA-CHAMPAIGN

each depth increment sampled, was found to be the best indicator of the potassium to sodium ratio found in leaves at harvest. The ratio of potassium to sodium concentrations found in the soil solution appears to be a better indicator of potassium uptake by wheat than is the absolute concentration of potassium measured in the solution. (Carroll-FRC)
W82-00469

3D. Conservation In Domestic and Municipal Use

WATER AND WASTEWATER RECLAMATION: AN ECONOMICAL ANSWER TO INDUSTRIAL WASTES AND POLLUTION,
Culligan Inc., Northbrook, IL.
For primary bibliographic entry see Field 3E.
W82-00188

BEFORE THE WELL RUNS DRY: A HANDBOOK FOR DESIGNING A LOCAL WATER CONSERVATION PLAN.
New England River Basins Commission, Boston, MA.
Available from the USGS, Dist. Br. Text Prod. Sect. 604 S. Pickett St. Alexandria, VA. 22304, Price: $4.50. Geological Survey Resources and Land Investigations Program Report, October 1980. 95 p, 30 Fig.

Descriptors: *Water conservation, *Water management, *Planning, *Water supply, Water use, Municipal water, Domestic water, Water loss, Drought, Water shortage, Water demand, Water costs, Potential water supply, Public utility districts, *New England River Basins Commission.

A seven-step procedure for designing a water conservation plan is described in textbook fashion. This procedure forces the water supplier to consider the full range of options available and the potential impacts of each option on the utility, the users, and the community. The handbook presents five supply management programs to consider which will reduce water loss and waste within the supply system. In addition to the supply management programs, three demand management programs, pricing, education, regulation and their impacts are discussed. (USGS)
W82-00396

WATER CONSERVATION DEVICES FOR NEW OR EXISTING DWELLINGS,
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
W. E. Sharpe.
Journal of the American Water Works Association, Vol 73, No 3, p 144-149, March, 1981. 4 Tab, 10 Ref. OWRT-A-999-PA(7), 14-34-0001-1140.

Descriptors: *Performance evaluation, *Water conservation, *Plumbing, Urban areas, Retarded flow, Flow regulators, Flow velocity, Domestic water.

The performance of water conservation devices and fixtures developed for home use is discussed. Many devices have been developed to reduce the amount of water used to flush a toilet, including dams, partitions, and various inserts to displace water in toilet tanks. Damming, displacement, and flush mechanism modification devices are compared on the basis of water use reduction efficiency, cost installation problems, and performance under conditions of actual use. Maximum water reduction efficiencies occurred with two-cycle flush mechanism devices. Other flush modifications rated second, and toilet dams rated third. These results do not indicate solids clearance from the toilet bowl or deal with other potential problems. Plastic bottles were the easiest device to install and also cost the least. Toilet dams were the next cheapest, followed by flush modification mechanisms. Little information is available on performance. One study found that 100% of bottles installed were still in place two years later, while only 42, 50, and 92% of other toilet devices were still in place. There have also been problems with water saving toilets, specifically inadequate flushing of solid material in some installations. Shower devices and water faucet devices have performed satisfactorily. (Small-FRC)
W82-00401

3E. Conservation In Industry

GERBER SAVES 465,000 GALLONS OF WATER/DAY,
R. Banner.
Food Engineering, Vol 52, No 3, p 105-107, March, 1980. 1 Fig.

Descriptors: *Water reuse, *Food processing industry, Industrial wastes, Water demand, Drought, Economic aspects, Reclaimed water, Water renovation, Cooling water, Economic aspects.

Gerber was able to reduce its water usage in Oakland, California from 500,000 gallons per day to 35,000 per day, just by recycling cooling water used in its hot-fill and retort cooking process. A further refinement planned for the system will enable Gerber to save as much as $40,000 per year in steam-generating costs, by recycling hot water as well as cool water. Gerber originally had considered water conservation 16 years ago, when the plant was remodeled, and had the necessary equipment installed at that time. However, it was the cost of utilities and energy, triggered by the California drought of 1977, that made the system attractive enough to use. In this system, Gerber is reusing the cooling water that has passed through the retorts and sterilizer/cooler. This is accomplished by cooling and filtering the water for reuse rather than flushing the cookers with a fresh supply of city water for each cook cycle. When the whole system begins to operate, about 314,000 gallons of water will be saved per day. (Baker-FRC)
W82-00187

WATER AND WASTEWATER RECLAMATION: AN ECONOMICAL ANSWER TO INDUSTRIAL WASTES AND POLLUTION,
Culligan Inc., Northbrook, IL.
J. Mulvihill.
Industrial Wastes, Vol 26, No 4, p 14-16, July/August, 1980. 1 Fig.

Descriptors: *Industrial wastes, *Reclaimed water, Water, Water reuse, Wastewater renovation, Water use, Wash water, Impaired water use.

Several examples are cited of water being reused or made to serve several purposes before being discharged to the sewer system. One example, in operation at many places in the United States, involves the washing of trucks, buses and trains, where the wash water is recycled for reuse. Another example is found in a motel, where the shower and sink water from the motel rooms is chlorinated, passed through a multi-media depth filter, then through a carbon filter, rechlorinated, and used for on-premise laundry. The laundry wastewater is collected and goes through the same type of system as the motel gray water. Water from the laundry gray water system is colored and scented and used for toilet flushing. A third type of process using reclaimed water is a coal processing plant reusing its coal washing wastewater. The reclamation process involves chemical clarification followed by alternating multi-media filters. Additional examples include a rolling steel mill, a cannery, and a metal conduit manufacturer. Designing such a system requires thorough knowledge of the incoming water's chemical and biological make-up, the breakdown of chemical components being used in the process and their effects, the chemical and physical elements added to the water during its intended use, and the available treatment methods, both chemical and physical in nature. (Baker-FRC)
W82-00188

3F. Conservation In Agriculture

PERFORMANCE OF BEARING CHERRY AND PRUNE TREES UNDER VERY LOW IRRIGATION RATES,
S & E Irrigated Agriculture Research and Extension Center, Prosser, WA.
E. L. Proebsting, Jr., J. E. Middleton, and M. O. Mahan.
Journal of the American Society for Horticultural Science, Vol 106, No 2, p 243-246, March, 1981. 4 Tab, 9 Ref.

Descriptors: *Irrigation requirements, *Fruit crops, Cherries, Prunes, Trees, Trickle irrigation, Soil moisture, Wilting point, Plant growth, Washington, Water shortage, Soil water, Water requirements, Agriculture, Water conservation, Orchards, Water stress.

The minimum amount of irrigation water needed to keep cherry (Prunus avium L.) and prune (Prunus domestica L.) trees alive during a 1 year water shortage was studied in Washington during 1976, the pre-test year; 1977, the stress period; and 1978-1979, the recovery period. During the stress period, total water applied to cherry trees by daily or weekly trickle irrigation was 30,200 liters per tree at 100% of evaporation, 16,000 at 50%, and 4,300 at 15%. Total amounts applied to prunes were approximately half that of the cherry trees. Although soil moisture remained above the wilting point for 100% evaporation treatments, it reached the wilting point at 50% and 15% except near the emitters. At 15% of evaporation irrigation rate, trees survived but growth of fruit and vegetative parts was reduced and leaves dropped early in the fall. Flower bud development was not affected. Cherry trees showed dieback of peripheral branches during 1977 and 1978 and grew and fruited normally by the third year after treatment. Prunes at 15% responded similarly and recovered well by 1978. The 50% rate produced a diminished fruit yield of prunes and cherries in 1977, but yields and growth were normal the following year. (Cassar-FRC)
W82-00119

OPTIMAL DESIGN OF FURROW IRRIGATION SYSTEMS,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
J. M. Reddy, and W. Clyma.
Transactions of the ASAE, Vol 24, No 3, p 617-623, May/June, 1981. 2 Fig, 2 Tab, 11 Ref.

Descriptors: *Furrow irrigation, *Irrigation efficiency, *Optimization, Economic aspects, Farms, Costs, Design criteria, Irrigation practices, Agriculture.

Furrow irrigation system design was optimized using a combination of generalized geometric programming and the Soil Conservation Service design procedure. Water, labor, and ditch construction costs were minimized. Variables in the system included: inflow rate, time of inflow, length of run, number of lengths of run, number of sets, and number of furrows per set. The problem was formulated in terms of cost coefficients, design variables, and system physical constraints. A sample field was designed. The method delineates that particular combination of design variables that minimizes the cost while satisfying system constraints. The procedure can be used to design and operate furrow irrigation systems with efficiency and can improve on-farm water management. The design procedure could be improved by basing the design on maximum profit and by including additional decision variables. (Small-FRC)
W82-00138

FURROW IRRIGATION PRACTICES IN NORTHERN COLORADO,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
T. W. Ley, and W. Clyma.
Transactions of the ASAE, Vol 24, No 3, p 610-116, 623, May/June, 1981. 4 Fig, 2 Tab, 14 Ref.

Descriptors: *Furrow irrigation, *Performance evaluation, *Irrigation practices, Irrigation, Irrigation efficiency, Farms, Agriculture, *Colorado.

Furrow irrigation evaluations were conducted for four years on several farms in the Fort Collins and Greeley areas of Colorado. Data from six farms was used to define state-of-the-art irrigation practices and priority problems in the area. Researchers found that while marginally acceptable designs could be achieved for the longer run lengths from 400 m to 800 m, improved system performance could be attained on the run lengths of 400 m or less. Eighty-five percent of the irrigations evaluated had unacceptable performance levels. Low water application efficiencies resulted from high runoff losses. Low water requirement efficiencies resulted from cumulative soil water deficits, poor timing, and insufficient applications. Farmers tended to irrigate too soon, and under- and over-irrigation were common. Proper requirements and management could improve water application efficiencies to 75 to 95% and water requirement efficiencies to 85 to 100%. (Small-FRC)
W82-00139

WATER, ENERGY AND LABOR REQUIREMENTS FOR FUTURE PACIFIC NORTHWEST IRRIGATION,
Oregon State Univ., Corvallis. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 6A.
W82-00143

ECONOMICS OF SNOW MANAGEMENT FOR AGRICULTURE IN THE GREAT PLAINS,
Colorado State Univ., Fort Collins. Dept. of Economics.
J. R. Snyder, M. D. Skold, and W. O. Willis.
Journal of Soil and Water Conservation, Vol 35, No 1, p 21-24, January/February, 1980. 1 Fig, 8 Tab, 5 Ref.

Descriptors: *Agriculture, *Snow management, *Cost-benefit analysis, Wheatgrasses, Barriers, Soil moisture, Wheat, Water conservation, Economic aspects, Precipitation, *Snowmelt, *Crop production.

A successful method for managing snow to increase infiltration into cropland is the use of tall (3-5 ft) wheatgrass barriers planted along topographic lines and perpendicular to prevailing winds. At Akron, Colorado, grass barriers combined with continuous cropping produced 43% more crop per acre than the traditional crop-fallow system without barriers. The amount of soil water stored averaged 150% of soil water accumulated on nearby fallow land. In Culbertson, Montana, the continuous cropping-barrier system produced an extra 15 bushels per acre of winter wheat and five bushels per acre of spring wheat compared with the conventional crop-fallow system. Net returns per acre-year were $10-$20 depending on whether the crop was originally spring or winter wheat. Profitability varied widely over the years studied, 1968-1975, depending on precipitation. Snow management practices may be of little benefit in years with low snowfall or adequate growing season precipitation. (Cassar-FRC)
W82-00178

FIELD TEST OF AN IRRIGATION SCHEDULING COMPUTER MODEL,
Soil and Irrigation Research Inst., Pretoria (South Africa). Dept. of Agriculture and Fisheries.
W. S. Meyer, and G. C. Green.
Water SA, Vol 7, No 1, p 43-48, January, 1981. 2 Fig, 3 Tab, 10 Ref.

Descriptors: *Irrigation requirements, *Evapotranspiration, *Computer models, Model studies, Irrigation efficiency, Transpiration, Evaporation, Mathematical models, Lysimeters, Crop yield, Wheat, Soil water, Field tests, Pretoria, *South Africa.

The United States Department of Agriculture Irrigation Scheduling Model was tested on wheat crops grown at Roodeplaat, near Pretoria, in 1979. The rate of evapotranspiration was predicted using current meteorological information. The model also utilizes a crop water use coefficient, irrigation forecasts, and soil water balance data. Results obtained during 1978 were examined to adjust the model for local conditions. Amounts of soil water depletion predicted by the model were in close agreement with those measured from soil samples. Experimental plots yielded about the same amount of grain as plots irrigated according to actual ET losses measured by weighing lysimeters stationed on the same location. However, predicted ET was higher than measured ET, so that the scheduled plots received more water than was probably required. (Geiger-FRC)
W82-00184

WATER APPLICATION UNIFORMITY OF HOSE TOWED TRAVELER IRRIGATORS,
Auburn Univ., AL. Agricultural Experiment Station.
R. L. Collier, and E. W. Rochester.
Transactions of the ASAE, Vol 23, No 5, p 1135-1138, 1980. 10 Fig, 1 Tab, 2 Ref.

Descriptors: *Irrigation systems, *Sprinkler irrigation, Application rates, Agriculture, Farm equipment, Irrigation engineering.

Two hose-towed traveler irrigators were studied to determine the effects of linear speed of the sprinkler carriage, reel rotation speed, flow rate, and water pressure on the uniformity of application. One irrigator was a 5-layer irrigator; the other was an irrigator with three layers of hose. Considering the diameter of the reel, a 44% theoretical increase in travel speed would be expected from beginning to end of the travel lane for the 5-layer irrigator and 24% for the 3-layer. Measured variations in travel speed averaged 42% for the 5-layer and 23% for the 3-layer. As the hose became wrapped on the reel, discharge and pressure at the nozzle decreased. Increased flow resistance caused the system to shift to a higher pump rate at a lower flow rate. The combined effect of all factors resulted in average final depths of application of 68% and 77% of initial depth for the 5-hose and 3-hose machines, respectively. (Cassar-FRC)
W82-00296

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

REVIEW OF REPORTS FOR FLOOD CONTROL; WESTCHESTER COUNTY STREAMS, NEW YORK.
Army Engineer District, New York.
Report, July, 1981, 75 p, 15 Fig, 12 Tab.

Descriptors: *Flood control, *Cost-benefit analysis, *Flood damage, Environmental effects, Cost analysis, Economic aspects, Disasters, *Westchester County, New York.

Numerous communities in Westchester County, New York have historically experienced serious problems due to flooding of the many streams draining the county. High intensity of prolonged rainfall such as occurred during recent floods have threatened the health and safety of the public and caused millions of dollars in damages, resulting in the county being declared a Federal Disaster Area. Flood control projects along the Saw Mill River in the Town of Chappequa and the City of Yonkers have been authorized and are presently under construction; flood control projects along the Saw Mill River in the Village of Ardsley and the Village of Elmsford - Town of Greenburgh have been authorized and are presently in the advanced engineering and design phase; and interim reports for flood control have been submitted to Congress for the Saw Mill River, Mamaroneck and Sheldrake Rivers, and the Byram River. Investigations are continuing for the Saw Mill River in the Nepera Park area of Yonkers and Nannyhagen Brook in Mount Pleasant. For the remaining areas in Westchester County, the investigations conducted in response to the study authority as well as the small flood control program have indicated that Federal flood control projects are not warranted at this time due to the lack of sufficient economic and environmental benefits to justify the cost of protective measures. (Moore-SRC)
W82-00103

USE OF RIVER WATERS THAT DID NOT REACH THE ARAL SEA AS A CONSEQUENCE OF ECONOMIC ACTIVITY DURING 1961-1975,
Akademiya Nauk SSSR, Moscow. Inst. Geografii.
E. N. Minaeva.
Water Resources (English Translation), Vol 7, No 5, p 418-422, September/October, 1980. 1 Tab, 15 Ref. Translated from Vodnye Resursy, No 5, p 82-88, September/October, 1980.

Descriptors: *Hydrologic budget, *Rivers, *USSR, Aral Sea, Irrigation, Water use, Reservoirs, Evaporation, Soil water, Water loss, Percolation, Seepage, Transpiration, Phreatophytes, Canals, Drainage water.

Intensification of irrigation agriculture in the Soviet Union resulted in the Aral Sea experiencing a shortfall of 215 cubic kilometers over the period 1961 through 1975. The State Hydrologic Institute estimated possible items of its expenditure, both lump-sum and constant, using extensive data reflecting the characteristics of the development of water management during this period. Water management developments included interbasin water transfers, creation of several shallow reservoirs on the plains, and new irrigation of large areas. All of the data were obtained by direct calculations, except for the volumes of waters filling soil pores on newly irrigated lands. Items of lump-sum water expenditure which were estimated include filling of reservoirs, filling of closed depressions with drainage waters, formation of water lenses under canals, and filling of soil pores on irrigated lands. Estimates were also developed for the following items of constant water expenditure: evaporation from irrigated lands, transpiration by phreatophytes in the zone of influence of large canals, evaporation from the water surfaces of reservoirs, evaporation from the water surfaces of depressions filled with drainage waters, and evaporation from large permanent canals. The methods of estimating each of these components of the water expenditure are described. The volumes of waters filling soil pores on newly developed lands were determined as the remainder from the calculations made. (Carroll-FRC)
W82-00190

A SUCCESSFUL TRANSFER,
Welsh Water Authority (Wales).
P. Goodman.
Water, No 33, p 19-20, July, 1980. 2 Fig.

Descriptors: *Water supply development, *Water transfer, *Diversion, *Wales, Diversion structures, Great Britain, Water supply, Rivers, Water conveyance, Interbasin transfers.

The small margin between existing normally available resources and actual consumption in south east Wales prompted the development of a water transfer scheme designed to meet the needs of homes and industries in South Gwent and Cardiff. Under the Wye Abstraction Scheme, 136.3 million liters per day will be diverted from the Wye and transferred across Gwent into the existing water supply there by pipeline. Additional discharges will be made from the Elan Valley reservoirs, located near the head of the Wye catchment, during periods of low flow in the river. An intake and pumping station will abstract the water from the Wye. The abstracted water will be transferred through 32 kilometers of 1.2 meter diameter steel pipeline direct to a new storage reservoir, where it can be treated for use in an area now using water from the Usk River and the Llandegfedd reservoir. Water from those sources will then be released for use in the Cardiff area. Provision will also be made for direct transmission of the water in the new

storage reservoir to treatment facilities serving the Cardiff area. The reservoir will serve as a buffer against river pollution and allow the pumps to be shut down during very dirty river conditions. The abstraction represents just over two percent of the average daily flow of the Wye and about four percent of the average flow during summer months. The intake facility has been designed to keep water velocity to a minimum to prevent fish, particularly salmon, from being drawn in and to keep silt out of the pumping station. The intermittent high and low flows in the upper Wye which will result from the abstraction scheme may tend to attract spawning fish into the river. (Carroll-FRC)
W82-00309

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING: SKAGIT RIVER BASIN, WASHINGTON.
Federal Energy Regulatory Commission, San Francisco, CA. Office of Electric Power Regulation.
For primary bibliographic entry see Field 6D.
W82-00368

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING: LEWIS RIVER BASIN, WASHINGTON.
Federal Energy Regulatory Commission, San Francisco, CA. Office of Electric Power Regulation.
For primary bibliographic entry see Field 6B.
W82-00370

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING: PIT RIVER BASIN, CALIFORNIA.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
For primary bibliographic entry see Field 6B.
W82-00373

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING: CLARK FORK-PEND OREILLE RIVER BASIN, MONTANA, IDAHO, WASHINGTON.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
For primary bibliographic entry see Field 6B.
W82-00374

AN ANALYSIS OF RESERVOIR STORAGE CONTENTS FOR THE PROPOSED ENLARGEMENT OF BUMPING LAKE IN WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
J. H. Bartells.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $1.75 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 80-440, 1981. 10 p, 1 Fig, 2 Tab, 3 Ref.

Descriptors: *Reservoir storage, *Storage capacity, *Reservoir operation, *Water supply, Reservoirs, Lakes, Reservoir releases, Reservoir capacity, Reservoir yield, Reservoir fisheries, Irrigation, Water rights, Hydrologic data, Hydrographs, *Washington, *Bumping Lake.

Monthend contents of the proposed Bumping Lake enlargement in Washington were determined for the period 1917-73 by using the historic streamflow record as a basis for inflow to the reservoir and imposing certain operational requirements on reservoir releases. The operational requirements used were those set forth in the Environmental Statement that was prepared for the project by the U.S. Water and Power Resources Service (formerly the U.S. Bureau of Reclamation). The computations show that after starting with an empty reservoir on October 1, 1917, the 458,000 acre-feet capacity of the enlarged lake could be nearly full (384,000 acre-feet) on November 30, 1925, which is the starting scenario given in the Environmental Statement. From 1925 to 1973 the computations compare favorably with those shown in the Environmental Statement, with minor differences due to releases of fish enhancement water. In all cases studied, all fishwater requirements and all existing irrigation requirements were met, and generally from 30,000 to 90,000 acre-feet of extra irrigation water could be available in most years. (USGS)
W82-00421

4B. Groundwater Management

BASIN MANAGEMENT IN THE SAN BERNARDINO VALLEY,
East San Bernardino City Water District, CA.
L. W. Rowe.
Water/Engineering and Management, Vol 128, No 5, p 79-80, 83, May, 1981.

Descriptors: *River basin development, *Watershed management, *Monitoring, Water quality, Water supply development, Water quality management, Wastewater treatment, *San Bernardino Valley, California, Groundwater management.

The San Bernardino Valley Municipal Water District manages the San Bernardino basin through monitoring, planning, and operation. Water quality data are collected for 60 key points within the district, including 13 streams and 45 wells. Basin production is monitored along with current and projected land use. Planning entails performing water supply studies for the eight service areas, including investigating the feasibility of wheeling in supplemental water or pumping groundwater from one system to another if required. Groundwater modeling is also performed. Wastewater treatment needs are being evaluated for five service areas. Operational programs include the establishment of the Santa Ana River-Mill Creek Cooperative Water Project Committee which pools area water to provide a stable water supply for all. Also, a recharge program discharges state project water into existing water conservation facilities at high elevations. The cooperative pumping agreement demonstrates the feasibility of obtaining water out of one purveyor's distribution system and conveying it to another. (Small-FRC)
W82-00075

PRELIMINARY DATA FROM A SERIES OF ARTIFICIAL RECHARGE EXPERIMENTS AT STANTON, TEXAS,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-00085

A 10-YEAR PLAN TO STUDY THE AQUIFER SYSTEM OF INDIAN WELLS VALLEY, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 6D.
W82-00086

AN OBSERVATION-WELL NETWORK CONCEPT AS APPLIED TO NORTH CAROLINA,
Geological Survey, Raleigh, NC. Water Resources Div.
M. D. Winner, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-106089, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-13, March 1981. 59 p, 24 Fig, 12 Tab, 11 Ref.

Descriptors: *Observation wells, *Networks, *Monitoring, *Groundwater management, Aquifers, Water level fluctuations, Discharge measurement, Geohydrologic units, Wells, Pumping, Groundwater recharge, Hydrologic data, Data collections, Data processing, *North Carolina.

A statewide observation-well program is proposed for North Carolina based on four networks of observation wells with different but clearly-defined objectives. These are referred to as the (1) climatic-effects network, (2) terrane-effects network, (3) local-effects network, and (4) areal-effects network. The characteristics of each network are related to natural and man-made stresses in aquifers, and the areas and hydrogeologic units in North Carolina where these networks are needed are identified. Formats for collection, processing, and publication of data from these networks is suggested. (USGS)
W82-00414

DIGITAL MODEL OF THE UNCONSOLIDATED AQUIFER SYSTEM IN THE MODESTO AREA, STANISLAUS AND SAN JOAQUIN COUNTIES, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
C. J. Londquist.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-102559, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigation 81-12, July 1981. 36 p, 17 Fig, 1 Tab, 19 Ref.

Descriptors: *Model studies, *Geohydrology, *Aquifers, *Confined groundwater, Groundwater movement, Pumping, Transmissivity, Groundwater recharge, Water level, Finite difference methods, *California, Modesto, Stanislaus County, San Joaquin County, *Groundwater availability.

A digital mathematical model of the unconsolidated alluvial aquifer system in the Modesto area, Calif., has been developed which can be used to determine the effects of increased pumping and water use of future water levels in the aquifer system. The model is divided into two units. The lower unit is confined in the western part of the study area by a confining clay bed; elsewhere in this unit the aquifer is unconfined. The upper unit represents an unconfined aquifer and lies above the clay bed or its extension. Where the clay bed is absent the upper and lower units are considered as a single aquifer. The model, as calibrated, can evaluate with reasonable accuracy the effects on water levels of changing stresses and stress patterns only within the area of primary interest for the upper unit. In other areas of the upper unit and for the lower unit, predicted changes should be looked upon as, at best, representing only general trends. (USGS)
W82-00415

PROPOSED OBSERVATION-WELL NETWORKS AND GROUND-WATER LEVEL PROGRAM FOR NORTH CAROLINA,
Geological Survey, Raleigh, NC. Water Resources Div.
M. D. Winner, Jr.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225, Price: $9.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-544, 1981. 69 p, 29 Fig, 14 Tab, 8 Ref.

Descriptors: *Observation wells, *Network design, *Monitoring, *Groundwater, Aquifers, Water level fluctuations, Discharge measurements, Geohydrologic units, Wells, Pumping, Groundwater recharge, Hydrologic data, Data collections, Data processing, *North Carolina.

An initial system of 223 observation wells is proposed for monitoring ground-water levels in North Carolina. These wells are suggested to replace and upgrade nearly 650 observation wells currently measured in separate State and Federal programs, and are arranged in four groups or networks each having specific objectives. These groups are (1) a climatic-effects network, (2) a terrane-effects network, (3) a local-effects network, and (4) an areal-effects network. Recommendations are also made regarding additional observation-well coverage in some areas of the State. Records review and network review procedures constituted the largest amount of effort in this study and required a considerable amount of organization to keep track of well records and water level data. These procedures are outlined in this report as a guide for those who are contemplating an observation-well program review. The report also contains suggested organizational contents of a data file, including

procedures for records processing, and various forms used to document the review and data-collection efforts. (USGS)
W82-00426

4C. Effects On Water Of Man's Non-Water Activities

QUARTERLY PROGRESS REPORT, NATIONWIDE URBAN RUNOFF PROGRAM.
Woodward-Clyde Consultants, San Francisco, CA.
For primary bibliographic entry see Field 5G.
W82-00044

PREMINING HYDROLOGIC CONDITIONS OF FIVE SOUTHEASTERN OHIO WATERSHEDS,
Bureau of Mines, Denver, CO. Denver Research Center.
G. E. McIntosh.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-135055, Price codes: A05 in paper copy, A01 in microfiche.
In: Surface Coal Mining Reclamation Equipment and Techniques, Proceedings: Bureau of Mines Technology Transfer Seminars, Evansville, Indiana, June 3, 1980 and Denver, Colorado, June 1980. Bureau of Mines Information Circular 8823, 1980. p 60-73, 6 Fig

Descriptors: *Strip mines, *Coal mines, *Water quality, *Hydrologic data, Groundwater, *Ohio, Precipitation, Infiltration, Erosion, Land reclamation, Watersheds, Watershed management.

In Appalachia, land is being disturbed by surface mining at an accelerating rate to obtain coal for electric power production and other uses. Five watersheds, range in size from 29 to 52 acres, were selected to study the effects of mining and reclamation on hydrology and water quality. Four of these watersheds will be mined, and one will be used as a control. All the watersheds are located in east-central Ohio. The study watersheds in Coshocton County (C06 and A06) and the one in Muskingum County (M09) are located in the Muskingum River Basin. The two Jefferson County sites (J11 and J08) drain into small tributaries of the Ohio River. On each watershed soil and vegetation surveys were run, and geologic cores were obtained in order to determine baseline physical conditions. Weather stations were set up to monitor precipitation, temperature, relative humidity, wind speed, and solar radiation. Infiltration tests, surface water quality and quantity measurements, and ground water studies are being conducted. In addition to the monitoring of the watersheds, erosion and treatment plots have been set up at three of the mine sites. (Moore-SRC)
W82-00054

HYDROLOGIC DATA FOR URBAN STUDIES IN THE AUSTIN, TEXAS METROPOLITAN AREA, 1979,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-00083

EFFECT OF AGRICULTURAL LAND DEVELOPMENT ON DRAINAGE WATERS IN THE NORTH CAROLINA TIDEWATER REGION,
North Carolina State Univ. at Raleigh.
For primary bibliographic entry see Field 5B.
W82-00094

PHYSICAL EFFECTS OF VEHICULAR DISTURBANCES ON ARID LANDSCAPES,
Stanford Univ., CA. Dept. of Applied Earth Sciences.
R. M. Iverson, B. S. Hinckley, R. M. Webb, and B. Hallet.
Science, Vol 212, No 4497, p 915-917, May, 1981. 1 Fig, 1 Tab, 20 Ref.

Descriptors: *Arid-zone hydrology, *Rainfall infiltration, *Soil erosion, *Surface runoff, Arid lands, Erosion, Erosion control, Infiltration capacity, Soil porosity, Mathematical studies, Runoff, Overland flow, Soil compaction, *Off-road vehicle effects.

The arid lands of the Southwestern part of the United States are increasingly being used for recreation by off-road vehicles. Such vehicles have been shown to cause damage to arid land hydrology by increasing the amount and frequency of water runoff and erosion by reducing soil porosity, infiltration capacity, and hydraulic resistance to overland flow. Natural surface stabilizers are also disrupted by vehicular travels. In 50 rainfall simulation tests, vehicle-used plots had about 5 times more runoff and 10-20 times greater sediment yield than adjacent unused plots. In a desert environment, such effects may occur even when use of off-road vehicles is light. Recovery times from vehicular damage are estimated to be nearly 100 years. Erosion rates were calculated from multivariate statistical analyses using 22 experimental factors. The character of the rainfall was identified as the most important variable in predicting increases in erosion. (Geiger-FRC)
W82-00111

SLASH TREATMENT AFTER CLEARCUTTING LODGEPOLE PINE AFFECTS NUTRIENTS IN SOIL WATER,
Utah State Univ., Logan. Dept. of Forestry and Outdoor Recreation.
G. E. Hart, N. V. DeByle, and R. W. Hennes.
Journal of Forestry, Vol 79, No 7, p 446-450, July, 1981. 1 Fig, 1 Tab, 14 Ref.

Descriptors: *Nutrients, *Forest soils, *Clear-cutting, Forests, Pine trees, Forest management, Cutting management, Coniferous trees, Industrial wastes, Organic wastes, *Waste disposal, Soil solution, Mulching, Incineration, Sodium, Phenols, Potassium, Magnesium, Calcium, Nitrate, Soil water.

Harvesting of old-growth coniferous forests in the northwest United States produces large volumes of organic debris which must be reduced to lower fire hazard, control insects, improve seedbeds, provide access, and/or ameliorate appearance. Changes in soil solution chemistry resulting from four slash disposal methods employed after clearcutting of old-growth lodgepole pine were investigated. The slash disposal methods used included nearly complete removal, spreading the residue as chips, broadcast burning, and windrow burning. Soil solutions from the areas which had been clearcut had slightly higher concentrations of sodium, potassium, magnesium, calcium, and nitrate than did those from an adjacent unharvested forest area. Effects on stream water resulting from leaching or runoff would be negligible and difficult to detect. High concentrations of nitrate-nitrogen were found in the intensively burned areas beneath windrows and following broadcast burning. Use of the residue as a mulch after near-complete harvesting resulted in a flush of phenolic compounds into the soil solution during the first post-treatment year. Phenol concentrations in soil solutions after mulching were significantly higher than acceptable levels for fish habitats. Broadcast burning apears to be preferable to windrow burning because it diffuses effects on soil and soil water over the entire area. Chemical composition of soil water appears to be least affected by residue disposal practices that cause minimal mechanical disturbance and minimal incorporation of organic matter into soil surfaces. (Carroll-FRC)
W82-00130

ROCKY MOUNTAIN PIPELINE PROJECT: ENVIRONMENTAL IMPACT STATEMENT,
Bureau of Land Management, Washington, DC.
For primary bibliographic entry see Field 5G.
W82-00394

A MODEL OF NATURAL AND MAN-INDUCED CHANGES IN OPEN FRESHWATER WETLANDS ON THE MASSACHUSETTS COASTAL PLAIN,
Massachusetts Univ., Amherst. Dept. of Forestry and Wildlife Management.
For primary bibliographic entry see Field 2I.
W82-00397

USE OF FLOW-DURATION CURVES TO EVALUATE EFFECTS OF URBANIZATION ON STREAMFLOW PATTERNS ON LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
K. R. Prince.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-114307, Price codes: A02 in paper copy, A01 in microfiche.
Geological Survey Water-Resources Investigations 80-114, 1981. 19 p, 4 Fig, 4 Tab, 15 Ref.

Descriptors: *Flow duration, *Urbanization, *Streamflow, *Urban runoff, Urban hydrology, Base flow, Storm runoff, Water level, Pumping, Water supply, Sewer systems, Population dynamics, *New York, *Long Island, Nassau County, Suffolk County, Peak flow.

Streamflow patterns on Long Island, N.Y., have been changing over the last three decades in response to eastward population growth and urbanization. Flow-duration curves for nine streams in Nassau and Suffolk Counties indicate that, during this time, streams in urbanized areas have had increased peak flows and decreased base flows, whereas streams in sparsely populated areas have shown little or no change. The increase in peak flows reflects the greater volume of storm runoff from impermeable surfaces such as roads, parking lots, and roofs. The decrease in base flows results from the lowering of groundwater levels, principally by sanitary sewerage and extensive pumping for public water supply. At East Meadow Brook, in a sewered, densely populated area of Nassau County, peak flows (1-percent duration) increased by 41% during 1946-74, and base flows (98-percent duration) decreased by 99%. In contrast, peak and base flows of Carmans River, in a largely undisturbed, rural area of Suffolk County, showed fluctuations no greater than 19% during the same period. (USGS)
W82-00416

4D. Watershed Protection

TERRACE PLANNING CRITERIA FOR RUNOFF CONTROL FOR DEEP LOESS SOIL,
Harza Engineering Co., Chicago, IL.
P. Jacobson.
Transactions of the ASAE, Vol 24, No 3, p 699-704, May/June, 1981. 4 Fig, 8 Ref.

Descriptors: *Runoff, *Terracing, Land forming, Loess, Contour terracing, Geological terraces, Agriculture, Farming, Erosion, *Erosion control.

Procedures used to develop a water control system adapted for ease in farming are described. The system was based on 19 years of experience. Adoption of these procedures should alleviate most objections to terraces and other control measures. Specific planning criteria are to be used for: lands having slopes less than 6% with deeply entrenched waterways; lands of uniform slopes with minor waterway entrenchment; lands with slopes over 6% with deeply entrenched waterways spaced 120 meters or less horizontally; lands having slopes over 6% with deeply entrenched waterways spaced over 120 meters apart; and relatively flat, moderately rolling upland areas which are dissected by a few deeply entrenched waterways. The terrace planning criteria outlined for these various slopes and topographies proved to offer fairly straight row alignment on much of the experimental farm. This would not have been the case with conventional terrace layouts. This sets the stage for a practically erosion-free surface obtained through the use of terraces and fills. To maintain fertility and crop yields across the terrace interval, steep backslope terraces and gully fills designed for subsequent benching will necessarily be limited to deep soils. (Baker-FRC)
W82-00144

PROTECTING AGRICULTURE'S NATURAL RESOURCE BASE,
Iowa State Univ., Ames.
J. F. Timmons.
Journal of Soil and Water Conservation, Vol 35, No 1, p 5-11, January/February, 1980. 3 Tab, 28 Ref.

Descriptors: *Erosion control, *Water pollution prevention, *Soil conservation, *Agriculture, Iowa, Resources management, Water quality, Suspended sediments, Economic aspects, Cultivated lands, Conservation, Grain crops.

Soil erosion and associated water quality problems may replace petroleum as the nation's most critical natural resource problem. One factor influencing soil erosion on the individual farm level is the tendency to maximize immediate income at the expense of long term erosion control measures or of water quality at a distant site. On the national or international scale, increased demand for agricultural products and limitations to the capacity to produce these crops contribute to soil erosion. Some productive agricultural practices are discouraged by water quality standards imposed on suspended silt and chemical residuals. At the same time, increasing grain exports, changing meadows and forests to more erosion-susceptible agricultural use, and decreasing funds for soil conservation have compounded the erosion problem. Strategies for reducing soil losses are: (1) research and education, (2) the 'red ticket' strategy to require the unwilling few to submit to the majority will, (3) the 'green ticket' strategy, providing financial incentives to conserve soil, (4) complementary controls and incentives, (5) public investments on private land, (6) cushioning impacts of grain exports, (7) soil conservation districts, and (8) integrating soil erosion control with food assistance policies. Some of these strategies are illustrated by examples of court decisions and activities in Iowa. (Cassar-FRC)
W82-00176

HYDRAULIC SEDIMENT MODEL STUDY FOR PROPOSED BLANCO DIVERSION DAM MODIFICATION,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 8A.
W82-00446

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

TOXICITY OF MOUNT ST. HELENS ASH LEACHATE TO A BLUE-GREEN ALGA,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5C.
W82-00001

MOUNT ST. HELENS VOLCANIC-ASH FALL IN THE BULL RUN WATERSHED, OREGON, MARCH-JUNE 1980,
Geological Survey, Portland, OR. Water Resources Div.
For primary bibliographic entry see Field 5B.
W82-00002

CHEMICAL INDICATORS OF ORGANIC RIVER SOURCES IN RIVERS AND ESTUARIES,
Washington Univ., Seattle. Dept. of Oceanography.
For primary bibliographic entry see Field 5B.
W82-00035

DEVELOPMENT OF OIL-IN-WATER MONITOR, PHASE II,
Southwest Research Inst., San Antonio, TX.
H. S. Silvus, Jr., F. M. Newman, and J. H. Frazar.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-226251, Price codes: A03 in paper copy, A01 in microfiche. Environmental Protection Agency Report EPA-600/4-80-040, August 1980. 45 p, 13 Fig, 8 Ref, 2 Append.

Descriptors: *Oily water, *Oil pollution, *Pollutant identification, *Hydrocarbons, Chromatography, *Monitoring, Oil industry, Chemical industry, Effluents, Fiber optics.

Wastewater from such sources as refineries, shale-oil recovery plants, coal-conversion operations, chemical plants, ships, offshore drilling platforms, petroleum-handling facilities, and other industries may contain harmful quantities of hydrocarbon materials in suspension. While installation and operation of wastewater treatment processes is a major step toward elimination of hydrocarbon pollution, to achieve maximum effectiveness it is necessary to monitor the effluent of a treatment process to insure that the system is functioning correctly. A new oil-in-water monitor technique brings together for the first time reverse-phase liquid chromatography and fiber optics. A special organophilic optical fiber, created by a chemical treatment process routinely used in reversed-phase liquid chromatography, collects and concentrates suspended hydrocarbon materials on its surface. Various methods of chemically treating an optical fiber and various treatment reagents were evaluated. For such aromatic hydrocarbons as n-hexylbenzene, cyclohexylbenzene, heptadecylbenzene, 3,3'-dimethylbiphenyl, and 1-phenylnaphthalene and for crude oil, detection thresholds of less than 3 mg/l were observed, and system reponse was linear over a contaminant concentration range of greater than 2.5 decades (greater than 300:1). Data indicate that the high end of the range can be extended if desired. (Moore-SRC)
W82-00100

DETERMINATION OF PRIORITY POLLUTANT PHENOLS IN WATER BY HPLC,
Altex Scientific, Berkeley, CA.
P. A. Realini.
Journal of Chromatographic Science, Vol 19, No 3, p 124-129, March, 1981. 6 Fig, 5 Tab, 13 Ref.

Descriptors: *Phenols, *Water analysis, Chromatography, Chemical analysis, Wastewater analysis, Pollutant identification.

An HPLC method is described for the analysis of waste water and drinking water for nanogram levels of phenols specified by the United States Environmental Protection Agency as priority pollutants. This classification includes: phenol, p-nitrophenol, o-chlorophenol, 2,4-dinitrophenol, o-nitrophenol, 2,4-dimethylphenol, 4-chloro-m-cresol, 2,4-dichlorophenol, 4,6-dintro-o-cresol, 2,4,6-trichlorophenol, and pentachlorophenol. Methylene chloride was used as the solvent for the concentration-extraction of phenols from water samples. After extraction the pH was adjusted to 14. Further extraction was carried out with methylene chloride. Both acidic and basic extracts were then combined and evaporated to dryness with a stream of nitrogen in a water bath. The sample was redissolved in 1 ml of acetonitrile and 10 microliters was injected directly onto the column. The calibration curve was linear between 1 ng and 50 ng. Extraction of phenols from waste water was also achieved with methylene chloride. The use of an ion-pair extraction in basic solution gave good recoveries, and the use of reversed-phase chromatography gave excellent separation of the priority pollutant phenols. (Baker-FRC)
W82-00110

ORGANIC MICROPOLLUTION INDICES OF EFFLUENTS AND RENOVATED WATERS,
Technion-Israel Inst. of Tech., Haifa. Environmental and Water Resources Engineering.
M. Rebhun, and J. Manka.
Water Research, Vol 15, No 7, p 789-801, July, 1981. 10 Fig, 4 Tab, 15 Ref.

Descriptors: *Water analysis, *Organic compounds, *Effluents, *Wastewater treatment, Pollutant identification, Trace levels, Solvents, Secondary wastewater treatment, Advanced wastewater treatment, Gas chromatography, Lime.

Solvent-extractable organics (SEO) were characterized in secondary and tertiary effluents by column fractionation, elution with solvents of different polarity, and gas chromatography. The most efficient solvent combination was benzene followed by chloroform. Diethyl ether alone was also a satisfactory eluant. In secondary effluents the SEO were 45% polar, 32% nonpolar, and the remainder, intermediate in polarity. Lime treatment removed 37% of the total SEO, 63% of the nonpolar compounds, 91% of the medium polarity compounds, and 53% of the polar compounds. After-lime polishing pond detention treatment removals were 68% of total SEO, 75% of nonpolar, 96% of medium polar, and 64% of polar. 74% of lindane and 97.5% of aldrin, respectively, were removed by after-lime flocculation and 97.4% and 100%, respectively, by after-lime flocculation plus detention. Electron capture detector chromatography indicated an 80% removal of organics, near that of the medium polarity compounds. Flame ionization detection indicated a 69% removal, similar to the total SEO removal. These methods may be useful as rapid and representative indicators of organic micropollutants in effluents and renovated waters. (Cassar-FRC)
W82-00123

THE EFFECT OF CENTRIFUGATION ON THE SUSPENDED PARTICLES OF RIVER WATERS,
Birzeit Univ., West Bank (Israel). Dept. of Chemistry.
R. Salim, and B. G. Cooksey.
Water Research, Vol 15, No 7, p 835-839, July, 1981. 3 Fig, 4 Tab, 9 Ref.

Descriptors: *Centrifugation, *Suspended solids, *Particle size, Particulate matter, Natural waters, Water analysis, Aggregates, *Clyde River, Galsgow, *Scotland.

Particle size distribution in water from the Clyde River, Glasgow, differed when measured by 2 methods: Coulter counter and centrifugation. This is probably due to agglomeration of fine particles during centrifugation. The weight and the surface area of particles separated by centrifugation at constant centrifugal force were linearly related to the reciprocal square root of time of centrifugation. Maximum efficiency of centrifugation to separate particles was 30 min at 5720 g centrifugal force and 22 min at 7000 g centrifugal force. About 90% by weight of particles 5 micrometers or larger in diameter were separated from the river water. The centrifugation method may be usable for separation of particulate matter in natural water samples to differentiate between labile and adsorbed trace metals. (Cassar-FRC)
W82-00124

USE OF THE ELECTROLYTIC RESPIROMETER TO MEASURE BIODEGRADATION IN NATURAL WATERS,
Procter and Gamble Co., Cincinnati, OH.
R. J. Larson, and R. L. Perry.
Water Research, Vol 15, No 6, p 697-702, June, 1981. 4 Fig, 4 Tab, 13 Ref.

Descriptors: *Biodegradation, *Surfactants, *Respirometer, Degradation, Natural waters, Measuring instruments, Fate of pollutants, Linear alkyl sulfonates, Alkylbenzene sulfonates, Ohio River.

The electrolytic respirometer was used to study the rate and extent of biodegradation of anionic, cationic, and nonionic surfactants in Ohio River water. The lowest concentration which could be tested was 5 mg per liter if the test material contained 60-80% carbon. Kinetics of oxygen uptake during degradation of the three surfactants studied, linear alkylbenzene sulfonate (LAS), cetyltrimethylammonium chloride (CTAC), and linear alcohol ethoxylate (LAE), were similar to those observed for glucose. Rates of LAE degradation were a saturable function of LAE concentration and did not increase proportionately with

concentration. CTAC degradation was a linear function of CTAC concentration, and saturation effects were not seen up to levels of 40 mg per liter. Beyond this point degradation decreased until 80 mg per liter, where it was totally inhibited. LAS degradation rates were proportional to concentration at 5 and 10 mg per liter and decreased sharply at 20 mg per liter. The surfactant was toxic to microorganisms at higher concentrations. If velocity curves are obtained, the rate data can be extrapolated to the lower surfactant concentrations normally encountered in natural waters. The electrolytic respirometer is useful to measure biodegradation of organic compounds where specific analytical methods are unavailable. (Cassar-FRC)
W82-00126

GEOCHEMISTRY OF A SUBARCTIC SALT MARSH ENVIRONMENT,
National Water Research Inst., Burlington (Ontario). Process Research Div.
For primary bibliographic entry see Field 2L.
W82-00148

INTERFERENCE OF SULPHIDE IN INORGANIC PHOSPHATE DETERMINATION IN NATURAL WATERS,
Nederlands Inst. voor Onderzoek der Zee, Texel.
V. N. De Jonge, and L. A. Villerius.
Marine Chemistry, Vol 9, No 3, p 191-197, June, 1980. 3 Fig, 1 Tab, 23 Ref.

Descriptors: *Spectrophotometry, *Phosphates, *Chemical interference, *Sulfides, Water analysis, Antimony, Natural waters.

The interference of sulfide with the assay of inorganic phosphate is caused by antimony, one of the reagents. There can be various effects on the absorption spectrum, depending upon the concentrations of antimony and sulfide. Different antimony-sulfide compounds are formed, and the spectrum of phosphomolybdenum-antimony blue is replaced by that of pure phosphomolybdenum blue. The disturbance can be prevented through the method proposed by Murphy and Riley, which uses a higher antimony concentration. An antimony concentration of 100 micromol/liter makes the PO4-P determination independent of sulfide interference when applied to oceanic and coastal waters. If sulfide concentrations are expected to be higher than 200 micromol/liter, it is desirable to remove most of the sulfide by adding 1 ml of 6 N sulfuric acid to a 100 ml water sample, followed by bubbling with nitrogen for 15 min. (Small-FRC)
W82-00154

SOLUTION SPECIES OF PLUTONIUM IN THE ENVIRONMENT,
Battelle Pacific Northwest Lab., Richland, WA.
D. Rai, R. J. Serne, and J. L. Swanson.
Journal of Environmental Quality, Vol 9, No 3, p 417-420, July-September, 1980. 1 Fig, 2 Tab, 23 Ref.

Descriptors: *Plutonium, *Thermodynamics, Oxidation, Radioactive wastes, Adsorption, Precipitation, Environment, *Polutant identification.

Experimental data is presented that demonstrates the presence of Pu(V) in solutions in equilibrium with solid Pu(IV) hydroxide under conitions similar to those expected in the environment. The presence of Pu(V) in solutions contacting PuO2 is also inferred from the data. An Eh-pH diagram showing the stability fields of different solution species of Pu was developed. Recently evaluated thermodynamic data was used to develop the diagram. From this diagram it was concluded that the expected predominant species under relatively reducing environmental conditions would be Pu(III), and that Pu(V) would be the expected species to predominate under relatively oxidizing environmental conditions. Measurement was made of the Eh-pH values of 0.0015M calcium chloride solutions contacting Pu(IV) hydroxide and PuO2(s), they fell in or near the region of uncertainty between the calculated Pu(III) and Pu(V) stability fields. Solvent extraction tests were performed that demonstrated the absence of Pu(IV) in these solutions. Spectrophotometric tests demonstrated the absence of Pu(VI) in these solutions and indirectly demonstrated that Pu(V) was the predominant species. (Baker-FRC)
W82-00163

PHOTOLYSIS OF N-NITROSODI-N-PROPYLAMINE IN WATER,
Lilly Research Lab., Greenfield, IN.
For primary bibliographic entry see Field 5B.
W82-00164

SORPTION-DESORPTION OF LINDANE BY ANAEROBIC AND AEROBIC SOILS,
Central Rice Research Inst., Cuttack (India).
P. A. Wahid, and N. Sethunathan.
Journal of Agricultural and Food Chemistry, Vol 28, No 3, p 623-625, May/June, 1980. 2 Fig, 2 Tab, 15 Ref.

Descriptors: *Pesticides, *Sorption, Leaching, Soil properties, *Lindane, Agricultural chemicals, Organic compounds, Pokkali soils, Laterite soils, Alluvial soils, Rice, Flooding, Tropical regions.

Sorption of lindane by aerobic soils and by soils prereduced by 30-day flooding was studied. Three soil types were studied: alluvial, laterite, and pokkali. No increase in soil potentials occurred following 30 min of equilibration of anaerobic soils with lindane in the sealed system used. Anaerobic soils sorbed relatively less lindane than the aerobic soils. Alluvial soil, having the least organic matter content, showed the largest difference relative to organic matter, followed by laterite soil and organic matter-rich pokkali soil. To study desorption, lindane sorbed by 30-day flooded soils during 30 min of equilibration was desorbed by equilibrating with water for 30 min. During equilibration for desorption, the redox potentials increased from -60, -160, and -220 mV to 120, -10, and -220 mV in alluvial, laterite, and pokkali soils, respectively. However, these potentials were clearly lower than those of the respective aerobic soils, with values ranging from 200 to 260 mV. No appreciable difference in desorption occurred despite the state of redox conditions of the soils. As in aerobic soils, an inverse relation between organic matter and desorption of lindane was noted in anaerobic soils as well with least desorption from organic-matter-rich pokkali soil. It is suggested that the reduction of the soil following flooding does not affect its pesticide desorbing power. The decreased sorption of lindane by anaerobic soils may influence its bioactivity and environmental transport, especially in tropical rice growing areas with soils low in organic matter and high in iron oxides. (Baker-FRC)
W82-00189

BACTERIAL CONTAMINATION OF DRINKING WATER SUPPLIES IN A MODERN RURAL NEIGHBORHOOD,
Oregon State Univ., Corvallis. Dept. of Microbiology.
K. G. Lamka, M. W. LeChevallier, and R. J. Seider.
Applied and Environmental Microbiology, Vol 39, No 4, p 734-738, April, 1980. 1 Fig, 3 Tab, 27 Ref.

Descriptors: *Bacteria, *Drinking water, *Rural areas, Well water, Coliforms, Staphylococcus aureus, Water quality, Public health.

An intensive bacteriological investigation was made of the incidence, numbers, and bacterial species present in drinking water, primarily well water, in a rural community. Water serving 78 households was sampled on six occasions during a 15-month period. Water was tested for coliforms, fecal coliforms, Staphylococcus aureus, and standard plate count bacteria. On at least one occasion, more than one-third of the water supplies were judged unsatisfactory on the basis of standard plate counts over 10,000/ml and the presence of coliforms, fecal coliforms, and/or S. aureus. The most frequently isolated total coliforms were Citrobacter freundii, Klebsiella pneumoniae, and Escherichia coli. At least twelve other genera of bacteria were identified. Coliform contamination was higher after rainfall, while standard plate counts were higher during warm weather. The coliform contamination was probably due to leakage of surface water into improperly sealed wells while high standard plate counts may have resulted from the lack of chlorination to control microbial regrowth during warm weather. (Small-FRC)
W82-00198

INFLUENCE OF ESTUARINE SEDIMENT ON VIRUS SURVIVAL UNDER FIELD CONDITIONS,
Baylor College of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
R. L. LaBelle, and C. P. Gerba.
Applied and Environmental Microbiology, Vol 39, No 4, p 749-755, April, 1980. 3 Fig, 2 Tab, 25 Ref.

Descriptors: *Viruses, *Sediments, *Adsorption, *Estuaries, Canals, Seawater, Poliovirus, Field tests, Survival.

Field studies were performed to determine whether sediment exhibits a protective effect on virus survival, as it has in laboratory studies. Experiments were carried out in two canals exposed to sewage using two types of survival chambers: cellulose dialysis tubes or a plexiglass chamber designed to support diffusion membranes. Virus inactivation rates for poliovirus 1 and echovirus in seawater were similar for the two chambers. Virus adsorption to sediment greatly increased survival time. For virus adsorbed to sediment at a relatively nonpolluted site, the time required to inactivate 99% of poliovirus increased from 1.4 days to 6.0 days. At a more polluted site, poliovirus inactivation time was increased from about 1 h to 4.25 days by adsorption to sediment. Thus, virus association with estuarine sediment tends to prolong its survival in a seawater environment, and sediment analysis should be considered when determining viral populations. (Small-FRC)
W82-00199

METHOD FOR RECOVERING VIRUSES FROM RIVER WATER SOLIDS,
Environmental Monitoring and Support Lab., Cincinnati, OH.
G. Berg, and D. R. Dahling.
Applied and Environmental Microbiology, Vol 39, No 4, p 850-853, April, 1980. 5 Tab, 8 Ref.

Descriptors: *Suspended solids, *Rivers, *Viruses, Enteroviruses, Adsorption, Assay, Costs, Performance evaluation, Pollutant identification.

A method was developed for recovering poliovirus 1 that was adsorbed to river water solids. Small numbers of virions were eluted by mixing the solids for 30 min with a 10% solution of beef extract that contained sufficient Na2HPO4 to bring the molarity of the salt to 0.05 and sufficient citric acid to bring the pH to 7. Using this technique, many different enteroviruses have been recovered from river water solids. The method is not very practical when small numbers of viruses are to be recovered because it requires large numbers of cell cultures for assay. The organic flocculation technique of Katzenelson et al can be incorporated to save costs, but there is some loss of efficiency. Using the beef extract method, 39 to 63% of the polioviruses that had been adsorbed were recovered. A technique such as this is important because the number of virions recovered from solids in the river waters often exceeds the number recovered from the waters alone. (Small-FRC)
W82-00200

COMPARISON OF NINE BRANDS OF MEMBRANE FILTER AND THE MOST-PROBABLE-NUMBER METHODS FOR TOTAL COLIFORM ENUMERATION IN SEWAGE-CONTAMINATED DRINKING WATER,
Health and Welfare Canada, Ottawa (Ontario). Health Protection Branch.
R. S. Tobin, P. Lomax, and D. J. Kushner.
Applied and Environmental Microbiology, Vol 40, No 2, p 186-191, August, 1980. 3 Tab, 36 Ref.

Descriptors: *Monitoring, *Water quality, Filtration, *Membrane filters, Filters, Membrane proc-

esses, Chlorination, Drinking water, *Coliforms, Bacteria, Sewage bacteria, Wastewater pollution.

The possibility of significant differences existing among membrane filters in their ability to enumerate chlorine-stressed coliforms in sewage-contaminated drinking water was examined. Results obtained with the membrane filtration (MF) method are compared with those obtained by the most-probable-number (MPN) method. Aerated Ottawa tap water was used as the challenge water. To produce a sewage-contaminated water for test purposes, 2-10 ml of the supernatant of settled raw sewage was added to 6 liters of tap water to produce a total coliform density of 15,000 to 20,000 colonies/100 ml before chlorination. Chlorination of the contaminated samples was performed with the addition of 0.8 mg of available chlorine/liter using a contact time of 30 min at room temperature. Nine different brands of membrane filter were compared in the MF method. Significant differences were noted among membranes in four of the six experiments, with two-to four-times higher recoveries between the membranes at each extreme of recovery. When results from the membranes with the highest total coliform recovery rate were compared with the MPN results, the MF results were significantly higher in one experiment and equivalent to the MPN results in the other five experiments. A comparison was made of the species enumerated by these methods. In general the two methods enumerated a similar spectrum of organisms, with some indication that the MF method was subject to greater interference by Aeromonas. (Baker-FRC)
W82-00203

DETERMINATION OF TRACE QUANTITIES OF DIMETHYLSULFOXIDE IN AQUEOUS SOLUTIONS,
Florida State Univ., Tallahassee. Dept. of Oceanography.
M. O. Andreae.
Analytical Chemistry, Vol 52, No 1, p 150-153, January, 1980. 2 Fig, 2 Tab, 14 Ref.

Descriptors: *Water analysis, *Solvents, Organic compounds, *Dimethylsulfoxide, Sulfoxides, Industrial wastewaters, Rain, Photometry, Flame photometry, Gas chromatography.

The determination of dimethylsulfoxide (DMSO) at the nanogram level in aqueous solutions is described. After removal of dissolved volatile sulfur compounds by sparging with helium, DMSO is reduced to dimethylsulfide with sodium borohydride or chromium(II) chloride. The dimethylsulfide is stripped from the solution with a stream of helium and trapped on a chromatographic packing in a U-tube immersed in liquid nitrogen. After gas chromatographic separation from potentially interfering compounds, the dimethylsulfide is measured by a flame photometric sulfur detector and/or a flame ionization detector. The detection limit of the method is 1 ng S(DMSO) per sample, which corresponds to 0.02 micrograms S(DMSO)/liter. Precision is 5-10%, depending which variant of the method is used. The method has been used for the determination of DMSO in a variety of samples, including seawater, freshwater, rain, and phytoplankton culture solutions. DMSO appears to be a common constituent in natural waters. Its occurrence in seawater is restricted to the zone of light penetration. It may occur as an end product of algal metabolism. The occurrence of DMSO in rain may be due either to the release of this substance from the biosphere into the atmosphere or to the atmospheric oxidation of DMS to DMSO. (Baker-FRC)
W82-00205

REDOX STABILITY OF INORGANIC ARSENIC(III) AND ARSENIC(V) IN AQUEOUS SOLUTION,
North Dakota State Univ., Fargo. Dept. of Chemistry.
D. E. Tallman, and A. U. Shaikh.
Analytical Chemistry, Vol 52, No 1, p 196-199, January, 1980. 1 Fig, 3 Tab, 7 Ref.

Descriptors: *Arsenic, *Sample preservation, *Water analysis, Chemical analysis, Water sampling, Arsenicals, Arsenic compounds.

The stability of inorganic As(III) and As(V) in aqueous solution was re-examined. The findings indicate that solutions containing inorganic As(III) or (V) at ppb levels can be retained for at least three weeks without significant interconversion of As(III) and As(V) or loss of total arsenic. This conclusion pertained to water samples from natural sources as well as laboratory prepared standards. The samples were stored in glass with minimum precautions to exclude oxygen or other redox promoting contaminants. These findings are offered in argument against another report wherein it is stated that As(III) at the ppb level in aqueous solution undergoes a spontaneous oxidation to As(V) with essentially complete conversion occurring within one week for solutions less than 100 ppb in As(III). (Baker-FRC)
W82-00206

MEASUREMENT OF THE SOLUBILITIES OF SLIGHTLY SOLUBLE ORGANIC LIQUIDS IN WATER BY ELUTION CHROMATOGRAPHY,
National Bureau of Standards, Washington, DC. National Measurement Lab.
F. P. Schwarz.
Analytical Chemistry, Vol 52, No 1, p 10-15, January, 1980. 2 Fig, 4 Tab, 20 Ref.

Descriptors: *Organic compounds, *Solubility, Chemical analysis, *Chromatography, Water analysis, Water pollution control.

A solubility measurement method was examined which is simple and may well meet the ideal criteria of high sensitivity and nonspecificity needed to determine the solubilities of organic liquids in water. The method is based on liquid phase elution chromatography. The solute is the stationary phase, and water is the mobile phase. A transparent column is packed with an inert support coated with a known amount of the solute and then water is forced through the column. As the total volume of water flowing through the column increases, a solute depleted zone, different in color from the stationary phase, develops and increases in length. The solubility is calculated from the amount of solute removed from the column, i.e., the length of the solute depleted zone and the volume of water passed through the column. This method has been applied to the determination of ten different organic solutes to evaluate its sensitivity and specificity. In these determinations the method was shown to be nonspecific, sensitive to the ppm level, accurate, and fairly precise. (Baker-FRC)
W82-00207

CONSECUTIVE AMPEROMETRIC TITRATIONS FOR CALCIUM AND MAGNESIUM,
Allied Chemical Corp., Idaho Falls, ID.
L. L. Jackson, J. Osteryoung, J. O'Dea, and R. A. Osteryoung.
Analytical Chemistry, Vol 52, No 1, p 71-75, January, 1980. 3 Fig, 5 Tab, 17 Ref.

Descriptors: *Water analysis, *Metals, *Calcium, *Magnesium, Titration, Polarographic analysis, Chemical analysis.

A procedure is described for the measurement of both calcium and magnesium in a single aliquot. In this procedure the calcium is first titrated with ethylene glycol bis(beta-aminoethyl ether)-N,N,N,N'-tetraacetic acid (EGTA), and then magnesium is titrated with ethylenediaminetetraacetic acid (EDTA). 1,2-Diaminocyclohexane-N,N,N,N'-tetraacetic acid (DCTA) was also examined as a possible titrant for magnesium. The end point in each titration is determined by amperometric detection of the excess chelate at a dropping mercury electrode. Both the normal pulse and differential pulse amperometric modes were used, in contrast to the dc amperometric mode which has been employed in other work. The methods were tested at calcium and magnesium levels of 1-0.001 mF. Analyses were also done at ratios of calcium to magnesium from 100:1 to 1:100. These amperometric techniques were then applied to a variety of natural samples. It was found that copper and nickel could effectively be masked with tetraethylenetriamine (TRIEN), an excess of which did not have an adverse effect on the calcium and magnesium titrations in the normal pulse mode. The mode appears attractive for analysis of natural waters and other sample types, particularly in the automated mode. (Baker-FRC)
W82-00208

A DIRECT DIFFERENTIAL PULSE ANODIC STRIPPING VOLTAMMETRIC METHOD FOR THE DETERMINATION OF THALLIUM IN NATURAL WATERS,
Geological Survey, Denver, CO.
J. E. Bonelli, H. E. Taylor, and R. K. Skogerboe.
Analytica Chimica Acta, Vol 118, No 2, p 243-256, August, 1980. 5 Fig, 4 Tab, 43 Ref.

Descriptors: *Thallium, *Water analysis, Chemical analysis, Surface water, Water pollution control, Fuel, Voltammetry, Anodes, Electrodes, Insecticides.

Routine thallium determinations in natural water samples submitted to the US Geological Survey Central Laboratory in Denver are being performed using a direct differential pulse anodic stripping voltammetric method (DPASV). This method requires no preconcentration, or at the most preconcentration for one hour and a sample volume of 25 ml, and provides a detection limit of 10 mg thallium per liter. This limit may be extended by appropriate alteration of experimental parameters or by the use of preconcentration steps. DPASV at the hanging mercury drop electrode and at the mercury film electrode is used in the concentration ranges 0.5-100 micrograms thallium per liter and 0.01-10 micrograms thallium per liter, respectively. Quantification is aided by the technique of standard additions. The response of the method is optimized for typical natural surface water matrices. An intercomparison of thallium determinations performed by the two anodic stripping methods and electrothermal-atomization atomic absorption spectrometry on normal and thallium-spiked surface water samples demonstrates equivalent accuracy within the range where atomic absorption is applicable. The method appears free from serious interferences. (Baker-FRC)
W82-00209

IMPROVED METHOD AND TEST STRATEGY FOR RECOVERY OF ENTERIC VIRUSES FROM SHELLFISH,
New Hampshire Univ., Durham. Dept. of Microbiology.
T. G. Metcalf, E. Moulton, and D. Eckerson.
Applied and Environmental Microbiology, Vol 39, No 1, p 141-152, January, 1980. 11 Tab, 24 Ref.

Descriptors: *Viruses, *Shellfish, Enteric bacteria, Filters, Enteroviruses, Membrane filters, Filtration.

A virus monitoring strategy is presented for recovery of enteric viruses from each of three commercially important shellfish species. The monitoring strategy includes the development of a single recovery method equally effective with oysters and hard- and soft-shell clams and identification of the test strategy needed for effective use of the improved method for recovery of low numbers of enteric viruses from each of these species. Effective recovery of virus depended as much upon details of the test strategy adopted for use of the improved method with each species as on the method itself. The most important test details involved sample composition, pool size, and method of use of cell culture. Recovery sensitivity measured permitted detection of 25 to 3 plaque-forming units of enteroviruses and 100 to 27 plaque-forming units of reovirus through their recovery in cell culture, with effectivenesses averaging 64 and 46%, respectively. Test samples prepared by the improved recovery method were virtually cytotoxicity free. Optimal recovery of virus on 45-square centimeter cell culture monolayers was obtained with 1-ml inocula adsorbed for 2 hr. The most effective recovery of virus from shellfish samples was made by a sequential adsorption procedure which allowed equal exposure to an entire

sample to each of two or more cell cultures. Removal of nonviral contaminants from test samples by antibiotic treatment was preferable to the use of ether or membrane filtration procedures. (Baker-FRC)
W82-00219

ENUMERATION OF POTENTIALLY PATHOGENIC BACTERIA FROM SEWAGE SLUDGES,
Texas Univ. Center for Applied Research and Technology at San Antonio.
D. J. Dudley, M. N. Guentzel, M. J. Ibarra, B. E. Moore, and B. P. Sagik.
Applied and Environmental Microbiology, Vol 39, No 1, p 118-126, January, 1980. 1 Fig, 5 Tab, 37 Ref.

Descriptors: *Bacteria, *Sludge, *Wastewater, Human diseases, *Land disposal, Salmonella, Staphylococcus, Mycobacterium, Shigella, Bacterial analysis, Sampling, Mixing.

Methodologies are presented that can provide quantitative data on the population densities in sludge of fluorescent Pseudomonas species, Staphylococcus, Mycobacterium, Clostridium, and Klebsiella, and semiquantitative data on Shigella and Salmonella. Enterobacteriaceae and oxidase-positive enteric organisms were quantitated using a multi-media rapid identification system. Determinations of routine indicator organisms were also performed on the sludges for the purpose of comparison with published studies on wastewater. Sludges used in the study were obtained from the Rilling Road Regional Wastewater Treatment Plant in San Antonio, Texas, as either primary or anaerobically digested sludges. Wasted secondary sludge samples from an activated sludge treatment process were collected at Kerrville, Texas. Bacterial surveys were performed on sludges undergoing land application at sites in the United States. The procedures compared included vortex mixing at high speed for 2 min of 20 ml of sludge containing about 1 g of sterile 3-mm glass beads in 50-ml centrifuge tubes, homogenization at high speed in a Waring blender, sonication at various wattage outputs, and direct plating without treatment. Sonication at all wattage levels was found to be bactericidal. Sludge sonicated at an output of 66 W yielded the highest recoveries from sludges that were sonicated. The best recovery of viable organisms was obtained in samples dispersed by vortex mixing with glass beads. Therefore, this method was selected as the sludge handling procedure before any bacterial analyses on subsequent sludge samples. (Baker-FRC)
W82-00221

TECHNIQUE FOR DETERMINING TOTAL BACTERIAL VIRUS COUNTS IN COMPLEX AQUEOUS SYSTEMS,
Clemson Univ., SC. Dept. of Microbiology.
D. L. Ewert, and M. J. B. Paynter.
Applied and Environmental Microbiology, Vol 39, No 1, p 253-260, January, 1980. 2 Fig, 3 Tab, 21 Ref.

Descriptors: *Viruses, *Isolation, Clarification, Bacteriophages, Sediments, *Activated sludge, Sludge, *Wastewater, Pollutant identification.

This paper describes an adaptation of the sedimentation technique of Sharp, performed so that total numbers of bacteriophages in samples from complex aqueous systems such as sewage, activated sludge mixed liquor, and bovine rumen fluid can be quantitated. All samples of sewage and activated sludge mixed liquor were obtained from Unit 1 of the Limestone Creek treatment plant at Gaffney, South Carolina. Sewage entering the plant was solely from domestic sources. Conditions for sample clarification, phage recognition, and recovery were optimized. In contrast to the plaque assay, this procedure permits quantitation of total numbers of phages, independent of bacterial host. Also, the modifications increase the sensitivity of the sedimentation assay, permitting detection of particles at a minimum concentration of 10,000 per ml. Maximal total phage concentrations in the aqueous phase of sewage and activated sludge mixed liquor were 1,300,000 and 4,300,000 per ml, respectively. This assay is the first one adapted for direct enumeration of total bacteriophages suspended in samples of unpurified aqueous ecosystems. (Baker-FRC)
W82-00222

AUTOMATION OF WATER BACTERIOLOGICAL ANALYSIS: RUNNING TEST OF AN EXPERIMENTAL PROTOTYPE,
Lille-1 Univ., Villeneuve d'Ascq (France).
P. A. Trinel, N. Hanoune, and H. Leclerc.
Applied and Environmental Microbiology, Vol 39, No 5, p 976-982, May, 1980. 6 Fig, 2 Tab, 9 Ref.

Descriptors: *Water quality, *Measuring instruments, Monitoring, Drinking water, Potable water, *Bacterial analysis.

An experimental apparatus is described which allows continuous and automatic bacteriological water examination. The apparatus ensures the analysis and detection of Escherichia coli by incubation of the water samples and then detection of glutamic acid decarboxylase in coils according to the Technicon principle. The analysis itself is rapid, taking less than 13 hr with a sensitivity of better than 1 bacterium/100 ml. A group of 120 samples of 100 ml of water can be examined in 24 hr. The device proved to be about as sensitive as conventional methods, with the observed differences arising from the low bacterial concentrations of the tested samples. The incubation coil made of Rilsan tubing ensured better flow stability than the usual glass coils and also permitted the removal of a great number of nipples, which could have been a possible source of contamination. Each week the culture coil should be cleaned with a sodium hypochlorite solution. Every three weeks the pump tubes should be replaced. Every month the ultrafiltration fibers should be changed. The phthalate-hydrochloric acid buffer decontamination method has proven to be very effective, always ensuring perfect integrity of the samples. The automatic device has the advantage of giving a much more representative sampling than is customarily obtained. The method costs about 75 cents per sample to run and allows rapid control of the treatment quality of water, as the analysis is carried out immediately in the treatment station. (Baker-FRC)
W82-00225

DETERMINATION OF AMINOCARB IN WATER BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY,
Department of the Environment, Moncton (New Brunswick). Inland Waters Directorate.
G. L. Brun, and R. M. MacDonald.
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 6, p 886-893, 1980. 4 Fig, 2 Tab, 13 Ref.

Descriptors: *Aminocarb, *Pesticide residues, *Water analysis, Pollutant identification, Carbamate pesticides, Insecticides, *Gas liquid chromatography.

Residues of aminocarb (4-dimethylamino-3-methylphenyl N-methylcarbamate) in water were determined by reverse phase high performance liquid chromatography using ultraviolet absorbance (254 nm) with fluorescence detection (248 nm). The water samples were preconcentrated by pouring through Amberlite XAD-4 resin and eluting with ethyl acetate. After drying, the extract was concentrated to 5-10 ml and the solvent replaced with acetonitrile. In addition to aminocarb, some degradation products (carbamates and phenols) were included in the study to determine the feasibility of their identification and the degree of interference. Details on the overlapping and detection are discussed. Recoveries were 76% as determined with spiked lake water samples. Using a signal to noise ratio of 2:1, detection limits were 0.5 micrograms per liter and 0.05 micrograms per liter for UV absorption and fluorescence detection, respectively. Rain water samples analyzed by this method and by gas-liquid chromatography were in good agreement; samples contained from about 0.15 to 5 micrograms per liter aminocarb. Other carbamates which did not interfere with the analysis were propoxur, carbofuran, carbaryl, methiocarb, and mexacarbate. (Cassar-FRC)
W82-00232

TRACE METAL GEOCHEMISTRY IN SEDIMENTS FROM THE MIRAMICHI ESTUARY, NEW BRUNSWICK,
North Carolina Univ. at Wilmington. Department of Chemistry.
J. D. Willey, and R. A. Fitzgerald.
Canadian Journal of Earth Sciences, Vol 17, No 2, p 254-265, 1980. 5 Fig, 6 Tab, 27 Ref.

Descriptors: *Estuarine environment, *Trace elements, Manganese, Zinc, Lead, Copper, Minerals, Mine wastes, Urban drainage, Industrial wastes, Miramichi Estuary, New Brunswick, Canada, Trace metals, Bottom sediments.

Forty-six sediment samples were collected in May of 1976 from the Miramichi estuary. Three core samples were obtained from the river and estuary and three vibrocores from the estuary and Inner Bay in February of 1977. Concentrations of lignin-rich organic matter, up to 10% of the total sediment weight in the central estuary, correlated with analytical results for trace elements, which showed that more than 40% of the total Mn, Zn, and Cu is held in the oxidizable and organically-bound state. Mineralogical influences were most obvious in the river portion, where Mn concentrations averaged 695 micrograms/g, zinc averaged 282 micrograms/g, copper averaged 32 micrograms/g, and lead averaged 200 micrograms/g in the less than 63 micrometer size fraction of the sediments. Concentrations of all trace elements in the coarse fraction were considerably less as compared with the fine fraction. Very high organic carbon content was associated with sediments in which more than 25% of the Mn, Zn, and Cu was organically bound. When compared with sediments from other eastern Canada areas, the Miramichi sediments have at least twice the weak acid leachable Zn; this higher level of reactive metal is associated with high organic carbon content in the top 15 cm of the cored sediments. Suggested sources include mining activities as well as urban and industrial effluents. (Baker-FRC)
W82-00236

A SALICYLATE-HYPOCHLORITE METHOD FOR DETERMINING AMMONIA IN SEAWATER,
Sea Research Foundation, West Hartford, CT. Inst. for Aquarium Studies.
C. E. Bower, and T. Holm-Hansen.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 5, p 794-798, May, 1980. 3 Tab, 24 Ref.

Descriptors: *Ammonia, *Seawater, *Marine animals, Nitrogen compounds, Cultures, *Pollutant identification, Water analysis.

Total ammonia-N at levels of 10 to 1000 micrograms per liter in artificial seawater was determined by reaction of ammonia with sodium salicylate-sodium nitroprusside catalyst solution and sodium hypochlorite to produce indophenol blue. Absorbances were measured by spectrophotometer at 640 mm. The salicylate-hypochlorite method and the phenol-hypochlorite method showed excellent agreement at levels of 10 to 500 micrograms per liter of ammonia-N. Coefficients of variation for samples containing 25 or more micrograms per liter of ammonia-N were less than 3% for the salicylate method. Since sodium salicylate is light sensitive and samples should be read within three hours, the method may not be suitable for field use. The characteristic color produced by the reagent permits visual estimates of the ammonia levels in culture systems. Zero level ammonia produces a light yellow; 100 micrograms per liter, green; and 1000 micrograms per liter, blue, with gradations of color between. (Cassar-FRC)
W82-00238

ISOLATION OF METHANOBACTERIUM BRYANTII FROM A DEEP AQUIFER BY USING A NOVEL BROTH-ANTIBIOTIC DISK METHOD,

Geological Survey, Menlo Park, CA. Water Resources Div.
E. M. Godsy.
Applied and Environmental Microbiology, Vol 39, No 5, p 1074-1075, May, 1980. 13 Ref.

Descriptors: *Bacteria, *Aquifers, Methanogenesis, Measuring instruments, Cultures, Water treatment facilities, Wastewater treatment, Wells, Pollutant identification.

A method for the isolation of a methanogenic bacterium from a mixed culture using a complex growth medium supplemented with antibiotic susceptibility disks is presented. The disk medium was prepared by adding from one to five antibiotic susceptibility disks to tubes of sterile broth medium in serum tubes capped with black rubber stoppers and crimped with aluminum seals. Tubes of sterile broth medium were inoculated with water samples obtained from wells located on the grounds of the West Palm Beach Regional Water Pollution Control Plant. The wells extended 657 to 673 meters below the land surface and flowed freely under an artesian head. After inoculation, the gas phase in each tube was exchanged for a pressurized atmosphere of 80% hydrogen and 20% carbon dioxide. The tubes were incubated at 30 degrees C for 4 weeks. The presence of methane in the headspace was monitored periodically by a gas chromatograph fitted with thermal conductivity detectors and a Poropak Q column. Total methane production in the headspace after 3 days averaged 1.2 micromol in all tubes except those containing chloramphenicol. No methane or cellular growth was noted in chloramphenicol containing medium after 21 days. Total methane production in the headspace averaged 76 micromol in all growth-supporting media after 7 days of growth. After antibiotic treatment, enrichment of fluorescent bacteria was noted in all media, but only in the presence of cephalothin (6-30 micrograms/ml) and clindamycin (1.6 and 2.0 micrograms/ml) was it noted that the cultures contained only fluorescing cells. The broth-antibiotic disk method offers a means by which methanogenic bacteria can be easily isolated from mixed cultures of bacteria. (Baker-FRC)
W82-00240

CONCENTRATION OF POLIOVIRUS IN WATER BY MOLECULAR FILTRATION,
Environmental Monitoring and Support Lab., Cincinnati, OH.
D. Berman, M-E. Rohr, and R. S. Safferman.
Applied and Environmental Microbiology, Vol 40, No 2, p 426-428, August, 1980. 3 Tab, 11 Ref.

Descriptors: *Viruses, *Filtration, Water quality, Water treatment, *Wastewater treatment, Poliovirus.

The efficiency of concentrating poliovirus 1 from distilled water samples was determined by using a recirculating-flow molecular filtration system. The molecular filtration unit was equipped with two PT series membranes which had a total surface area of 920 square centimeters and a nominal molecular weight limit of either 10,000 or 100,000. Two of the four ports connected to the manifold of the unit served as filtrate outlets. The sample-retentate flow, to and from the unit, was through the remaining two ports. Virus feed samples at a final concentration of 1 to 10 plaque-forming units per ml were prepared by rapidly mixing poliovirus 1 (Mahoney LP) in 2- or 4-liter volumes of distilled water. Initially, membranes with a 100,000 nominal molecular weight limit were used. Virus recoveries in this system after 23- to 46-fold concentrations averaged only 10.5%, and less than 1% of the unaccounted-for virus was present in the filtrate. To check the possibility that virus was nonreversibly adsorbed on the membranes, single runs were made in which 1% glycine was used either to pretreat the membrane or to supplement the feed. Either treatment resulted in the apparent blockage of virus adsorption sites. When these treatments were combined, the average recovery of virus increased to 39.0%. Upon pretreatment with flocculated beef extract, a nearly five fold increase in virus recovery was noted. At the same time the number of virions passing into the filtrate averaged 20.4% of the total viral input. The results of the study indicate that the described molecular filtration system can effectively concentrate viruses from water, provided membranes are pretreated with flocculated beef extract. Clarification may be needed for water containing suspended particles larger than 10 micrometers. (Baker-FRC)
W82-00246

CONCENTRATION OF COLIPHAGES FROM LARGE VOLUMES OF WATER AND WASTEWATER,
Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
S. M. Goyal, K. S. Zerda, and C. P. Gerba.
Applied and Environmental Microbiology, Vol 39, No 1, p 85-91, January, 1980. 10 Tab, 35 Ref.

Descriptors: *Bacteria, *Filters, Drinking water, Wastewater, Measuring instruments, Secondary treatment, Natural waters, Water quality, Coliphages.

An evaluation was made of the positively charged filters used for concentrating coliphages from sewage and tap water, and they were compared with negatively charged filters. Four different coliphages were studied. Positively charged microporous filters were found to efficiently adsorb these coliphages from tap water, sewage, and lake water at neutral pH. Adsorbed viruses were eluted with a 1:1 mixture of 8% beef extract and 1 M sodium chloride at pH 9. Using this method, coliphages could be concentrated from 17-liter volumes of tap water with recoveries ranging from 34 to 100%. Coliphages occurring naturally in raw and secondarily treated sewage were recovered with average efficiencies of 56.5 and 55.0%, respectively. This method should be useful in isolating rare phages, studying the ecology of phages in natural waters, and evaluating water quality. (Baker-FRC)
W82-00247

ENUMERATION AND RELATIVE IMPORTANCE OF ACETYLENE-REDUCING (NITROGEN-FIXING) BACTERIA IN A DELAWARE SALT MARSH,
Delaware Univ., Newark. Coll. of Marine Studies.
For primary bibliographic entry see Field 2L.
W82-00248

TEMPORAL VARIATIONS IN TRIHALOMETHANE CONTENT OF DRINKING WATER,
Texas Univ. Health Science Center, Houston. Dept. of Environmental Sciences.
V. L. Smith, I. Cech, J. H. Brown, and G. F. Bogdan.
Environmental Science and Technology, Vol 14, No 2, p 190-196, February, 1980. 8 Fig, 1 Tab, 14 Ref.

Descriptors: *Drinking water, *Organic compounds, *Trihalomethanes, Chemical analysis, Water analysis, Timing, Variability.

The importance of temporal and spatial aspects in environmental monitoring of drinking water is stressed. Trihalomethane concentrations were measured every 4 hours for 7 days at a site within the University of Texas Health Science Center. This site is representative of a moderate size office building housing a population of about 750 persons during working hours and minimally staffed at night. The 24-hr variations in concentrations of total trihalomethanes, chloroform, dichlorobromomethane, dibromochloromethane and bromoform in drinking water were assessed in a dynamic system using a solvent-extraction electron-capture gas chromatographic procedure. Spectral analysis and replicate harmonic regression were used to evaluate temporal patterns in fluctuations of the trihalomethanes. Data indicate that for reliable monitoring the time of sampling is an important factor. Both within the 24 hr period and in day to day samples, variations in the results were clearly evident. Naturally, these findings have a bearing on the predictability of trihalomethane concentrations in drinking water. (Baker-FRC)
W82-00255

IDENTIFICATION OF ORGANIC COMPOUNDS IN A MUTAGENIC EXTRACT OF A SURFACE DRINKING WATER BY A COMPUTERIZED GAS CHROMATOGRAPHY/MASS SPECTROMETRY SYSTEM (GC/MS/COM),
Health Effects Research Lab., Cincinnati, OH.
W. E. Coleman, R. G. Melton, F. C. Kopfler, K. A. Barone, and T. A. Aurand.
Environmental Science and Technology, Vol 14, No 5, p 576-588, May, 1980. 3 Fig, 1 Tab, 34 Ref.

Descriptors: *Organic compounds, *Trace levels, *Water analysis, *Drinking water, Mutagenesis, Gas chromatography, Polychlorinated biphenyls, Aromatic compounds, Amines, Chlorinated hydrocarbons, Pollutant identification, Reverse osmosis, Mass spectrometry.

Reverse osmosis and lyophilization were used to concentrate organic compounds from drinking water in Cincinnati, Ohio. The diethyl ether soluble extract of this concentrate, which was mutagenic according to the Ames test, was partitioned into acid and base/neutral fractions. Computerized gas chromatography/mass spectrometry was used to analyze the following: original concentrate, acid fraction, methylated acid fraction, unpartitioned base/neutral extract, and 5 base/neutral eluants from silica gel partitioning. Polychlorinated biphenyls (PCB) and chlorinated aromatics were found in the second base/neutral fraction, and polynuclear aromatic hydrocarbons in the fourth base/neutral fraction. Altogether, 460 organic compounds were identified: 41 polynuclear aromatics, 15 PCBs, ketones and aldehydes (C3 to C20), alcohols (C3 to C19), ethers (C3 to C12), acids (C2 to C20), esters and lactones (C2 to C26), nonaromatic hydrocarbons (C2 to C26), phthalates and anhydrides (C8 to C28), and compounds containing halogens, sulfur, phosphorus, and nitrogen. (Cassar-FRC)
W82-00256

GAS CHROMATOGRAPHIC DETERMINATION OF SELENIUM (-II, O), -(IV), AND -(VI) IN NATURAL WATERS,
Okayama Univ. (Japan). Dept. of Chemistry.
H. Uchida, Y. Shimoishi, and K. Toei.
Environmental Science and Technology, Vol 14, No 5, p 541-544, May, 1980. 6 Fig, 4 Tab, 6 Ref.

Descriptors: *Selenium, *Water analysis, *Metals, Pollutant identification, *Gas chromatography, Natural waters, Seawater, Trace metals.

Selenium in river water and seawater was determined by electron capture detection gas chromatography using 1,2-diamino-3,5-dibromobenzene. This reagent reacts only with Se(4+) to form 4,6-dibromopiazselenol, which is extracted into toluene and determined by gas chromatography. Se(2-) and Se(0) are oxidized by Br to Se(4+); Se(6+) is reduced by a bromine-bromide solution to Se(4+). The Se(4+) is detected, and the amounts of Se in different oxidation states calculated by difference. The lower limit of the method is 2 ng per liter. The seawater samples tested contained 50-70 ng per liter Se, and river water, 16-230 ng per liter. River water contains more Se(2-) and Se(0) and less Se(6+) than seawater. (Cassar-FRC)
W82-00257

DETERMINATION OF ORGANICALLY COMBINED CHLORINE IN HIGH MOLECULAR WEIGHT AQUATIC ORGANICS,
Minnesota Univ., Minneapolis. Dept. of Chemistry.
M. P. McCahill, L. E. Conroy, and W. J. Maier.
Environmental Science and Technology, Vol 14, No 2, p 201-203, February, 1980. 5 Tab, 10 Ref.

Descriptors: *Chlorine, *Water analysis, Chemical analysis, Organic compounds, *Chlorination, Disinfection, Water treatment.

A method to determine total organic chlorine content of high molecular weight aqueous organic mixtures by photochemical mineralization was developed. In chlorinated sewage effluent total organic chlorine was found to increase after chlorination, so that from 0.002 to 0.009 ml of total organic chlorine per mol of total organic carbon

was present. Thus, chlorination of sewage effluents was shown to produce small amounts of organochlorine compounds of molecular weight greater than 1000 as defined by ultrafiltration of the sample. In its present form, this method is not sufficiently sensitive to detect total organic chlorine in unpolluted waters. However, sensitivity can be increased in principle to any desired level by more extensive preconcentration of the sample. In this method total organic chlorine is measured after preconcentrating the sample, photolyzing the organics to mineralize the chlorine, and measuring inorganic chloride. (Baker-FRC)
W82-00258

CONCENTRATION OF SEEDED SIMIAN ROTAVIRUS SA-11 FROM POTABLE WATERS BY USING TALC-CELITE LAYERS AND HYDROEXTRACTION,
Ottawa Univ. (Ontario). Dept. of Microbiology and Immunology.
S. Ramia, and S. A. Sattar.
Applied and Environmental Microbiology, Vol 39, No 3, p 493-499, March, 1980. 6 Tab, 38 Ref.

Descriptors: *Drinking water, *Water pollution control, Monitoring, Rotavirus, Viruses, Human diseases, *Pollutant identification, Tal-Celite adsorption, Polyethylene glycol.

The combined use of talc-Celite adsorption and polyethylene glycol 6000 hydroextraction was tested for its efficiency in preparing water samples to analyze for possible rotavirus contamination. The water to be sampled was seeded with simian rotavirus SA-11 and MA-104 cells. The dechlorinated tap water samples were adjusted to pH 6.0, and addition of Earle balanced salt solution was made to a final concentration of 1:100. Passage of a one liter volume of such a sample through a layer containing a mixture of talc (300 mg) and Celite 503 (100 mg) led to the adsorption of nearly 93% of the added SA-11 plaque-forming units. For the recovery of the layer-adsorbed virus, 3% beef extract and lx tryptose phosphate broth were found to be superior to a variety of other eluents tested. When the 100 liter sample volumes were tested, layers containing 1.2 g talc and 0.4 g Celite were used. Virus elution was conducted with 100 ml of tryptose phosphate broth. The eluate was concentrated 10-fold by overnight hydroextraction at 4 degrees C with polyethylene glycol. With total virus inputs of 7.0 x 10 to the fifth power and 1.4 x 10 to the second power plaque-forming units, the recoveries were about 71% and 59%, respectively. The use of this combination of techniques may be of use to detect the presence of rotavirus contamination in drinking water, and thus may be helpful in controlling outbreaks of rotavirus gastroenteritis. (Baker-FRC)
W82-00272

EVALUATION OF METHODOLOGIES FOR THE DETERMINATION OF ACUTE TOXICITY IN PULP AND PAPER EFFLUENTS,
Institute of Paper Chemistry, Appleton, WI.
E. F. Zanella, and S. A. Berben.
Tappi, Vol 63, No 3, p 77-82, March, 1980. 1 Fig, 6 Tab, 21 Ref.

Descriptors: *Bioassay, *Fish, *Pulp and paper industry, Pollutant identification, Water pollution effects, Toxicity, Fathead minnows, Daphnia, Caddisflies, Larvae, Testing procedures, Pulp wastes, Effluents, Industrial wastes, Sulfites.

Acute toxicity bioassays for pulp and paper mill effluents were evaluated in a multiple-parameter testing program using treated and untreated samples of unbleached kraft, bleached sulfite, and bleached kraft mill effluent. Test organisms included fathead minnows (Pimephales promelas), Daphnia (Daphnia magna), and caddis fly larvae (Hydropsyche sp.). There was no appreciable difference in the LC50 values from the following fish tests: dynamic, 24-hour replacement, and static bioassays. The 12-hour replacement fish bioassay gave comparable results but was more variable. The residual oxygen assays did not coincide with LC50 values from standard tests and failed to produce a response to several of the toxic effluents tested. The relative sensitivity of Daphnia, caddis fly larvae, and fathead minnows was consistent for different samples of the same effluent type but different for different effluents. Daphnia were sensitive to bleached sulfite effluents but resistant to bleached kraft mill effluent. Caddis fly larvae was the least sensitive of the test organisms used. (Cassar-FRC)
W82-00297

SHALLOW CORE SNOW CHEMISTRY OF ATHABASCA GLACIER, ALBERTA,
New Hampshire Univ., Durham. Dept. of Earth Sciences.
For primary bibliographic entry see Field 2C.
W82-00320

DISTRIBUTION OF OBLIGATELY OLIGOTROPHIC BACTERIA IN LAKE BIWA,
Kyoto Univ. (Japan). Dept. of Fisheries.
Y. Ishida, K. Shibahara, H. Uchida, and H. Kadota.
Bulletin of the Japanese Society of Scientific Fisheries, Vol 46, No 9, p 1151-1158, 1980. 7 Fig, 2 Tab, 14 Ref.

Descriptors: *Oligotrophy, *Bacteria, *Aquatic microorganisms, *Lake Biwa, Japan, Lakes, Epilimnion, Hypolimnion, Bioindicators, Water pollution effects.

The NPN-C14-substrate method was used to investigate seasonal changes and vertical and horizontal distributions of oligotrophic bacteria in Lake Biwa, Japan. In unpolluted areas the ratio of obligate oligotrophic bacteria to total heterotrophic bacteria was 50%, and in moderately polluted waters 15%, while in heavily polluted waters none were detected. The vertical distribution was studied in unpolluted waters. At the thermocline the ratio of total oligotrophs to total heterotrophs was lowest, and eutrophs were predominant. In the epilimnion, proportions were very variable; there was less variability in the hypolimnion. During three periods of algal bloom no obligate oligotrophs were detected in the water. There were large populations present in unpolluted water from late May to early autumn. (Cassar-FRC)
W82-00346

DISTRIBUTION OF CLOSTRIDIUM BOTULINUM,
Technical Univ. of Denmark, Lyngby. Technical Lab.
H. H. Huss.
Applied and Environmental Microbiology, Vol 39, No 4, p 764-769, April, 1980. 3 Tab, 31 Ref.

Descriptors: *Clostridium botulinum, *Distribution patterns, *Aquatic environment, *Bacteria, Soil bacteria, Aquatic bacteria, Microbiological studies, Sediments.

The incidence and distribution of C. botulinum in the soil, freshwater sediments, and marine environments of Denmark, the Faroe Islands, Iceland, Greenland, and Bangladesh were determined. Six hundred eighty-four samples were tested. Type E was found in 90% of the Danish aquatic samples and in 86% of the marine samples from Greenland. Type E was not present in Danish cultivated soils and woodland soils, but Type B was frequently found in these environments. Types A, B, or E were present in 2.6% of the samples collected in the Faroe Islands and Iceland, and Types C and D were found in 42% of the Bangladesh samples. Neither general industrial pollution nor a high rate of rotting vegetation was related to the incidence of Type E. Presence of fish or a rich aquatic fauna did appear to be related to a high incidence of Type E. Type E may be a true aquatic organism, because its environment offered the best conditions for spore survival. (Small-FRC)
W82-00349

ANALYTICAL METHODS EVALUATION FOR APPLICABILITY IN LEACHATE ANALYSIS,
Washington Univ., Seattle.
F. B. DeWalle, T. Zeisig, J. F. C. Sung, D. M. Norman, and J. B. Hatlen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-172306, Price codes: A15 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-046, May 1981. 4 p, 3 Tab.

Descriptors: *Leachates, *Pollutants, *Water analysis, Physical properties, Chemical properties, Organic compounds, Cations, Anions, Variation coefficient, Statistical analysis, Precision, *Pollutant identification.

Thirty-two laboratories in the United States and Canada conducted round-robin analyses of leachate samples. Ten samples from nine locations and one spiked sample were analyzed for up to 28 parameters to evaluate accuracy and precision of the methods employed. The 28 parameters included physical parameters (pH, oxidation reduction potential, conductivity, turbidity, and solids), organics (chemical oxygen demand, total organic carbon, organic nitrogen, and free volatile fatty acids), anions (sulfate, phosphate, chloride, nitrate, and bicarbonate), and cations (alkali metals, alkaline earth metals, transition metals, and heavy metals). Individual parameter coefficients of variation ranged from 32% for COD to 210% for cadmium. Significant differences were noted between results from colorimetric methods and from titrimetric and physical methods. The between-laboratory component of variation was larger than the within-laboratory component. The average recovery for spiked parameters varied widely for individual parameters. The most applicable method for analysis of each parameter is recommended. Use of the standard addition technique is required in each laboratory to determine the matrix depression or enhancement for each type of leachate sample. The accuracy (agreement between measured and actual amounts) and the precision (reproducibility) of different analytical methods were evaluated in depth. (Brambley-SRC)
W82-00380

METHODS FOR LEVEL 2 ANALYSIS BY ORGANIC COMPOUND CATEGORY,
Little (Arthur D.), Cambridge, MA.
K. E. Thrun, J. C. Harris, C. E. Rechsteiner, and D. J. Sorlin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-179855, Price codes: A14 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S7-81-029, July 1981. 3 p, 3 Ref.

Descriptors: *Effluents, *Industrial wastes, *Organic compounds, *Chemical analysis, Gas chromatography, Mass spectrometry, Pollutants, Environmental effects.

As a step in the development of a general methodology for chemical and biological assessment of environmental effects of industrial effluents, specific detailed methods for analysis of organic chemicals in particular compound categories were evaluated. This supplements the earlier Level 2 Procedures manual and provides an initial experimental data base as a resource for laboratories undertaking Level 2 studies. Methods were evaluated using sets of model compounds spanning a range of molecular weights and boiling points in each category. Evaluation criteria included: detection limit, retention time, chromatographic resolution, and precision and accuracy of the methods. Specific detailed Level 2 methods have been recommended for 25 categories of organic compounds. Most of the primary recommendations are based on packed column gas chromatography/mass spectrometry, with alternative procedures suggested where appropriate for particular sample matrices or compound types. Level 2 inquiries are expected to be directed primarily at the identification quantification, and confirmation of specific compounds whose presence could be inferred on the basis of the categorical analysis of Level 1. (Moore-SRC)
W82-00384

THE ANALYSIS OF OIL SHALE WASTES: A REVIEW,
Denver Univ., CO. Charles H. Prien Center for Synthetic Fuel Studies.
J. R. Wallace.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-190522, Price codes: A13 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S7-81-084, July 1981. 4 p, 1 Tab.

Descriptors: *Oil shale, *Industrial wastewater, *Chemical analysis, *Wastewater analysis, Hydrogen ion concentration, Conductivity, Ammonia, Ammonium, Sulfur compounds, Organic compounds, Dissolved solids.

The current status of methods for chemical analysis of oil shale effluents was studied in order to provide a reference for those who must measure and control the effects of oil shale waste products on the environment. The effluents studied include spent and raw shale, process waters of various types, retort gas and burned fuel gas. Methods were considered for the measurement of trace and minor elements, dissolved ions, organic compounds, sulfur and nitrogen species of environmental importance, and physical properties such as dissolved solids. When analytical methods developed for simple, homogeneous material are applied to complex samples like oil shaleeffluents, extraordinary interferences or matrix effects can render the method ineffective. Methods for determining pH, conductivity, fluorine, ammonium and ammonia have been shown to be adequate for a limited number of wastewaters. Methods for other dissolved inorganics such as chloride, phosphate, total phosphorus, and sulfur oxides either lack confirmation or have been shown to be inaccurate. Quality assurance is of utmost importance when dealing with analytical methods for the chemical determination of oil shale samples. (Moore-SRC)
W82-00388

A BACTERIAL BIOASSAY FOR ASSESSMENT OF WASTEWATER TOXICITY,
Oregon State Univ., Corvallis. Dept. of Civil Engineering.
K. J. Williamson, and D. G. Johnson.
Water Research, Vol 15, No 3, p 383-390, March, 1981. 8 Fig, 24 Ref. OWRT-A-036-ORE(2), 14-34-0001-6038.

Descriptors: *Bioassay, *Bacteria, Toxicity, Nitrogen fixing bacteria, Microorganisms, Nitrification, Wastewater analysis, Biological properties, Pollutant identification.

A bioassay technique using freeze-dried Nitrobacter as the test organism was applied to the analysis of a wastewater treatment system at a fiberboard plant near Portland, Oregon. Treatment facilities on site consist of settling ponds, activated sludge basin, clarifier and holding ponds. The treated water is recycled to the mill for reuse. Soluble and particulate organics began accumulating in the system when the removal of BOD dropped significantly. Both the influent and effluent flows were determined by this method to be toxic. This toxicity spread throughout the entire wastewater treatment system. Toxicity tests were conducted, but no single agent could be identified as the cause of the problem. Various physical and chemical methods were used to treat the situation. It was concluded that the Nitrobacter bioassay meets criteria for a bioassay of industrial and municipal wastewater and is simple and inexpensive for environmental source sampling. The bioassay is a sensitive indicator of toxicity in biological wastewater treatment and can be used to identify toxic wastewater sources and to evaluate treatment and control technologies. (Baker-FRC)
W82-00398

A RESONANCE RAMAN METHOD FOR THE RAPID DETECTION AND IDENTIFICATION OF BACTERIA IN WATER,
Rhode Island Univ., Kingston. Dept. of Chemistry.
W. F. Howard, W. H. Nelson, and J. F. Sperry.
Applied Spectroscopy, Vol 34, No 1, p 72-75, January/February, 1980. 4 Fig, 3 Tab, 24 Ref. OWRT-B-078-RI(2).

Descriptors: *Water analysis, *Bacteria, Water quality control, Resonance, *Spectroscopy, Raman spectroscopy, Pollutant identification.

This study demonstrates that a substantial number of carotene-containing bacteria and algae produce specific, interpretable resonance Raman spectra when irradiated at 488.0 and 514.5 nm. Further, these spectra are easily obtained using simple sample preparation techniques. Spectra are of high quality and are reproducible. Such spectra may be suitable for rapid identification of bacteria even in the presence of substantial amounts of organic material. A total of 16 types of carotene-containing bacteria and algae were studied. Most of the information was contained in the 900 to 1600/cm region. Several bacteria exhibited pronounced carotenoid overtone and combination bands which could be assigned along with the fundamental vibrations. (Baker-FRC)
W82-00404

RADIONUCLIDE CONCENTRATIONS IN STREAMS IN THE UPPER BLACKFOOT RIVER BASIN, SOUTHEASTERN IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
W. H. Low.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $4.00 in paper copy, $4.00 in microfiche. Geological Survey Open-File Report 81-142 (WRI), March 1981. 17 p, 2 Fig, 1 Plate, 4 Tab, 15 Ref.

Descriptors: *Surface water, *Water quality, *Pollutant identification, *Mine drainage, Streams, Overburden, Bottom sediments, Suspended sediments, Phosphates, Uranium, Sampling, Water analysis, Water quality standards, Geochemistry, Path of pollutants, *Idaho, Southeastern Idaho, Blackfoot River basin, Radium, *Phosphate mining, *Radionuclides.

Data on radionuclide concentrations in water and sediment material in the phosphate-mining area of the upper Blackfoot River basin were collected from May to October 1979. Maximum measured uranium and radium-226 concentrations dissolved in water were 3.7 micrograms per liter and 1.8 picocuries per liter, respectively. Maximum measured uranium and radium-226 concentrations in stream-bottom material were 5.5 micrograms per gram and 1.8 picocuries per gram, respectively. Maximum measured uranium and radium-226 concentrations on bottom material were 9.9 micrograms per gram and 3.9 picocuries per gram, respectively, in sediment-retention ponds, and 17 micrograms per gram and 3.5 picocuries per gram, respectively, in a mine pit. Maximum observed radon-222 concentration was 120 picocuries per liter in surface water and averaged 550 picocuries per liter at Formation Springs (site 10). All radionuclide concentrations were within existing State and Federal water-quality standards. Radionuclide concentrations were not significantly increased downstream from active mining sites. (USGS)
W82-00418

COMPARATIVE STUDY ON ORGANIC CONSTITUENTS IN POLLUTED AND UNPOLLUTED INLAND AQUATIC ENVIRONMENTS. II. FEATURES OF FATTY ACIDS FOR POLLUTED AND UNPOLLUTED WATERS,
Tokyo Metropolitan Univ. (Japan). Dept. of Chemistry.
G. Matsumoto.
Water Research, Vol 15, No 7, p 779-787, July, 1981. 2 Fig, 3 Tab, 25 Ref.

Descriptors: *Fatty acids, *Water analysis, Pollutant identification, Organic acids, Organic compounds, Natural waters, Rivers, Tokyo, Ogasawara Islands, Japan.

There was no marked difference between the fatty acid constituents of polluted rivers in the Tokyo area and unpolluted waters from the Ogasawara Islands. The predominant fatty acids in both types of water were even carbon chains in the lower molecular weight ranges, C13 to C19. Straight chain, unsaturated, and branched acids from C8 to C34 were detected. Tokyo waters contained total fatty acids at 270 + or - 120 micrograms per liter; fatty acids as carbon/total organic carbon, 2.6 + or - 0.93%; and fatty acids as carbon/ethyl acetate extractable organic carbon, 16 + or - 6.7%. Similar values for the Ogasawara Islands water were lower, 58 + or - 29 micrograms per liter, 0.79 + or - 0.48%; and 2.1 + or - 0.51%, respectively. Over 95% of the fatty acids were in particulate fractions. Levels of combined fatty acids were twice as great as those of free fatty acids. Unsaturated fatty acids were found only in the combined form. (Cassar-FRC)
W82-00454

APPLICATION OF A MULTIPLE ALGINATE FILTER METHOD FOR THE DETERMINATION OF WATER VIRUSES CONCENTRATION (CONCEPTION D'UNE MEMBRANE FILTRANTE A BASE D'ALGINATE POUR LA CONCENTRATION DES VIRUS HYDRIQUES),
Ecole Polytechnique, Limoges (France).
P. La France, A. J. Drapeau, and E. Kurstak.
Water Research, Vol 15, No 6, p 713-718, June, 1981. 2 Fig, 2 Tab, 16 Ref.

Descriptors: *Viruses, *Membrane filters, *Filtration, *Pollutant identification, Water treatment, Alginate filters, Water analysis, Gels.

Alginate gels were modified by additives to improve the filtration characteristics for concentrating viruses from large water samples. The filtering capacity of the pure 0.5% alginate unitary membranes increased directly with an increase in intramembrane concentrations of sodium gluconate. The filtration output of pure 0.75% alginate membranes remained constant for intramembrane Tween 80 concentrations of less than 0.5%. The existence of a stratified membrane (alginate-sodium gluconate and alginate-Tween 80) was recognized. The double membrane (sample volume, 5 liters) with or without 0.75% gluconate permitted no poliovirus to enter the filtrate. The unitary membranes (sample volume 10 liters), 0.5% and 0.75%, with and without sodium gluconate or Tween 80, had between 12.6% and 89.0% virus in the filtrate. (Cassar-FRC)
W82-00458

NITROSAMINES IN TAP WATER AFTER CONCENTRATION BY A CARBONACEOUS ADSORBENT,
Science and Education Administration, Philadelphia, PA. Eastern Regional Research Center.
W. I. Kimoto, C. J. Dooley, J. Carre, and W. Fiddler.
Water Research, Vol 15, No 9, p 1099-1106, September, 1981. 1 Fig, 7 Tab, 15 Ref.

Descriptors: *Nitrosamines, *Water analysis, *Carcinogens, Amines, Nitrogen compounds, *Drinking water, Adsorption, Ion exchange resins, Activated carbon, Pollutant identification.

Volatile nitrosamines were determined in municipal tap water using Ambersorb XE-340, a carbonaceous adsorbent. Between 58 and 99% of seven added nitrosamines were removed from spiked distilled water samples. Analysis of tap water (flow rate through the adsorbent, 1.2 liters per hour) showed the following levels of nitrosamines, in micrograms per liter: N-nitrosodimethylamine, 0.003-0.006; N-nitrosmorpholine, 0.006-0.016; and N-nitrosodiethylamine, traces. When low levels of secondary amines were added to tap water, nitrosamines were detected, indicating that the water had nitrosating ability. Experimental evidence obtained by adding sulfamic acid, piperidine, and sodium sulfite to the water showed that the nitrosamines did not form on the resin. It was proposed that the trace nitrosamines may have been produced from the reaction of nitrates (present at levels up to 10 micrograms per liter N02-N) with an oxidizing agent, such as chlorine, and amines in the water. (Cassar-FRC)
W82-00459

TESTING THE FLOCCULATION/COAGULATION OF WASTEWATER BY GRANULOMETRIC ANALYSIS OF SUSPENDED SOLIDS IN THE WATER USING A LASER DIFFRACTION METER,
Centre de Recherche de l'Omnium d'Assainissement, Colombes (France).

For primary bibliographic entry see Field 5D.
W82-00463

CLINICAL TESTS IN AQUATIC TOXICOLOGY: STATE OF THE ART,
Columbia National Fisheries Research Lab., MO.
P. M. Mehrle, and F. L. Mayer.
Environmental Health Perspectives, Vol 34, p 139-143, February 1980. 20 Ref.

Descriptors: *Aquatic life, *Toxicity, Chemical compounds, Water pollution, Assessment, Poisons, Indicators, Bioindicators, Public health, Environmental effects, Effects of pollutants, *Fish.

Problems involved in developing diagnostic tests for fish are described, along with the philosophy behind their development and their application in aquatic toxicology. Development of diagnostic tests for fish requires consideration of an understanding of the functions and composition of organs primarily affected by toxic chemmicals; knowledge of analytical procedures to measure appropriate biochemical constituents, cellular morphology, and physiological responses; and the ability to interpret the significance of chemical-induced biophysiological changes and relate them to fish health and survival. The current state of the art of clinical analyses or diagnostic tests in aquatic toxicology is not well advanced. Useful diagnostic or biological indicators have not been developed. One major problem has been the lack of a comprehensive, integrated approach in toxicological studies on fish. To adequately assess the influence of contaminants on the aquatic environment and to overcome the avoidance of biochemical and physiological testing, investigators should develop techniques that can serve as biological indicators in the field as well as predictors in the laboratory to estimate the health of a particular aquatic resource. One of the major principles to be followed is the need to plan and execute the biochemical and physiological research within the framework of conditions existing in the 'real world'. (Baker-FRC)
W82-00464

TADPOLES AS INDICATORS OF HARMFUL LEVELS OF POLLUTION IN THE FIELD,
Nature Conservancy, Abbotts Ripton (England). Monks Wood Experimental Station.
A. S. Cooke.
Environmental Pollution, (Series A), Vol 25, No 2, p 123-133, June, 1981. 4 Fig, 31 Ref.

Descriptors: *Frogs, *Bioindicators, *Water pollution effects, Indicators, *Tadpoles, Water pollution, Oxamyl, Sublethal effects, Runoff, Spraying.

A technique was developed using caged tadpoles to assess potential freshwater pollutants from runoff of spray drift. Mortality, growth, rate of metramorphosis, and occurrence of deformities are monitored. A field test was performed, and the incidence of tadpole deformities was found to be unusually high in cages near a potato field which was treated with oxamyl. Oxamyl is a carbamate nematicide and insecticide. Tadpoles next to the potato fields suffered significantly higher incidences of vertical curvature deformities. Treatment of tadpoles in the laboratory showed similar results. Thus, exposure to environmental stress can cause increases in deformities seen in tadpoles. While this does not prove that the chemical being tested is dangerous, it indicates that the chemical warrants further study. (Small-FRC)
W82-00478

CHARACTERIZATION OF SOLUBLE AND COLLOIDAL-PHASE METAL COMPLEXES IN RIVER WATER BY ULTRAFILTRATION. A MASS-BALANCE APPROACH,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
M. R. Hoffmann, E. C. Yost, S. J. Eisenreich, and W. J. Maier.
Environmental Science and Technology, Vol 15, No 6, p 655-661, June, 1981. 3 Fig, 3 Tab, 64 Ref.

Descriptors: *Ultrafiltration, *Trace metals, *Rivers, Measurement techniques, Membrane filters, Organic matter, Copper, Calcium, Magnesium, Colloids, Solutes, Cadmium, Lead, Dissolved solids, Molecular structure, Mathematical equations.

Previous water quality studies have indicated that it is necessary to know both the total metal concentrations in soluble and particulate phases and the species of the metal in order to reliably predict biological availability and ultimate fate in aquatic systems. This paper reports the development of a new approach to size fractionation by ultrafiltration which uses a cascade procedure and a system of mass-balance equations, eliminating the need for repeated washings or excessive concentration. This procedure is followed by atomic absorption spectrophotometry and anodic stripping voltammetry measurements of metal concentrations. The process has been used to determine the distribution and degree of association of major trace metals with discrete size fractions of dissolved organic matter which initially passes through a 0.4 micrometer membrane filter. Application of the process to samples from the Mississippi and Minnesota Rivers demonstrated that the highest concentrations of trace metals are often found in intermediate molecular weight ranges (1,000 to 10,000) with no detectable free or labile metal as determined by anodic stripping voltammetry. Calcium and magnesium, which were generally found in the lower molecular size ranges, did not appear to have a significant impact on the apparent extent of interaction of other metals with dissolved organic matter. The moderate residual complexation capacity for copper (1.0 plus or minus 0.1 microM) and the relatively high pseudostability constant (log K = 10.4) for copper complexation found in samples from the Mississippi River suggest that complexation of trace metals such as copper, cadmium, and lead may be dominated by aquatic organics and that formation of carbonato complexes is of secondary importance. (Carroll-FRC)
W82-00480

COMPARISON OF AUTOMATED SEGMENTED-FLOW AND DISCRETE ANALYZERS FOR THE DETERMINATION OF NUTRIENTS IN WATER,
National Water Quality Lab., Arvada, CO.
V. C. Marti, and D. R. Hale.
Environmental Science and Technology, Vol 15, No 6, p 711-713, June, 1981. 4 Fig, 2 Tab, 5 Ref.

Descriptors: *Nutrients, *Water analysis, *Measurement techniques, Chemical analysis, *Colorimetry, Measuring instruments, Comparison studies, Pollutant identification.

Many automated colorimetric analysis methods using segmented flow systems have come to be referenced as standard techniques. However, colorimetric analyses can usually be made with greater speed on automated 'discrete' systems for most of the chemical species determined by the referenced methods. The analytical results obtained using the Technicon AAII, a segmented flow system which automatically moves a sample through a closed system of tubing and mixing coils using air-segmented streams of reagents and sample, and the Coulter IKL, a discrete technique which automatically moves a sample and reagents in an open reaction tube through a water bath, were compared. Thirty-nine randomly selected water samples from six states were analyzed for ammonia-N (NH3-N), nitrate plus nitrite-N (NO3 plus NO2-N), nitrite-N (NO2-N), and phosphate-P (PO4-P). Plots of the discrete versus the segmented flow results demonstrated linear correlation coefficients of 0.9980 for NH3-N, 0.9997 for NO3 plus NO2-N, 0.9998 for NO2-N, and 0.9950 for PO4-P. The significances of the slope and of the y intercept of each plot are discussed in terms of possible biases which may exist between the two systems. The discrete analyzer was able to analyze 60 samples per hour for the four analytes, while the segmented-flow analyzer's rate was 40 samples per hour. The comparative accuracy and precision of the two instruments were indicated by the results of the standard reference analyses, by the results of six natural samples used for the precision study, and by the regression statistics pertaining to the 39 unknown water samples. (Carroll-FRC)
W82-00483

MEMBRANE FILTER METHOD FOR ENUMERATING ESCHERICHIA COLI,
Health Effects Research Lab., West Kingston, RI.
A. P. Dufour, E. R. Strickland, and V. J. Cabelli.
Applied and Environmental Microbiology, Vol 41, No 5, p 1152-1158, May, 1981. 4 Fig, 3 Tab, 23 Ref.

Descriptors: *Membrane filters, *Escherichia coli, *Bacterial analysis, Coliforms, Bacteria, Enteric bacteria, Sewage bacteria.

Although many tests have been devised to enumerate Escherichia coli based on the ability of this organism to produce indole from tryptophane at an elevated temperature, there are two inherent problems with the method. The determination of indole production in conjunction with a most probable number procedure generally requires transfer of bacteria from lactose broth to another medium and an additional 24-hour incubation period. In addition, further examination of the colonies under consideration is prohibited since the reagents used for the indole test are bactericidal. The development of a simple, accurate, nonlethal membrane filter technique for rapid enumeration of E. coli is reported. E. coli can be quantitied within 24 hours using this method without requiring subculture and identification of isolates. The method incorporates a primary selective-differential medium for gram-negative, lactose-fermenting bacteria; resuscitation of weakened organisms by incubation for 2 hours at 35 degrees C prior to incubation at 44.5 degrees C for 18 to 22 hours; and an in situ urease test to differentiate E. coli from other thermotolerant, lactose-positive organisms. Use of the method on marine, estuarine, and freshwater samples resulted in recovery rates for E. coli exceeding 90%. Of the presumptively positive colonies, 91% were verified as E. coli. Nonspecificity occurred most often with fresh water samples, but the frequency of false-positive colonies (15%) was not high enough to preclude its use in those environments. Over 99% of the verified E. coli colonies reacted typically. (Carroll-FRC)
W82-00487

INCIDENCE OF VIBRIO ALGINOLYTICUS AND BACTERIA OF SANITARY SIGNIFICANCE IN THE BERING SEA,
Food and Drug Administration, Seattle, WA.
C. A. Kaysner.
Applied and Environmental Microbiology, Vol 41, No 5, p 1279-1282, May, 1981. 1 Fig, 2 Tab, 14 Ref.

Descriptors: *Sewage bacteria, *Bering Sea, *Vibrio, Bacteria, Marine bacteria, Marine environments, Sediments, Seawater, Clams, Mollusks, Environmental tracers, Commercial shellfishing, Public health.

Vibrio parahaemolyticus is a bacterium commonly isolated from temperate marine environments throughout the world. Vibrio alginolyticus, the non-enteropathogenic species, is commonly found in marine samples at temperatures above 5 degrees C. The feasibility of commercial clam harvest in the Bering Sea was studied by a joint industry-government assessment team in 1977. Clams, seawater samples, and sediment samples were analyzed in the bacteriological laboratory on board the National Oceanic and Atmospheric Administration's research vessel used in the study. The bacteriological counts of the clams, sediment samples, and seawater samples were all low. V. alginolyticus was isolated from 2 of 153 total samples at most probable numbers of 5.1 and 16 per 100 milliliters. V. parahaemolyticus was not detected in any of the samples, probably due to the low water temperatures. It is possible that V. parahaemolyticus may be found in the coastal regions of the Bering Sea, where temperatures are higher during the summer months. (Carroll-FRC)
W82-00490

MICROPLATE TECHNIQUE FOR DETERMINING ACCUMULATION OF METALS BY ALGAE,
Syracuse Univ., NY. Dept. of Civil Engineering.
J. M. Hassett, J. C. Jennett, and J. E. Smith.

Applied and Environmental Microbiology, Vol 41, No 5, p 1097-1106, May, 1981. 4 Fig, 6 Tab, 31 Ref.

Descriptors: *Heavy metals, *Algae, *Measurement techniques, Mercury, Lead, Cadmium, Zinc, Salinity, Bioaccumulation, Accumulation, Chelating agents, Pollutant identification.

Although the ability of many species of algae to accumulate metals from their aqueous environments may have a significant impact on bioaccumulation of metals in the food chain and implications for wastewater treatment, there has been no systematic survey of algae for this ability. A microplate analytic technique has been developed which can be used to determine the uptake of heavy metals by pure cultures of algae. The equipment includes plastic, U-bottomed microtiter plates, disposable harvesting frames, a transfer fork, and a press. The technique was used to survey the effects of several combinations of environmental factors on the removal of mercury, lead, cadmium, and zinc by green and blue-green algae and to describe the kinetics of metal uptake. Variables investigated included algal species and strain, culture age (11 and 44 days), pH, effects of different buffer solutions, and time of exposure. Concentration factors, which are the ratio of the metal concentration in the algae to that in the surrounding water, were determined for the various metal-alga combinations. The concentration factors obtained were in reasonably good agreement with those reported in the literature. Mercury was removed from solution by all species of algae studied, while no alga studied removed zinc, possibly due to keeping the cells in the dark during the labeling period. Green algae were found to be better at accumulating cadmium than were blue-green algae. Chlamydomonas sp. proved superior to all other species of algae studied in ability to remove lead from solution. The techniques was found to be rapid, statistically reliable, and economical of materials, cells, and laboratory space. There is no reason to believe that the technique could not be used successfully in similar studies with bacteria, fungi, protozoa, and other microbes or with other gamma-emitting and possibly beta-emitting nuclides. (Carroll-FRC)
W82-00492

IMPACT OF VERIFICATION MEDIA AND RESUSCITATION ON ACCURACY OF THE MEMBRANE FILTER TOTAL COLIFORM ENUMERATION TECHNIQUE,
Oregon State Univ., Corvallis. Dept. of Microbiology.
T. M. Evans, R. J. Seidler, and M. W. LeChevallier.
Applied and Environmental Microbiology, Vol 41, No 5, p 1144-1151, May, 1981. 2 Fig, 2 Tab, 23 Ref.

Descriptors: *Bacterial analysis, *Coliforms, *Membrane filters, Bacteria, Water quality, Filter media.

The membrane filter method is usually the method of choice for the enumeration of total coliforms in water supply samples. However, serious limitations of this technique have been discovered recently, including failure to detect coliforms in turbid drinking water samples and production of green sheen in lactose-containing media, which interferes with the accuracy of the count. A verification procedure has been adopted by the Environmental Protection Agency for use on green-sheen colonies. The influence of verification media and resuscitation on the number of membrane filter typical colonies which produce gas during verification was investigated. The use of lauryl tryptose broth (LTB), lactose broth (LB), and m-LAC broth as primary media was compared, and the need for and use of brilliant-green-lactose-bile (BGLB) broth as secondary media was investigated. Verification in m-LAC broth yielded the greatest number of aerogenic isolates for both untreated surface water and drinking water samples. Verification in BGLB broth increased the number of false-negative reactions. The addition of a resuscitation step in membrane filter analysis did not result in verification of greater numbers of coliforms per sample. The use of m-LAC broth for verification of typical and atypical colonies resulted in a 10-fold increase in coliform numbers from untreated surface water. Verification of both colony types in drinking water resulted in an increase from less than 1 coliform/100 milliliters to greater than 1/100 milliliters. It is concluded that a single-step verification in m-LAC broth would provide a more rapid and sensitive coliform verification procedure than the standard technique involving both subculturing in LTB and subsequent subculturing in BGLB broth. (Carroll-FRC)
W82-00494

COMPARISON OF TWO DIRECT-COUNT METHODS FOR DETERMINING METABOLIZING BACTERIA IN FRESHWATER,
Wisconsin-Milwaukee Univ. Center for Great Lakes Studies.
J. S. Maki, and C. C. Remsen.
Applied and Environmental Microbiology, Vol 41, No 5, p 1132-1138, May, 1981. 1 Fig, 2 Tab, 29 Ref.

Descriptors: *Bacterial analysis, *Metabolism, *Aquatic bacteria, Bacteria, Freshwater, Analytical techniques, Comparison studies.

Since not all bacteria present in aquatic systems are metabolically active, determination of a normalized percentage of metabolically active cells to total counts would be useful to microbial ecologists interested in determining the influence of microorganisms on a given aquatic environment. Two methods for determining the numbers of metabolizing bacteria were compared using planktonic bacteria collected from several freshwater environments and cultured bacteria. The first method involves the reduction of 2-(rho-iodophenyl)-3-(rho-nitrophenyl)-5-phenyl tetrazolium chloride (INT) to INT-formazan crystals by active bacterial electron transport systems. The second method uses a preincubation of the sample with a combination of yeast extract and nalidixic acid (YE + NA), which results in specific inhibition of deoxyribonucleic acid synthesis and subsequent cell elongation. No statistically significant difference was found between methods in determining metabolizing bacteria, although significant differences ($P < 0.05$) were found when comparing numbers of total bacteria. The proportion of metabolizing bacteria with respect to the total count found in this study agreed with values previously reported. Combination of the two techniques resulted in slightly higher counts of metabolizing bacteria than those found in the tests performed individually in some cases and in significantly lower counts in several instances. Both methods are easily performed and provide data on total and metabolizing bacteria within a matter of hours. (Carroll-FRC)
W82-00495

5B. Sources Of Pollution

MOUNT ST. HELENS VOLCANIC-ASH FALL IN THE BULL RUN WATERSHED, OREGON, MARCH-JUNE 1980,
Geological Survey, Portland, OR. Water Resources Div.
M. V. Shulters, and D. G. Clifton.
Available from the Br. of Dist., USGS, 604 S. Pickett St. Alexandria, VA 22304. Geological Survey Circular 850-A, 1980. 15 p, 6 Fig, 3 Tab, 8 Ref.

Descriptors: *Volcanoes, *Environmental effects, *Water quality, Large watersheds, Water supply, Fallout, Particle size, Water pollution sources, Path of pollutants, Precipitation, Weather patterns, Oregon, *Bull Run watershed, Washington, *Mount St. Helens, *Volcanic ash.

During several periods of volcanic-ash eruption at Mount St. Helens, Wash., (March 30, May 25-26, May 30-June 2, and June 12-13, 1980) strong winds from the north occurred at high altitudes. As a result, the volcanic ash fell some 50 miles to the south in the Bull Run watershed, the principal water-supply source for the metropolitan area of Portland, Oreg. Water samples collected from three stream sites within the watershed were compared with samples collected during the same season in previous years. No detectable changes were noted in chemical characteristics. Precipitation samples collected immediately after the June 12-13 ash fall ranged in specific conductance from 20 to 41 micromhos per centimeter at 25C and in pH from 4.0 to 4.3 pH units. Stream samples collected during the May-June period ranged in specific conductance from 18 to 28 micromhos per centimeter at 25C and in pH from 6.7 to 7.5 pH units. Volcanic-ash samples were collected and analyzed for particle size, chemical composition, and weight. Significant differences in particle size of ash were found in samples from two separate eruptions. (USGS)
W82-00002

MUDFLOWS RESULTING FROM THE MAY 18, 1980, ERUPTION OF MOUNT ST. HELENS, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
J. Cummans.
Available from the Br. of Dist., USGS, 604 S. Pickett St. Alexandria, VA 22304. Geological Survey Circular 850-B, 1981. 16 p, 11 Fig, 2 Tab, 2 Ref.

Descriptors: *Mudflows, *Volcanoes, *Streams, *Drainage areas, Avalanches, Detritus, Sediments, Floods, Runoff, *Washington, *Mount St. Helens, North Fork Toutle River, Toutle River, Cowlitz River, Debris avalanche, Volcanic ash.

On May 18, 1980, Mount St. Helens, in southwestern Washington, erupted violently, setting off a chain of devastating hydrologic event. During the eruption, a massive debris avalanche moving down the north side of Mount St. Helens was deposited in the North Fork Toutle River valley. Approximately 3 billion cubic yards of material, including rock, ash, pumice, snow, and ice was deposited directly north of the mountain in the upper 17 miles of the valley. Following the eruption, mudflows quickly developed in the South Fork Toutle River, and in the Lewis River tributaries of Smith Creek, Muddy River, and Pine Creek. Several hours later a massive mudflow originated from the debris avalanche deposit in the North Fork Toutle River valley. This North Fork mudflow caused widespread destruction as it moved downstream through the lower Toutle and Cowlitz Rivers. This report describes the location and chronology of the mudflows which followed the May 18 eruption. Average velocities are presented for the mudflows in the South and North Fork Toutle Rivers, and photographs illustrate the character of the debris and mud deposits. (USGS)
W82-00003

CHANNEL CONDITIONS IN THE LOWER TOUTLE AND COWLITZ RIVERS RESULTING FROM THE MUDFLOWS OF MAY 18, 1980,
Geological Survey, Tacoma, WA. Water Resources Div.
R. E. Lombard, M. B. Miles, L. M. Nelson, D. L. Kresch, and P. J. Carpenter.
Available from the Br. of Distr., USGS, 604 S. Pickett St. Alexandria, VA 22304. Geological Survey Circular 850-C, 1981. 16 p, 13 Fig, 1 Tab, 9 Ref.

Descriptors: *Volcanoes, *Floodwater, *Flood control, *Mudflows, Sediments, Dredging, Flood protection, Flood plains, Runoff, Flood forecasting, Maximum probable floods, *Washington, *Mount St. Helens, Toutle River, Cowlitz River, Castle Rock.

The volcanic eruption of Mount St. Helens on May 18, 1980, triggered mudflows on the South and North Forks of the Toutle River that deposited up to 15 feet of sediment in the channels of the lower Toutle and Cowlitz Rivers. The thickness of the sediment deposited on the flood plain ranged from almost none just upstream from Kelso to about 10 feet near Castle Rock and the mouth of the Toutle River. Existing levees in Castle Rock, Kelso, and Longview contained the mudflows and prevented flooding of those communities. The

mudflow reduced the within-channel flow capacity, except at Kelso and Longview where the effect was minor. The potential exists for unusually high flood levels, up to 10-feet higher than normal, from autumn and winter precipitation. Planned flood-alleviation measures include dredging, additional levees, and sediment-retention structures. A flood-warning system has been established, and the current potential for flooding is being monitored through continued surveillance of the river system. (USGS)
W82-00004

POLYCHLORINATED BIPHENYL TRANSPORT IN THE HUDSON RIVER, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
J. T. Turk, and D. E. Troutman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-249757, Price codes: A02 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-9, 1981. 11 p, 5 Fig, 2 Tab, 3 Ref.

Descriptors: *Water quality, *Polychlorinated biphenols, *Suspended solids, *Pollutants, River flow, Wastewater disposal, Sediments, Suspended sediments, *New York, *Hudson River, Resuspension, Point discharge, Path of pollutants.

Polychlorinated biphenyls (PCB's) have been entering the Hudson River estuary since 1951. Concentration and loading of PCB's in the river below Waterford, N.Y., are controlled at present by resuspension of sediments containing these substances; therefore, until the amount of PCB's in the sediments is significantly lowered, reduction of point-source PCB discharge from the present rate of 0.4 kilograms per day will produce no more than a 10% reduction in loading to the river. Potential concentrations of PCB's in solution and suspension in the river can be predicted by a simple model for mixing and dilution. From a known range of PCB influent rates, total PCB loading to the Hudson River from above Waterford is shown to be between 2,000 and 12,000 kilograms per year. (USGS)
W82-00008

RELATIONSHIP OF WATER QUALITY OF HUDSON RIVER, NEW YORK, DURING PEAK DISCHARGES TO GEOLOGIC CHARACTERISTICS OF CONTRIBUTING SUBBASINS,
Geological Survey, Albany, NY. Water Resources Div.
J. T. Turk, and D. E. Troutman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-249740, Price codes: A02 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 80-108, 1981. 15 p, 1 Fig, 6 Tab, 6 Ref.

Descriptors: *Water quality, *Streams, *Polychlorinated biphenols, *Sediment transport, Pollutants, Geohydrology, Sediments, Phosphorus, Heavy metals, Suspended sediments, Chemical analysis, Least squares method, *New York, *Hudson River, Resuspension.

Water samples from two Hudson River floods in 1977--one originating mainly in shale subbasins that produce high sediment loads, the other in soil-poor, crystalline rock terrane that yields little sediment--were analyzed to evaluate the relationship of iron, manganese, lead, phosphorus, and polychlorinated biphenyls (PCB's) to suspended-sediment concentration. During the flood of high sediment discharge, ratios for all substances studied except PCB's reflected their concentration within the basin regolith. During the flood of smaller magnitude, from the low-sediment crystalline terrane, however, only the ratio for iron correlated with predicted concentrations in the basin, which suggests that the chemical constituents studied were contributed principally from other sources, possibly anthropogenic sources. High lead concentrations in the low-sediment flood were derived from an unidentified, basinwide source whose contribution was relatively insignificant during the flood from the shale area. (USGS)
W82-00009

RECONNAISSANCE OF THE EFFECT OF LANDFILL LEACHATE ON THE WATER QUALITY OF MARSHALL BROOK, SOUTHWEST HARBOR, HANCOCK COUNTY, MAINE,
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 5C.
W82-00013

EVALUATION OF THE MALAGA BEND SALINITY ALLEVIATION PROJECT, EDDY COUNTY, NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
J. L. Kunkler.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $4.75 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 80-1111, September 1980. 31 p, 5 Fig, 4 Tab, 20 Ref.

Descriptors: *Brines, *Rivers, *Water quality, *Salinity, Reservoirs, Leakage, Water analysis, Aquifers, Evaluation, *New Mexico, Eddy County, Pecos River, Malaga Bend.

In an effort to reduce the flow of brine springs in the Malaga Bend reach of the Pecos River in southeastern New Mexico, brine was pumped from an aquifer underlying the Malaga Bend reach to a local depression known as Anderson Lake. The attempt to improve the quality of river water with this experiment was not successful because brine leakage from Anderson Lake to the nearby Pecos River through permeable subsurface rocks was greater than the previous natural spring inflow. Brine leakage from Anderson Lake from July 22, 1963, through September 30, 1968, was estimated by evaporation-pan, salt accumulation, and dissolved-constituent methods. The leakage values given by these three methods are in good agreement with each other and indicate that between the dates given, leakage from the lake was about 2,300 acre-feet, compared with a brine inflow to the lake of about 3,690 acre-feet. Other data indicate that pumping from the brine aquifer greatly reduced the natural inflow from brine springs to the Malaga Bend reach. The rate of brine leakage from Anderson Lake is probably greater than might be expected from other brine lakes in the area because the cavities in the bottom of the lake apparently are in hydrologic connection with the Pecos River. This connection is shown by a relation between the salinity of the Pecos River and the reservoir stage of Anderson Lake. (USGS)
W82-00018

CARBON ISOTOPES AS INDICATORS OF THE SOURCE AND FATE OF CARBON IN RIVERS AND ESTUARIES,
Geological Survey, Reston, VA.
E. C. Spiker.
Available from the National Technical Information Service, Springfield, VA as CONF-8009140, Price codes: A18 in paper copy, A01 in microfiche. In: Flux of Organic Carbon by Rivers to the Oceans, Report of a Workshop, Woods Hole, MA, Sept 21-25, 1980, Dept. of Energy Report CONF-8009140, April 1981. p 75-108, 6 Fig, 2 Tab, 44 Ref.

Descriptors: *Carbon radioisotopes, *Carbon cycle, *Indicators, *Tracers, Vegetation, Estuaries, Rivers, Organic carbon.

The double isotopic labeling of carbon is particularly useful for the analysis of sources and sinks of carbon. The onset of nuclear weapons testing in 1954 resulted in a large input of bomb-produced excess carbon-14. The spread of bomb carbon-14 through the terrestrial carbon pool offers considerable potential in resolving the question of whether an increase in carbon transport by rivers might be due to increased photosynthesis or to increased soil erosion, by determining the time of fixation by photosynthesis. Delta carbon-13 is a relatively simple and reliable source indicator that can discriminate between terrestrial and marine organic carbon. A comparison of delta carbon-13 distributions in the San Francisco Bay and the Potomac River estuary demonstrates the varying importance of estuarine primary productivity in different systems. The analysis of both carbon-14 and carbon-13 provides unique information about the derivation and processing of carbon in rivers. The usefulness of these techniques is of course greatly enhanced when applied in conjunction with other tracers, such as nitrogen-15, C/H/N ratios, and various organic compounds. Delta nitrogen-15 may be very useful if it can distinguish between fresh-water aquatic plants and land plants. The new solid-state carbon-13 NMR techniques should provide a powerful tool that can discriminate between algal and vascular plant carbon. (Moore-SRC)
W82-00033

DEPOSITION OF RIVERBORNE ORGANIC CARBON IN FLOODPLAIN WETLANDS AND DELTAS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 2J.
W82-00034

CHEMICAL INDICATORS OF ORGANIC RIVER SOURCES IN RIVERS AND ESTUARIES,
Washington Univ., Seattle. Dept. of Oceanography.
J. I. Hedges.
Available from the National Technical Information Service, Springfield, VA 22161 as CONF-8009140, Price codes: A18 in paper copy, A01 in microfiche. In: Flux of Organic Carbon by Rivers to the Oceans, Report of a Workshop, Woods Hole, MA, Sept 21-25, 1980, Dept. of Energy Report CONF-8009140, April 1981. p 109-141, 7 Fig, 1 Tab, 61 Ref.

Descriptors: *Indicators, *Tracers, *Organic matter, *Biochemistry, *Water pollution sources, Carbohydrates, Lipids, Proteins, Organic compounds, Estuaries, Terrestrial plants, Lignins.

Almost all molecular tracers used to distinguish the geographic or biological sources of organic matter in natural environments are derived from photosynthetic plants. Molecular organic indicators can be classified in terms of the four major categories of plant natural products: carbohydrates, proteins, phenolics (primarily lignins), and lipids. Higher land plants, which are composed primarily of cellulose and lignin, contain relatively little organic nitrogen. C/N ratios have been used to establish the presence of land derived organic matter in sediments and suspended particulate matter, but the wide range of C/N values in higher plants and the effects of diagenesis are a disadvantage. Of the carbohydrates, the natural sugars and uronic acids have some potential for use as terrestrial tracers. Lignins are the only major biochemicals to have an unambiguous terrestrial origin. Lignin-derived phenols can be used to obtain information concerning the taxonomic and tissue sources of lignin mixtures, and to estimate quantitatively the amount of vascular plant remains. This lipids include a variety of molecular types that can be applied as terrestrial tracers. Leaf wax hydrocarbons have been used extensively to trace higher-plant lipids in rivers, estuaries, and the open ocean. Certain tricyclic diterpenoid hydrocarbons are also used as terrestrial source indicators. Linear, unsaturated fatty acids are a major lipid component of higher plants, and can be used as indicators of land-derived material. Diterpenoid resin acids are also useful terrestrial source indicators. Sterols are useful geochemical tracers because of their relatively high chemical stability and taxonomically related structural diversity. (Moore-SRC)
W82-00035

WATER QUALITY ISSUES AND ENERGY ASSESSMENTS,
Argonne National Lab., Argonne, IL.
For primary bibliographic entry see Field 6B.
W82-00036

MODELING PHOSPHORUS LOADING AND LAKE RESPONSE UNDER UNCERTAINTY: A

URBANA-CHAMPAIGN

MANUAL AND COMPILATION OF EXPORT COEFFICIENTS.
Environmental Protection Agency, Washington, DC.
Report EPA-440/5-80-011, June 1980. 223 p, 22 Fig, 31 Tab, 195 Ref, Append.

Descriptors: *Mathematical models, *Phosphorus, *Cycling nutrients, *Eutrophication, Pollution load, Land use, Trophic level, Air pollution, Error analysis, Precision, Prediction, Lakes, *Limnology, Environmental effects.

A procedure is proposed that may be used to quantify the relationship between land use and lake trophic quality. The methodology is based on an input-output phosphorus lake model. When it is employed to predict the impact of projected land use changes, it is necessary to use phosphorus export coefficients extrapolated from other points in time and/or space. These coefficients represent the mass loading of phosphorus to a surface water body per year per unit of source. Nitrogen and phosphorus export coefficients from different land uses including forest, crops, pasture and grazing land, urban, septic tanks and absorption fields, and sewage treatment plants are given. The impact of atmospheric inputs is noted. The criteria for selecting the appropriate coefficients are: accuracy, precision, representativeness, temporal extent of sampling, nutrient flux estimation, and concentration and flow data. The model includes an error estimation procedure, and is applicable to a fairly wide range of lake types. The limitations of the methodology involve uncertainties in the input information and their impact on prediction precision. (Brambley-SRC)
W82-00039

ABSORPTION OF RADIUM AND THORIUM FROM NEW MEXICO URANIUM MILL TAILING SOLUTIONS,
Bureau of Mines, Salt Lake City, UT. Salt Lake City Research Center.
For primary bibliographic entry see Field 5D.
W82-00040

COMPUTER MODELING OF FLUID FLOW DURING PRODUCTION AND ENVIRONMENTAL RESTORATION PHASES OF IN SITU URANIUM LEACHING,
Bureau of Mines, Twin Cities, MN. Twin Cities Research Center.
For primary bibliographic entry see Field 6A.
W82-00043

QUALITY OF WATER IN TIBBEE CREEK AND TRIBUTARIES NEAR WEST POINT, MISSISSIPPI,
Geological Survey, Jackson, MS. Water Resources Div.
S. J. Kalkhoff.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225, Price codes: $6.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-406, 1981. 42 p, 7 Fig, 3 Tab, 12 Ref.

Descriptors: *Water quality, *Surface water, *Streamflow, *Hydrologic data, Sampling, Water analysis, Bacteria, *Mississippi, Tibbee Creek, Town Creek, Catalpa Creek, Path of pollutants.

An intensive water-quality study was conducted on Tibbee Creek and two of its tributaries, Town Creek and Catalpa Creek, on June 19-22, 1979. The data were collected during a period of low discharge and high air temperatures. The water in Tibbee Creek and Catalpa Creek was of much better quality than water in Town Creek. Large quantities of nitrogen, phosphorus, and dissolved solids and high densities of fecal coliform were present in Town Creek. The five-day biochemical oxygen demand values averaged 14 mg/L, and the mean total nitrogen concentration was 56 mg/L. The mean concentrations of ammonia, nitrate plus nitrite nitrogen, and organic nitrogen were 1.8 mg/L, 50 mg/L, and 3.7 mg/L, respectively. A total phosphorus load of more than 400 pounds per day, more than 91% of the total phosphorus load leaving the study area, was carried by Town Creek into Tibbee Creek. Total phosphorus concentrations averaged 14 mg/L in Town Creek and 0.11 and 0.12 mg/L in Tibbee and Catalpa Creeks respectively. Bacterial densities were higher at site 2 in Town Creek than at sites 1 and 3 in Tibbee and Catalpa Creeks respectively. The median fecal coliform bacterial density was 25,000 col/100 mL (colonies per 100 milliliters) in Town Creek and less than 200 col/100 mL in Tibbee and Catalpa Creeks. Median fecal streptococcal densities were 1,000 col/100 mL in Town Creek, 210 col/100 mL in Tibbee Creek, and 800 col/100 mL in Catalpa Creek. Fecal coliform to fecal streptococcal ratios were greater than 4.0 in Town Creek, indicating wastes of human origin were probably present during the study. Ratios were less than 0.7 in Tibbee and Catalpa Creeks, indicating human wastes were probably absent during the study. (USGS)
W82-00084

PLANNING STUDY TO MODEL AND MONITOR COAL PILE RUN-OFF,
TRC Environmental Consultants, Inc., Wethersfield, CT.
For primary bibliographic entry see Field 6A.
W82-00091

EFFECT OF AGRICULTURAL LAND DEVELOPMENT ON DRAINAGE WATERS IN THE NORTH CAROLINA TIDEWATER REGION,
North Carolina State Univ. at Raleigh.
R. W. Skaggs, J. W. Gilliam, T. J. Sheets, and J. S. Barnes.
Environmental Protection Agency Project Summary EPA-600/S3-80-087, July 1981. 3 p.

Descriptors: *Agricultural runoff, *Drainage, Water quality, *Pesticide residues, *Agricultural hydrology, *Land development, Land use, Nitrogen, Phosphorus, Organic soils, Herbicides, Coliforms, Evapotranspiration, Pesticide drift, Subsidence, *North Carolina, *Tide lands.

In a three-year study, the effect of agricultural drainage and development on hydrology and the effect of runoff water quality on high organic soils were examined in the North Carolina Tidewater Region. A small but significant increase was found in organic nitrogen in drainage water as a result of agricultural development. True organic soils lost considerably more phosphorus to drainage waters. Development caused a decrease in evapotranspiration with a consequent small increase in annual outflow even during years when droughts occurred. Dissolved oxygen, biochemical oxygen demand, temperature, pH, and other water quality parameters exhibited relatively small changes as a result of development. A significant increase in the loss of fecal and total coliform bacteria from pasture land was observed, which represents a potential water quality problem. Studies of the herbicide alachlor showed that it disappeared rapidly from soil after application but also showed that low, nonphytotoxic concentrations persisted from one season to the next. High concentrations in drainage waters appeared to be caused by direct spraying or by spray drift. Soil subsidence was greatest immediately after development.
W82-00094

WATER POLLUTION POTENTIAL OF COAL-SLURRY PIPELINES,
Montana State Univ., Bozeman, Dept. of Civil Engineering and Engineering Mechanics.
For primary bibliographic entry see Field 6A.
W82-00096

USE OF THE ELECTROLYTIC RESPIROMETER TO MEASURE BIODEGRADATION IN NATURAL WATERS,
Procter and Gamble Co., Cincinnati, OH.
For primary bibliographic entry see Field 5A.
W82-00126

AN EMPIRICAL EQUATION FOR PREDICTING SOLUBLE PHOSPHORUS LOADS FROM AGRICULTURAL WATERSHEDS,
Wisconsin Univ.-Madison. Water Resources Center.
B. A. Miller, and T. C. Daniel.
Transactions of the ASAE, Vol 24, No 2, p 375-381, 390, March-April, 1981. 8 Tab, 33 Ref.

Descriptors: *Phosphorus compounds, Land use, *Nutrients, Runoff, Regression analysis, Rainfall-runoff relationships, Fate of pollutants, Small watersheds, *Agricultural watersheds, Pollutant load, *Agricultural runoff.

An empirical equation was developed to predict soluble reactive phosphorus (SRP) loads from agricultural watersheds. This equation was derived from regression analysis of data on nutrient loading studies conducted on locations with Midwest-type climates. Factors affecting SRP loadings were precipitation, area, slope, soil type, land use, and farm practices. The equation was used to predict SRP loads from agricultural watersheds in Washington County, Wisconsin, based on 1976-1978 data. Predicted and observed loads were a function of land use, the percentage of land in hay having the most influence. Effects of fertilizer usage, depth of surface runoff, and tillage practices were not statistically significant. The equation does not account for weather and snowmelt variations nor for sediment-soluble P interactions. It is more accurate on small watersheds. (Cassar-FRC)
W82-00134

SEDIMENT AND NUTRIENT MOVEMENT FROM THE BLACK CREEK WATERSHED,
Purdue Univ., Lafayette, IN. Dept. of Agricultural Engineering.
E. J. Monke, D. W. Nelson, D. B. Beasley, and A. B. Bottcher.
Transactions of the ASAE, Vol 24, No 2, p 391-395, 400, March-April, 1981. 1 Fig, 14 Tab, 8 Ref.

Descriptors: *Sediment transport, *Nutrients, *Pollution load, Path of pollutants, Erosion, Phosphorus compounds, Nitrogen compounds, Snowmelt, Runoff, Rainfall, Nonpoint pollution sources, Agricultural runoff, Water quality, Black Creek, *Indiana, Maumee River, Lake Erie.

Discharge from the Black Creek Watershed, Indiana, was monitored to study the effects of nonpoint source pollution from agricultural runoff on water quality of the Maumee River, which flows into Lake Erie. Data from 1975, a high rainfall year (108.0 cm), and 1976, a low rainfall year (67.0 cm), were used. Two subbasins with contrasting soils and land uses were compared. The Dreisbach drainage area (gently rolling, glacial till) is more residential and has more grain and pasture. The Smith-Fry drainage area (lake plain and beach, nearly level) has few homes and 63% row crops. Runoffs were 26.0-29.1 cm in 1975 and 10.1-12.4 cm in 1976. Sediment yields (in kg per ha) were: Smith-Fry, 2130 in 1975 and 640 in 1976; Dreisbach, 3740 in 1975 and 380 in 1976; and Black Creek, 2370 in 1975 and 530 in 1976. Total N loadings (in kg per ha) were: Smith-Fry, 53.2 in 1975 and 10.3 in 1976; Dreisbach, 44.1 in 1975 and 6.6 in 1976; and Black Creek, 48.7 in 1975 and 8.6 in 1976. Total P loadings (in kg per ha) were: Smith-Fry, 5.4 in 1975 and 1.1 in 1976; Dreisbach, 5.0 in 1975 and 1.0 in 1976; and Black Creek, 5.2 in 1975 and 1.1 in 1976. More soluble inorganic P came from the residential Dreisbach area, and more nitrates from the Smith-Fry agricultural area. From 77 to 96% of P and about 50% of the N was bound to sediment transported. Large storms produced the greatest amount of sediment and nutrient transport. Therefore, continuous sampling is required for accurate assessment. During snowmelt, soluble P and other soluble nutrients were disproportionately high compared with snowmelt runoff. Sediments in the Black Creek contain three times the total P and five times the total N found in uneroded soils. (Cassar-FRC)
W82-00135

PREDICTING RUNOFF POLLUTANT REDUCTION IN BUFFER ZONES ADJACENT TO LAND TREATMENT SITES,

North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
M. R. Overcash, S. C. Bingham, and P. W. Westerman.
Transactions of the ASAE, Vol 24, No 2, p 430-435, March-April, 1981. 6 Fig, 5 Tab, 21 Ref.

Descriptors: *Animal wastes, *Land application, *Nonpoint pollution sources, *Water pollution control, Buffer zones, Model studies, Mathematical models, Infiltration, Runoff, Pollution load, Soil types, Rainfall-runoff relationships.

A mathematical model was developed to estimate the proper buffer zone length for preventing non-point source pollution from animal waste application sites. Three major factors were considered: pollutant concentration in runoff, dilution, and infiltration. A family of reduction percentages vs. buffer zone/waste area curves are presented. Soil type significantly affected buffer zone performance. For an infiltration rate/rainfall rate ratio of 0.7, characteristic of clay loam soil, a buffer area/length ratio of 1.0 is required to reduce pollutant concentrations by 90-100%. (Cassar-FRC)
W82-00141

CHARACTERISATION OF DOMESTIC AND INDUSTRIAL SEWAGE IN SOUTHERN CALIFORNIA COASTAL SEDIMENTS USING NITROGEN, CARBON, SULPHUR, AND URANIUM TRACERS,
California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics.
R. E. Sweeney, E. K. Kalil, and I. R. Kaplan.
Marine Environmental Research, Vol 3, No 3, p 225-243, July, 1980. 9 Fig, 5 Tab, 15 Ref.

Descriptors: *Mathematical models, *Marine sediments, *Isotopic tracers, Sediments, Isotope studies, Wastewater, Nitrogen, Carbon, Sulfur, Uranium, Sedimentation, Water pollution effects, *San Pedro, California, Path of pollutants.

A degradation-mixing model was developed to aid in the interpretation of geochemical processes occurring in sewage-contaminated marine sediment near San Pedro, California. An effective tracer of sewage discharge in this area was the nitrogen isotope ratio. Uranium enrichment from seawater did not occur in the sediments contaminated by sewage. The uranium content of effluent particles was 18 ppm, while that for uncontaminated sediment was 5 ppm. This allows uranium content to also be a tool in tracing the deposition of the sewage sediment in the marine environment. Cadmium and sulfur, however, were not mobilized during sewage deposition and degradation. Data summarized by Morel et al. (1975) are presented and discussed in terms of the degradation-mixing model. About 30 to 40% of the discharged nitrogen and uranium in the particulates was lost during sedimentation. Cadmium is retained entirely in the sediment, and sulfur is further enriched by in situ reduction of seawater sulfate. (Small-FRC)
W82-00147

EFFECT OF KAOLIN CONCENTRATION ON DISTRIBUTION COEFFICIENT OF COPPER,
Maryland Univ. Eastern Shore, Princess Anne. Dept. of Natural Sciences.
G. C. Gupta, and F. L. Harrison.
Water, Air, and Soil Pollution, Vol 13, No 2, p 247-250, June, 1980. 1 Fig, 15 Ref.

Descriptors: *Copper, *Adsorption, *Kaolin, Fate of pollutants, Clays, Metals, Sediments, Mathematical equations, Laboratory studies.

Prior work on adsorption of copper by sediments and clays cannot be compared because a variety of clays and concentrations were used. In this study H-kaolin was equilibrated with Cu64 spiked water, shaken overnight in a constant temperature shaker, filtered through a 0.45 micrometer Millipore membrane, and the partitioning of radioactivity between filtrate and filter measured with a gamma ray well counter. The pH was stable at 6.37-6.42. Adsorption of Cu, expressed as the distribution coefficient, as a function clay concentration decreased sharply from over 7,000 at 10 ppm clay to 2,000 at 150 ppm and 1,2000 at 480 ppm. This curve agrees with other work in which higher adsorption occurs at lower concentrations and reaches an equilibrium at higher concentrations. The higher adsorption at lower concentrations may be caused by higher particle aggregation of the metal with the suspended clay. (Cassar-FRC)
W82-00153

HYDROLYSIS OF FENITROTHION IN MODEL AND NATURAL AQUATIC SYSTEMS,
Dept. of Agriculture, Ottawa (Ontario).
R. Greenhalgh, K. L. Dhawan, and P. Weinberger.
Journal of Agricultural and Food Chemistry, Vol 28, No 1, p 102-105, January/February, 1980. 4 Fig, 2 Tab, 18 Ref.

Descriptors: *Fenitrothion, *Natural waters, *Degradation, Pesticides, *Insecticides, Lakes, Photolysis, Microbial degradation, Hydrolysis, Chemical reactions, Fate of pollutants.

Fenetrothion can enter aquatic systems directly or indirectly, from surface runoff, after aerial application to forests. The degradation of fenitrothion, O,O-dimethyl O-(3-methyl-4-nitrophenyl) phosphorothioate, was studied in the dark in buffered distilled water, natural lake water, and buffered lake water. Above pH 8, 3-methyl-4-nitrophenol was formed by specific base catalysis. Below pH 7, demethylfenitrothion was formed by dealkylation. This reaction was temperature dependent. Aminofenitrothion appeared in reaction mixtures involving lake water, but not distilled water; in buffered lake water aminofenitrothion comprised 16% of the reaction products and in natural lake water, 5%. Buffering probably supports growth and activity of degrading microorganisms. Photolysis and microbial degradation are suggested as the main mechanisms for degradation of fenitrothion in natural aquatic systems because the half-life for disappearance in natural lake water (23C and pH 7.5) was 49.5 days in the dark and 1.5-2 days in the field. (Cassar-FRC)
W82-00157

FENITROTHION SPRAYED ON A POND: KINETICS OF ITS DISTRIBUTION AND TRANSFORMATION IN WATER AND SEDIMENT,
National Water Research Inst., Burlington (Ontario).
R. J. Maguire, and E. J. Hale.
Journal of Agricultural and Food Chemistry, Vol 28, No 2, p 372-378, 1980. 4 Fig, 3 Tab, 36 Ref.

Descriptors: *Fenitrothion, *Degradation, *Kinetics, Pesticides, *Insecticides, Suspended solids, Sediments, Adsorption, Hydrolysis, Chemical reactions, Volatility, Fate of pollutants, *Ponds, New Brunswick, Canada.

Fenitrothion, O,O-dimethyl O-(p-nitro-m-tolyl) phosphorothionate, sprayed on the surface of a pond in New Brunswick, Canada, to control spruce budworm, volatilized rapidly (half-time, 18 min at 20 degrees C). Concentrations of the insecticide in water, suspended solids, and sediments were below the detectable level two days after spraying. The most persistent degradation products were p-nitro-m-cresol in water (zero concentration reached at 48 hours) and aminofenitrothion in sediments (zero concentration reached in four days). Volatilization from the surface took place in two steps. Following the 'fast' volatilization, in which the fenitrothion probably codistilled with the formulation solvents, a second, slower process of volatilization from the subsurface water began. The half-life of this step was 64 days. Addition of 5 mg per liter of dissolved fulvic acid to the water retarded volatilization to a half-life of greater than 180 days. (Cassar-FRC)
W82-00159

PHOTOLYSIS OF N-NITROSODI-N-PROPYLAMINE IN WATER,
Lilly Research Lab., Greenfield, IN.
D. G. Saunders, and J. W. Mosier.
Journal of Agricultural and Food Chemistry, Vol 28, No 2, p 315-319, 1980. 4 Fig, 1 Tab, 16 Ref.

Descriptors: *Nitrosamines, *Degradation, *Herbicides, Fate of pollutants, Organic compounds, Nitrogen compounds, Amines, Photolysis, Chemical reactions, Trifluralin, Lakes, Natural waters, Carcinogens, Solar radiation.

Although N-nitroso-di-n-propylamine (NDPA) has not yet been detected in irrigation waters or pond waters, this trace contaminant of the herbicide trifluralin is a potential hazard in natural waters. The photolysis of NDPA was studied in lake water, in distilled water, and in waters buffered to pH 3, 6, and 9. NDPA rapidly degraded in all experiments. Concentrations of 1-100 ppm had little effect on the results. Photolysis rate was independent of pH. After 120 min the major photoproduct was n-propylamine (47-73%), with some di-n-propylamine (2-24%). (Cassar-FRC)
W82-00164

AMOUNTS AND RELATIVE SIGNIFICANCE OF RUNOFF TYPES IN THE TRANSPORT OF NITROGEN INTO A STREAM DRAINING AN AGRICULTURAL WATERSHED,
Massey Univ., Palmerston North (New Zealand). Dept. of Soil Science.
A. N. Sharpley, and J. K. Syers.
Water, Air, and Soil Pollution, Vol 15, No 3, p 299-308, April, 1981. 4 Fig, 3 Tab, 31 Ref.

Descriptors: *Runoff, *Nitrogen, Streamflow, *Agricultural watersheds, Watersheds, Agriculture, Agricultural runoff, Nutrients, Nonpoint pollution sources, Pollution load, Solute transport.

This paper reports an investigation of the relationships between flow and concentration of N forms; the sampling frequency required to reliably estimate the loading of N forms; the amounts of N forms transported in surface, accelerated subsurface, and subsurface runoff and stream flow; and the relative significance of the three runoff types to stream flow and nitrogen discharge from a watershed under pasture. The watershed under study was located adjacent to Massey University in Palmerston North, New Zealand. A slight decrease of NO3-N and an increase of particulate N concentrations was noted with increased flow of the runoff and the stream, due to dilution and increased sediment transport, respectively. The concentrations of NO3-N in surface, accelerated subsurface and subsurface runoff and stream flow, average over three years, was 0.3, 6.6, 4.8, and 4.6 mg/liter, respectively, amounting to 0.5, 9.4, 11.6, and 16.8 kg/ha/yr, respectively, transported annually. Although NO3-N accounted for only a minor portion of the total nitrogen transported in surface runoff, it was the major form of nitrogen transported in the other runoff types and in streamflow. Subsurface runoff contributed the major portion of stream discharge and NO3-N, particulate, and total N loadings of the stream. These findings are of interest in the study of non-point pollution of surface waters. (Baker-FRC)
W82-00173

ELEMENT MASS BALANCES FOR SOUTH CAROLINA COASTAL PLAIN WATERSHEDS,
South Carolina Univ., Columbia. Dept. of Geology.
L. R. Gardner.
Water, Air, and Soil Pollution, Vol 15, No 3, p 271-284, April, 1981. 1 Fig, 2 Tab, 27 Ref.

Descriptors: *Watersheds, *Chemical properties, Groundwater, *South Carolina, Coasts, Fertilizers, Precipitation, Runoff, *Agricultural chemicals, Path of pollutants, Chemistry of precipitation, Calcium, Solutes, Agricultural runoff.

An attempt was made to relate rainfall chemistry and agricultural and forestry practices to regional variations in water quality among the South Carolina Coastal Plain watersheds. The area is underlain by unconsolidated-to-poorly-consolidated sediments, ranging in age from late Cretaceous to Recent. The average annual precipitation over the Coastal Plain ranges from 114 cm along the western margin to 140 cm along the coast. Runoff from Upper Coastal Plain watersheds averages about 46 cm, compared to 33 cm for Lower Coastal Plain

watersheds. Fertilizers and liming materials appeared to be the major sources for Ca, Mg, K, Cl, and HCO3 inputs, whereas precipitation is the major source for Na and sulfates. Streamflow is the chief mode of output for all these elements. A balance between input and output is evident only for chlorides. Retentions of 50% or more are shown by Ca, Mg, K, HCO3 and SO4, whereas Na shows an apparent net loss. About 25% of the dolomitic liming materials applied to the landscape actually dissolve, and the carbonate chemistry of the Lower Coastal Plain streams is therefore probably largely controlled by seepage of groundwaters from underlying calcareous aquifers. K retention and Na loss may be due to cation exchange reactions on soil clays, whereas sulfate retention is due to reduction to H2S in floodplain environments and soil adsorption. (Baker-FRC)
W82-00175

CARBON TRANSFORMATIONS IN THE LAND AREAS RECEIVING ORGANIC WASTES IN RELATION TO NONPOINT SOURCE POLLUTION: A CONCEPTUAL MODEL,
Florida Univ., Sanford. Agricultural Research and Education Center.
K. R. Reddy, R. Khaleel, and M. R. Overcash.
Journal of Environmental Quality, Vol 9, No 3, p 434-442, July-September, 1980. 2 Fig, 8 Tab, 50 Ref.

Descriptors: *Carbon, *Decomposition, Plants, Animal wastes, Water quality, Monitoring, Model studies, Mathematical models, Nonpoint pollution sollution, Soil environment.

The available literature on organic carbon (C) transformations in soils treated with organic wastes was reviewed. A conceptual model to describe the fate of C in the soil-waste system was developed. The effects of soil, environment, and management factors on the rate of C decomposition was determined. The impact of C decomposition on the runoff transport of C and on water quality was described. The organic matter was obtained from three sources: animal waste, plant residues, and native soil organic matter. The model describes decomposition of wastes in two or three phases, assuming first-order kinetics at each phase. The fraction decomposed at each phase was determined graphically. Rapid decomposition of an easily decomposable C fraction in Phase I and II was followed by the decomposition of more resistant C fractions. The amount of C decomposed for plant residues in Phase I was significantly related to the log C/N ratio of the residue, whereas a similar relation was not noted for animal wastes. Decomposition rates were 6-10 times faster during Phase I and II decomposition as compared to Phase III. Kinetic rate constants, calculated at each phase of decomposition, were adjusted for the soil temperature, soil moisture, and method of application. Equations are presented to calculate the transport of waste particles and sediment-associated C in the runoff water. (Baker-FRC)
W82-00179

MODELING THE FLUX OF ATMOSPHERIC POLYCHLORINATED BIPHENYLS ACROSS THE AIR/WATER INTERFACE,
Wisconsin Univ.-Madison.
P. V. Doskey, and A. W. Andren.
Environmental Science and Technology, Vol 15, No 6, p 705-711, June, 1981. 4 Tab, 48 Ref.

Descriptors: *Air-water interfaces, *Polychlorinated biphenyls, *Mathematical models, Aroclors, Sampling, Measurement techniques, Deposition, Chemical analysis, Lakes, Lake Michigan.

Many freshwater lakes serve as sinks for polychlorinated biphenyls (PCBs), which are found throughout the environment. However, quantification of the total PCB flux across the air/water interface presents many problems. The total atmospheric PCB burden is analytically underestimated due to insufficient collection of the most volatile PCB fraction. Most quantification methods fail to indicate the extent of PCB mixture weathering. Speciation of airborne PCBs indicates that more than 90% exist in the vapor phase. Indirect calculations based on semiempirical expressions also suggest that particle-bound Aroclors are generally associated with submicrometer-size aerosols. Data from Lake Michigan are used to demonstrate a model of the PCB flux across the air/water interface. The model includes the processes of vapor and particle deposition, volatilization, and bubble ejection. Calculations indicate that atmospheric transport currently plays a major role in the deposition of PCBs in Lake Michigan in comparison with other modes of deposition. The importance of vapor deposition and volatilization is dependent upon the magnitude of the Henry's law constant. The role of bubble ejection in transferring PCBs from freshwater lakes back into the atmosphere is uncertain. A combination of approaches is needed to achieve an accurate picture of the atmospheric PCB flux. (Carroll-FRC)
W82-00193

BACTERIAL CONTAMINATION OF DRINKING WATER SUPPLIES IN A MODERN RURAL NEIGHBORHOOD,
Oregon State Univ., Corvallis. Dept. of Microbiology.
For primary bibliographic entry see Field 5A.
W82-00198

PICLORAM DISSIPATION IN A SMALL SOUTHWESTERN STREAM,
Science and Education Administration, Tucson, AZ.
T. N. Johnsen, and W. L. Warskow.
Weed Science, Vol 28, No 5, p 612-615, September, 1980. 2 Fig, 1 Tab, 23 Ref.

Descriptors: *Picloram, *Streamflow, Degradation, *Herbicides, Dissipation, Environmental effects, Flow, Mixing.

The disappearance of a known amount of picloram (4-amino-3,5,6-trichloropicolinic acid) after injection into a small stream located in semiarid southwestern pinyon-juniper and interior chaparral woodlands was investigated. This herbicide is widely used in the southwest to control a variety of woody plants. The picloram was lost by normal flow actions such as the mixing of fast- and slow-moving water, and the interchange of surface and subsurface water in gravel and sand beds. The herbicide was injected at a concentration of 6.26 ppmw. It was detected in the following amounts in the stream: 0.943 ppmw at 0.8 km, 0.316 ppmw at 1.6 km, 0.014 ppmw at 3.2 km, 0.001 ppmw at 6.4 km, and none further downstream. Photodegradation tests were also performed, and sunlight decomposed 57% of the picloram after 8.8 hr of sunlight exposure. Little herbicide damage was observed on the day following injection, although algae growth may have been limited by the herbicide. (Small-FRC)
W82-00212

EVALUATION OF THE OVERLAND RUNOFF MODE OF LAND WASTEWATER TREATMENT FOR VIRUS REMOVAL,
Army Medical Bioengineering Research and Development Lab., Fort Detrick, MD.
S. A. Schaub, K. F. Kenyon, B. Bledsoe, and R. E. Thomas.
Applied and Environmental Microbiology, Vol 39, No 1, p 127-134, January, 1980. 3 Fig, 4 Tab, 12 Ref.

Descriptors: *Viruses, *Wastewater, Land disposal, Runoff, *Overland flow, Primary sludge, Sludge, Secondary wastewater, Advanced wastewater treatment, Bacteria, Bacteriophage, Adsorption, Poliovirus.

This study was conducted on an overland runoff treatment system in Ada, Oklahoma. The system and treatability parameters here were well characterized, and the raw and primary and secondary treated wastewater applied could be examined in identical soils, application regimes, and climatological conditions. Raw, primary, and secondary treated wastewaters were sprayed onto grass-covered 36 meter soil plots of fine sandy loam overlying an impermeable clay subsoil. Tracer bacteriophage f2 was seeded into the applied wastewaters, which were subsequently sampled at several points along the length of the plots. Assay of effluent samples revealed modest tracer virus removals of 30 to 60%. Data from timed experiments indicated that advancement of tracer virus to the bottom of the slopes proceeded at the same rate as wastewater, reaching the plot effluents within 50 to 90 minutes after application. Indigenous enteric virus levels were reduced by about 68 to 85% during migration down the treatment slopes. Soil sampling revealed that, although some f2 virus was found associated with the wastewater-saturated topsoil, little penetration of virus into the soil occurred. Lab soil adsorption studies revealed that poliovirus I was adsorbed much more readily than f2 virus. Comparison of virus removal during overland runoff with chemical removal of wastewater did not reveal any obvious correlations that could be used to predict virus removal. (Baker-FRC)
W82-00220

STAPHYLOCOCCUS AUREUS IN RURAL DRINKING WATER,
Oregon State Univ., Corvallis. Dept. of Microbiology.
M. W. LeChevallier, and R. J. Seidler.
Applied and Environmental Microbiology, Vol 39, No 4, p 739-742, April, 1980. 3 Tab, 23 Ref.

Descriptors: *Staphylococcus aureus, *Drinking water, *Rural areas, Well water, Water pollution sources, Plumbing, Chlorination, Water pollution prevention, Public health.

Coagulase-positive Staphylococcus aureus was isolated from over 6% of 320 drinking water specimen during routine monitoring of drinking water quality. Coliforms were detected in 49 of the samples. Only five times were coliforms and S. aureus detected simultaneously. Samples were collected from three points in household water systems to determine the source of S. aureus. Faucet screens were the most common reservoir of the highest S. aureus cell densities. Frequent cleaning of faucet screens, flushing of storage tanks, and, in cases of severe contamination, intermittent chlorination of rural water supplies would help eliminate various contaminants including S. aureus from domestic water supplies. This could lower the possibility of waterborne illness in rural water supplies. Well water was the most common water source in the study. (Small-FRC)
W82-00223

DISTRIBUTION AND TRANSPORT OF HEAVY METALS IN THE SEDIMENTS OF A SMALL NORTHERN EUTROPHIC LAKE,
Alberta Environmental Center, Vegreville.
J. W. Moore.
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 6, p 828-833, 1980. 3 Tab, 15 Ref.

Descriptors: *Heavy metals, *Lake sediments, *Mine wastes, Metals, Mercury, Copper, Zinc, Arsenic, Strontium, Titanium, Chromium, Lead, Gold, Organic matter, Lakes, Path of pollutants, Sediments, Tailings, Water quality, Sorption, Distribution patterns.

Concentrations of heavy metals were measured in the sediments of a small, eutrophic lake, which received waste discharges from a gold mine between 1941 and 1949. Tailings in Thompsons Lake, Canadian Northwest Territories, contained an average of 190 micrograms per kg Hg, 57 mg per kg Cu, 93 mg per kg Pb, 100 mg per kg Zn, and 2100 mg per kg Ti. Cr, Sr, and As levels in tailings were much lower. In the sediments, Hg was high (440 micrograms per kg) nearest the mine and decreased with increasing distance away from the mine. Cu and Sr concentrations behaved similarly. Concentrations of Zn, Ti, As, Cr, and Pb in lake sediments were lower than in tailings; for all but Zn and As, the concentrations decreased at distances further from the mine. Evidently, tailings have not yet spread evenly throughout the lake, although the last wastes were deposited 30 years ago. Levels of Hg in water were generally less

than 0.2 mg per cu meter, with values of 2.5 and 0.5 mg per cu meter next to the mine. Concentrations of metals were strongly correlated with one another, indicating that the metals tend to move together. Organic matter in the sediment was 20-37% dry weight near the mine, 62-81% at 0.2 to 1.0 km from the mine, 65-87% at 1.1-2.0 km, and 68-91% at 2.1-3.0 km. There was a strong negative correlation between organic content and all metals but arsenic. (Cassar-FRC)
W82-00235

REDUCTION, METHYLATION, AND INCORPORATION OF ARSENIC INTO LIPIDS BY THE MARINE PHYTOPLANKTON DUNALIELLA TERTIOLECTA,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Marine Ecology Lab.
J. J. Wrench, and R. F. Addison.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 5, p 518-523, May, 1981. 4 Fig, 23 Ref.

Descriptors: *Arsenic compounds, *Lipids, *Phytoplankton, Dunaliella, Metabolism, Algae, Fate of pollutants, Marine algae, Arsenic.

The chemical forms of arsenic present in marine organisms affect its toxicity. This study is concerned with the reactions only within the first 45 min of exposure of the unicellular marine phytoplankton Dunaliella tertiolecta to As74 labeled arsenate. The algal cells synthesized three polar arsenic metabolites--arsenite, monomethylarsonic acid, and dimethylarsinic acid--and three arsenolipids. A large fraction of the assimilated As appeared in the lipid fraction. Equilibrium of the arsenic metabolites was approached within 30 min of exposure. Two of the arsenolipids were labile in acid solution, producing arsenite as a primary acid hydrolysis product. Acid-labile arsenolipid 1 was hydrolyzed by phospholipase D and was similar chromatographically to a product synthesized from phosphadityl inositol and arsenite. Arsenolipid 2, also an arsenite complex, was categorized as a neutral or zwitterionic glycolipid. Arsenolipid 3, stable on silicic acid columns and not an arsenite, also appeared to be a glycolipid. (Cassar-FRC)
W82-00239

POLLUTION FROM LAND RUNOFF,
Great Lakes Basin Commission, Ann Arbor, MI.
W. C. Sonzogni, G. Chesters, D. R. Coote, D. N. Jeffs, and J. C. Konrad.
Environmental Science and Technology, Vol 14, No 2, p 148-153, February, 1980. 1 Fig, 2 Tab, 4 Ref.

Descriptors: *Runoff, *Water pollution sources, Lakes, Great Lakes, Agricultural chemicals, Phosphorus, Land use, Chlorides, Municipal wastes, Climates, *Nonpoint pollution sources.

Nonpoint sources of pollution affecting the Great Lakes were identified and the causes cited. Practical remedial measures were considered. Eight areas, representing the full range of land use activities in the basin, were selected for detailed study. Land factors, such as land form, land use intensity, and materials usage, were found to be necessary for inclusion along with general land use when an area is evaluated as a nonpoint pollution source. Land form characteristics include soil texture, soil type, surficial geology, physiography, and soil chemistry. Land use intensity, or degree to which land is developed, has a major impact on water quality. Any land practice that exposes soil to the erosive forces of rainfall and runoff represents an erosion and pollution hazard. High chloride levels were often found along transportation corridors as a result of highway deicing operations and other activities. A number of materials are applied to land in the Great Lakes region, one of the most influential being fertilizers and other agricultural chemicals. Pesticide residues may be carried in the runoff waters. Among the pesticides detected in the study of the Great Lakes were atrazine, simazine, DDT, dieldrin, endosulfan, lindane, endrin, and heptachlor. Guthion, though heavily applied in orchards and found in runoff water, decomposes rapidly. (Baker-FRC)
W82-00253

MODELING THE RELATIONSHIP BETWEEN DEVELOPMENT AND STORM WATER AND NUTRIENT RUNOFF,
Louisiana State Univ., Baton Rouge. Coastal Ecology Lab.
For primary bibliographic entry see Field 2A.
W82-00260

CONCENTRATION AND SIZE OF ASBESTOS IN WATER SUPPLIES,
Health Effects Research Lab., Cincinnati, OH.
J. R. Millette, P. J. Clark, M. F. Pansing, and J. D. Twyman.
Environmental Health Perspectives, Vol 34, p 13-25, February 1980. 6 Tab, 25 Ref.

Descriptors: *Drinking water, *Asbestos, Pipes, Natural waters, Storms, Potable water, Erosion, Industrial wastes, Stream discharge.

Evidence is presented which suggests that asbestos is a significant contaminant in a number of water supplies in the United States. Chrysotile, a serpentine mineral, is the most common asbestos variety found in water supplies, but some amphiboles have also been identified. The amphibole crocidolite has been found in some waters distributed through asbestos cement pipe. Amphibole fibers in Lake Superior have been primarily of the cummingtonite-grunerite series, of which amosite, a commercial asbestos, is a member. Amphiboles of the tremolite-actinolite series were found in the Pacific Northwest drinking water supplies. No fibers of anthrophyllite have been reported. Filtration and coagulation can control asbestos fibers. To provide fiber size distribution data on asbestos in drinking water, only direct transfer preparation methods with transmission electron microscopy are used. Available data on asbestos concentrations in United States water supplies as determined by transmission electron microscopy are tabulated. In natural water systems the weather plays an important part in varying the concentration of asbestos fibers in water over time. The erosion of natural serpentine rock and of asbestos waste piles undoubtedly increases or decreases depending on rainfall and stream flow. Current data suggests that the consumer is not exposed to constant concentrations of asbestos fibers above one million per liter in most cases. Fibers contributed by natural erosion are generally shorter than those contributed by asbestos cement pipe. (Baker-FRC)
W82-00262

PREDICTIONS FOR PARTICLE DEPOSITION ON NATURAL WATERS,
Battelle Pacific Northwest Labs., Richland, WA.
S. A. Slinn, and W. G. N. Slinn.
Atmospheric Environment, Vol 14, No 9, p 1013-1016, 1980. 2 Fig, 16 Ref.

Descriptors: *Deposition rates, *Aerosols, *Air-water interfaces, Air pollution, Natural waters, Turbulence, Particle size, Wind, Model studies, Fate of pollutants.

A simple model is presented for investigating the influence of particle growth on particle deposition on natural waters. If particle growth by water vapor condensation occurs in the humid region adjacent to the air-water interface, then the deposition velocity for particles with dry radii of 1 micrometer is independent of particle size and equal to the limiting value set by atmospheric turbulence. A formula for calculating deposition velocity is given. (Cassar-FRC)
W82-00264

A COMPARISON OF NITROGEN IN SHALLOW GROUND WATER FROM SEWERED AND UNSEWERED AREAS, NASSAU COUNTY, NEW YORK, FROM 1952 THROUGH 1976,
Geological Survey, Towson, MD.
B. G. Katz, J. B. Lindner, and S. E. Ragone.
Ground Water, Vol 18, No 6, p 607-616, November-December, 1980. 7 Fig, 5 Tab, 37 Ref.

Descriptors: *Groundwater, *Nitrogen, *Hydrogeology, *Landfills, *Streams, Sewage treatment, Leachate, Water quality, Ammonium, Toxicity, Management planning, Water sampling, Precipitation, Soil water, Water table, *Nassau County, New York.

Median nitrogen concentrations of groundwater and water from streams in Nassau County, New York were statistically analyzed on an areal and temporal basis and by individual well to compare concentrations of nitrogen in ground water beneath sewered and unsewered areas. The predominant contributions of nitrogen in groundwater in 1976 were from nonpoint sources such as cesspool effluents and domestic fertilizers. Other significant sources are exfiltration from sewers, rainfall, overland runoff to recharge basins, agricultural fertilizers, animal wastes, landfills, and sewage-treatment plants. Extensive future monitoring is necessary to account for the lack of a significant difference between nitrate concentrations of sewered and unsewered areas. (Titus-FRC)
W82-00277

AN EVALUATION OF SOURCES OF NITROGEN AS CAUSES OF GROUND-WATER CONTAMINATION IN NASSAU COUNTY, LONG ISLAND,
Cornell Univ., Ithaca, NY. Center for Environmental Research.
K. S. Porter.
Ground Water, Vol 18, No 6, p 617-625, November-December, 1980. 7 Fig, 4 Tab, 35 Ref.

Descriptors: *Groundwater, *Nitrogen, *Hydrogeology, *Landfills, *Streams, Sewage treatment, Leachate, Water quality, Ammonium, Toxicity, Management planning, Water sampling, Precipitation, Soil moisture, Water table, *Nassau County, New York.

The sources of nitrogen in Nassau County and their relative magnitudes, obtained from routine surveys, are evaluated. Two principal sources of nitrogen are human waste water and fertilized turf. The partial concentrations produced by fertilizers are sufficiently high, relative to those produced by human waste water, to produce considerable masking of the effects of sewerage. This masking will be compounded when additional sources such as precipitation and domestic animals are also included. Because of this, management of one source may not be effective. Management of water pollution sources other than sewerage should be considered. (Titus-FRC)
W82-00279

NATURAL ABUNDANCES OF 15N AS A SOURCE INDICATOR FOR NEAR-SHORE MARINE SEDIMENTARY AND DISSOLVED NITROGEN,
California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics.
R. E. Sweeney, and I. R. Kaplan.
Marine Chemistry, Vol 9, No 2, p 81-94, April, 1980. 7 Fig, 4 Tab, 28 Ref.

Descriptors: *Marine sediments, *Nitrogen, *Isotope studies, Sediments, Coastal waters, Organic matter, Water pollution sources, Ammonium, *Santa Barbara basin, California.

Delta nitrogen-15 (15N) values for total nitrogen and dissolved ammonium were measured in Santa Barbara Basin sediment to determine the sources of nitrogen in marine sediments. Organic matter originating in the euphotic zone of the ocean may have a distinctive nitrogen isotope composition when compared to organic matter originating in terrestrial soils. Nitrogen isotope ratios were measured for 42 sediment samples of total nitrogen and 38 dissolved pore-water ammonium samples from Santa Barbara Basin sediment cores. Delta-15N values ranged from 2.89 to 9.4%, with a mean of 6.8% while pore water ammonium values ranged from 8.2 to 12.4% with a mean of 10.2%. The dissolved ammonium in the pore water is thought to be produced by bacterial degradation of marine organic matter. The isotopic ratio for terrestrially derived nitrogen is about 2%, and for marine derived is about 10%. (Small-FRC)
W82-00283

VIRAL TRANSPORT THROUGH SOIL COLUMNS UNDER CONDITIONS OF SATURATED FLOW,
Texas Univ. Center for Applied Research and Technology at San Antonio.
S. W. Funderburg, B. E. Moore, B. P. Sagik, and C. A. Sorber.
Water Research, Vol 15, No 6, p 703-711, 1981. 1 Fig, 5 Tab, 22 Ref.

Descriptors: *Viruses, *Soil types, *Adsorption, *Land disposal, Wastewater disposal, Path of pollutants, Fate of pollutants, Saturated flow, Organic matter, Cation exchange, Clays, Loam.

Movement of poliovirus 1, reovirus 3, and bacteriophage OX174 was studied in eight soils with a wide range of properties--cation exchange capacity, organic carbon content, pH 5.7-8.3, silt and clay content, bulk density, and specific surface area. Soils were sampled to a depth of 100 cm and packed into cylinders 10 cm in diameter, each containing one-third of the soil profile length. Columns were flooded with wastewater-virus mixture followed by distilled water for five complete cycles. Virus elution was cyclical. Total number of virus eluted was affected by differences in soil properties. Poliovirus retention in the soil was greatest in soils with high cation exchange capacity values, low organic matter and clay content. OX174 retention was greatest in soils with high organic carbon, high residence time in combination with low soil pH or percent clay. Cation exchange capacity in combination with either soil pH or specific surface area were important in reovirus retention. In general, agricultural type soils were most suitable for adsorbing enteric viruses from land-applied wastewater. (Cassar-FRC)
W82-00295

DEPOSITION OF HEAVY ELEMENTS ON BELGIAN AGRICULTURAL SOILS,
Laboratoire de Chimie Inorganique et Nucleaire, Louvain (Belgium).
J-L. Navarre, C. Ronneau, and P. Priest.
Water, Air, and Soil Pollution, Vol 14, p 207-213, 1980. 1 Fig, 2 Tab, 21 Ref.

Descriptors: *Soil contamination, *Heavy metals, Metals, Fertilizers, Agriculture, *Belgium, Path of pollutants, *Agricultural chemicals, Farms, Air pollution, Water pollution sources, Precipitation, Rainfall, Deposition, Fallout.

Wet plus dry deposition processes contributed more heavy metals to Belgian agricultural soils than did chemical fertilizers. Sampling was conducted for one year in 19 purely rural sites as far removed as possible from obvious contamination sources: chimneys, roads, etc. Metals clearly attributable to human origin were Zn, As, Se, Hg, Pb, Cd, and Sb. The sea atmosphere was responsible for the higher levels of Zn (from corroded roofing), Br, and Na found at seaside sites. Certain other metals reached higher levels near factories emitting these materials. Cd, Cr, and Ba were relatively uniform throughout the country. (Cassar-FRC)
W82-00306

DISTRIBUTION OF OBLIGATELY OLIGOTROPHIC BACTERIA IN LAKE BIWA,
Kyoto Univ. (Japan). Dept. of Fisheries.
For primary bibliographic entry see Field 5A.
W82-00346

BEHAVIOR OF DDT, KEPONE, AND PERMETHRIN IN SEDIMENT-WATER SYSTEMS UNDER DIFFERENT OXIDATION-REDUCTION AND PH CONDITIONS,
Louisiana State Univ., Baton Rouge.
R. P. Gambrell, C. N. Reddy, V. Collard, G. Green, and W. H. Patrick, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-213266, Price codes: A06 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S3-81-038, July 1981. 3 p.

Descriptors: *Pesticide residues, *DDT, *Kepone, *Permethrin, *Hydrogen ion concentration, *Redox potential, Sediments, Soil types, Aerobic conditions, Anaerobic conditions, Degradation, Chlorinated hydrocarbons.

The effects of physicochemical conditons on the persistence of pesticide residues were investigated to improve prediction of the fate and potential impacts of residues in various environmental compartments. Three pH levels, ranging from moderately acidic to mildly alkaline, were studied for each compound. Four redox potentials(-150,50,250, and 450 mv) ranging from strongly reduced (anaerobic) to well oxidized (aerobic) were studied. The insecticide-substrate combinations included in the project were DDT in a Mobile Bay (Mobile, Alabama) sediment material, Kepone in the sediment material of a tributary of the James River (Hopewell, Virginia) and Permethrin in an Olivier soil material (Baton Rouge, Louisiana). Sample aliquots were removed from the laboratory microcosms to determine the recovery of the added compounds with time. A substantial redox potential effect was noted for DDT where recovery decreased from the spiking level of around 25 ppm to less than 10% of the spiking level for DDT where recovery decreased from the spiking level of around 25 ppm to less than 10% of the spiking level n). A less rapid loss of DDT was noted at 50 mv (moderately reduced condition), but the pesticide appeared stable under better oxidized conditions during the 45-day incubations. The levels of Kepone recovered did not change appreciably during 56 days of incubation under any of the combination of imposed pH and redox potential conditions. The recovery of Permethrin was affected by both pH and redox potential conditions over 25-day incubations. Unlike DDT, Permethrin was lost more rapidly under oxidizing conditions. Increasing pH enhanced the loss of this compound over the range of redox potential levels studied. (Brambley-SRC)
W82-00382

ASSESSMENT OF OIL SHALE RETORT WASTEWATER TREATMENT AND CONTROL TECHNOLOGY - PHASES I AND II,
Monsanto Research Corp., Dayton, OH.
J. R. Klieve, G. D. Rawlings, and J. R. Hoeflin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-187288, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S7-81-081, May 1981. 5 p, 3 Fig.

Descriptors: *Oil shale, *Wastewater treatment, *Water pollution sources, *Wastewater composition, *Water reuse, Mine drainage, Leachates, Trace metals, Organic compounds, Dissolved solids.

Phases I and II of a five-phase project comprise surveys of literature and other information sources to obtain data on oil shale retorting technologies, wastewater sources and characteristics, potential wastewater uses, and potentially applicable treatment technologies. In-situ oil shale retorting is the source of three waste streams - mine water, retort water, and gas condensate - and surface retorting also produces three waste streams - gas condensate, product water, and spent shale pile leachate. Mine water is known to contain high levels of alkalinity, COD, chloride, fluoride, sulfate, boron and sodium, and significant trace metals. Retort wastewater and product wastewater contain high levels of most pollutants identified. Gas condensates contain high levels of ammonia, alkalinity, and organics, but lower levels of trace metals than the retort wastes. High levels of organics, TDS, sulfate and sodium have been found in spent shale pile leachate. Research on treatment of these waste streams has shown that a number of treatments are possible, depending on the intended use of the treated water, but that the research has generally been small-scale, and that there are significant unresearched areas. (Brambley-SRC)
W82-00390

HUMAN USE IN A DISPERSED RECREATION AREA AND ITS EFFECT ON WATER QUALITY,
Pacific Northwest Forest and Range Experiment Station, Seattle, WA.
H. H. Christensen, R. E. Pacha, K. J. Varness, and R. F. Lapen.
In: Recreational Impact on Wildlands Conference Proceedings, October 27-29, 1978, Seattle, Washington. Forest Service, Pacific Northwest Region, Portland, Oregon, 1979. p 107-119, 1 Fig, 4 Tab, 38 Ref.

Descriptors: Wilderness areas, *Recreation, *Camping, *Water quality, *Recreation wastes, *Environmental effects, Camp sites, Coliforms, Human wastes, Feces, Water pollution sources, Rainfall.

Potential problems are associated with increases in dispersed outdoor recreation. This study was conducted to determine the effects camping, style of camping, self-contained parties, human waste disposal, and rain have on water quality. Two camping sites were selected, one downstream from the other, in the Greenwater watershed, Washington. The campsites were close to the water, with high frequency and heavy concentration of human use, and had no formal, sanitary facilities, and were studied from May 1975 - July 1976. Few vehicles with self-contained toilets were used so most human waste was deposited on the ground around the sites. Total coliforms at the upstream site ranged from 2-6/100 ml and 2-14/100 ml at the downstream site, well within the range for general recreation and esthetic enjoyment but above the acceptable level for drinking water. The higher levels were associated with the weekend when more campers were present. The coliform counts were not lower when self-contained vehicles were present. The bacteria were rapidly transmitted to the river water, even in dry periods. Site differences could play a part in the differences observed, and there is a dilution factor involved at the downstream site. (Brambley-SRC)
W82-00393

WATER IN THE ELIZABETHTOWN AREA - A STUDY OF LIMESTONE TERRANE IN NORTH-CENTRAL KENTUCKY,
Geological Survey, Louisville, KY. Water Resources Div.
T. W. Lambert.
Geological Survey Water-Resources Investigations 79-53 (open-file report) 1979. 81 p, 23 Fig, 4 Plates, 16 Tab, 44 Ref.

Descriptors: *Groundwater, *Surface water, *Water quality, *Limestone, Carbonate rocks, Karst, Aquifers, Wells, Water level, Springs, Groundwater movement, Surface water-groundwater relations, Chemical analysis, Trace elements, Streamflow, Low flow, Floods, Climatic data, *Kentucky, Elizabethtown, Nolin River, *Available water.

An inventory of the water resources of a 240-square-mile area in north-central Kentucky is reported. It includes water distribution, chemical quality, water use, and principles of water occurrence and availability, and references. Nolin River is the only major stream in the area. Two of its tributaries, Valley Creek and North Fork Nolin River, have water withdrawn for public supply by Elizabethtown and Hodgenville. The quality of the water from the streams is typical of a limestone terrane. Ground water is also used for public supplies by Elizabethtown and Hodgenville and by two industrial plants. Many springs have flows of more than 0.25 cubic foot per second. Except for stock water, only three springs serve as a water source. Water from wells and springs is typical of limestone terrane. (USGS)
W82-00413

HYDROGEOLOGIC DATA FOR ROCKY CREEK LANDFILL AND ADJACENT AREA, NORTHWEST HILLSBOROUGH COUNTY, FLORIDA, 1969-73,
Geological Survey, Tallahassee, FL. Water Resources Div.
A. D. Duerr, and J. W. Stewart.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $9.75 in paper

copy, $3.50 in microfiche. Geological Survey Open-File Report 80-1291, 1981. 72 p, 3 Fig, 9 Tab, 4 Ref.

Descriptors: *Geohydrology, *Landfills, Hydrologic data, *Water quality, Waste disposal, Observation wells, Well data, Water level, Lithologic logs, Water analysis, Nitrogen, Phosphorus, Metals, Trace elements, Biochemical oxygen demand, Carbon, Coliforms, *Florida, Hillsborough County, *Leachates, Groundwater pollution.

Well location and construction data are summarized for 222 wells in the Rocky Creek landfill and adjacent area in northwest Hillsborough County. Most of the data are for 92 wells within the immediate vicinity of the landfill. Water-quality data are presented for 78 wells and 9 surface-water sites. Water-level data for 133 wells penetrating the surficial and Floridan aquifers and lithologic logs for 35 wells are also presented. (USGS)
W82-00417

RADIONUCLIDE CONCENTRATIONS IN STREAMS IN THE UPPER BLACKFOOT RIVER BASIN, SOUTHEASTERN IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 5A.
W82-00418

WATER LEVEL DATA FOR WELLS IN AND NEAR BURIAL GROUND 3, OAK RIDGE NATIONAL LABORATORY, TENNESSEE, 1975-1979,
Geological Survey, Knoxville, TN. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-00423

PRELIMINARY EVALUATION OF GROUNDWATER CONTAMINATION BY COAL-TAR DERIVATIVES, ST. LOUIS PARK AREA, MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
M. F. Hult, and M. E. Schoenberg.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $24.25 in paper copy, $19.50 in microfiche. Geological Survey Open-File Report 81-72, January 1981. 57 p, 18 Fig, 6 Plates, 4 Tab, 41 Ref.

Descriptors: Groundwater, *Water quality, *Groundwater pollution, Water pollution sources, Chemical wastes, Aquifers, Glacial drift, Bedrock, Geohydrology, Aquifer characteristics, Wells, Water level fluctuations, Withdrawal, Groundwater movement, Flow rates, Path of pollutants, Infiltration, Chemical analysis, *Minnesota, St. Louis Park, *Coal-tar derivatives, Industrial wastewater.

Operation of a coal-tar distillation and wood preserving plant for 1918-72 in St. Louis Park, Minnesota, resulted in ground-water contamination. This report presents the results of the first year (1979) of an ongoing study. By 1932, water in the Prairie du Chien-Jordan aquifer, the region's major source of ground water, was contaminated 3,500 feet from the plant. The hydraulic characteristics of the Prairie du Chien-Jordan aquifer, its long contamination history, and fluctuating pumpage combine to creat a complex distribution of coal-tar derivatives observed in the aquifer. The Prairie du Chien-Jordan aquifer underlies the area at depths of 250 to 500 feet and is overlain by two bedrock aquifers (Platteville and St. Peter), two confining beds (Glenwood and basal part of St. Peter), and 70 to 100 feet of glacial drift. Multiaquifer wells in the area have permitted contaminated water from near-surface aquifers to flow downward into the Prairie du Chien-Jordan aquifer. Flow rates of 20 to 150 gallons per minute from the shallower aquifers into the Prairie du Chien-Jordan aquifer were observed in five wells. In the drift, a hydrocarbon fluid phase is moving vertically downward relative to the aqueous phase. Dissolved constituents in the drift and Platteville aquifer, the uppermost bedrock unit over most of the area, have moved at least 4,000 feet. Low-molecular-weight compounds are moving preferentially through the drift and Platteville aquifer system. (USGS)
W82-00430

ENVIRONMENTAL CONTROL TECHNOLOGY FOR THE FLASH HYDROPYROLYSIS OF COAL,
Brookhaven National Lab., Upton, NY. Process Sciences Div.
For primary bibliographic entry see Field 5D.
W82-00435

COMPARATIVE STUDY ON ORGANIC CONSTITUENTS IN POLLUTED AND UNPOLLUTED INLAND AQUATIC ENVIRONMENTS - I. FEATURES OF HYDROCARBONS FOR POLLUTED AND UNPOLLUTED WATERS,
Tokyo Metropolitan Univ. (Japan). Dept. of Chemistry.
G. Matsumoto, and T. Hanya.
Water Research, Vol 15, No 2, p 217-224, February, 1981. 4 Fig, 3 Tab, 25 Ref.

Descriptors: *Organic compounds, *Water pollution sources, *Industrial wastes, Water pollution, Path of pollutants, Suspended solids, Aquatic environment, Fossil fuels, Pollutant identification, *Japan, Water analysis.

The hydrocarbon constituents of polluted river waters from the Tokyo area and unpolluted water bodies from the Ogasawara Islands were compared. In the river waters from the Tokyo area, n-alkanes with carbon chain lengths of 12 to 36, squalane and unresolved complex mixtures of hydrocarbons (UCMH) were found at levels of 0.026-14, 0.004-1.7, and less than 5-290 micrograms/liter, respectively. In the waters of the Ogasawara Islands, fro, 12-37 carbon compounds were found at levels of 0.042 5o 4.0 micrograms/liter. The presence of squalane, UCMH and even-carbon numbered n-alkanes were associated with artificial hydrocarbon sources such as industrial wastes, fossil fuels and their products. Odd carbon numbered n-alkanes were more predominant in the unpolluted waters, and originated mostly from algae and higher plants. Squalane and UCMH make up the major portion of the n-alkanes identified in the water samples and are associated with particulate matter in both polluted and non-polluted waters. (Geiger-FRC)
W82-00453

ENTERIC BACTERIAL CONCENTRATIONS IN RESERVOIR FEEDER STREAMS: BASEFLOW CHARACTERISTICS AND RESPONSE TO HYDROGRAPH EVENTS,
Leeds Univ. (England). School of Geography.
A. McDonald, and D. Kay.
Water Research, Vol 15, No 8, p 961-968, August, 1981. 4 Fig, 3 Tab, 24 Ref.

Descriptors: *Enteric bacteria, *Coliforms, *Catchment areas, Watersheds, Hydrographs, Water quality, Rainfall, Precipitation, Streams, Path of pollutants, Thruscross Reservoir, England.

The relationship between coliform bacterial concentration and stream hydrology was investigated within two multiple-use Pennine catchments. The River Washburn and the Capelshaw Beck catchments are located on feeder streams to the Thruscross Reservoir in northern England. The first sampling program defined the background diurnal fluctuations, while the second phase defined the bacterial concentration during a total of 11 hydrograph events. During each hydrograph event on Capelshaw Beck an increase in total coliform and E. coli concentrations occurred at statistically significant levels. During the six River Washburn hydrographs, total coliforms increased significantly on five occasions, and E. coli increased significantly on four occasions. E. coli concentration during high flow conditions in both of the streams exceeded guidelines for direct contact recreational activities. The store of organisms may be located in bottom sediments, fecal material along the shore, or soil. It should be noted that management practices which affect the hydrological response of a catchment to rainfall are likely to cause changes in the enteric bacterial concentration of catchment streams. (Small-FRC)
W82-00462

UNDERSTANDING ACID RAIN,
S. Budiansky.
Environmental Science and Technology, Vol 15, No 6, p 623-624, June, 1981.

Descriptors: *Acid rain, *Sampling, *Pollutant identification, Precipitation, Rainfall, Water pollution effects.

Acid rain is a complex phenomenon which involves almost every component of the biosphere. The intensity and effects of acid rain may be affected by varying weather, varying soils, the presence of other pollutants, and species differences. Investigations of the effects of meteorological factors on amounts of chemical wet deposition have identified a number of systematic relationships. Cold fronts and squall lines, thunderstorms, and summer rainfall were all found to be associated with increased concentrations of hydrogen plus ions and sulfates. A considerable proportion of the available data on acid rain, both current and historical, is disjointed and based on inadequate sampling procedures. Much of the data does not include direct measurements of pH. Methods used to measure dry deposition are particularly inadequate, relying on such surrogate collectors as plastic buckets, which are incapable of measuring dry gaseous deposition. Study of the effects of acid rain on individual species often ignores the overall effect of the pollutant on the ecosystem as a whole and the effects of multiple pollutants on an individual species. Also, the amount of acidic material accumulated and absorbed into the soil will be affected by such subsequent events as runoff and snow melts. (Carroll-FRC)
W82-00479

ALKYLPYRIDINES IN SURFACE WATERS, GROUNDWATERS, AND SUBSOILS OF A DRAINAGE LOCATED ADJACENT TO AN OIL SHALE FACILITY,
Battelle Pacific Northwest Lab., Richland, WA.
R. G. Riley, T. R. Garland, K. Shiosaki, D. C. Mann, and R. E. Wildung.
Environmental Science and Technology, Vol 15, No 6, p 697-701, June, 1981. 3 Fig, 1 Tab, 16 Ref.

Descriptors: *Oil shale, *Alkylpyridines, *Hydrocarbons, Organic compounds, Bases, Solutes, Industrial wastes, Subsoil, Groundwater pollution, Surface water, Pollutants, Path of pollutants, Rifle, *Colorado.

Studies were conducted at the Department of Energy's Anvil Points Oil Shale Facility at Rifle, Colorado, to determine the concentration of water-soluble organic compounds in materials disposed of or stored at the site and in surface waters, ground waters, and subsoils above and below the site. Water from seeps and alluvial groundwaters downstream of the retorted shale disposal pile were found to have higher levels of total dissolved organic carbon than those upstream of the pile. Analysis of samples from one seep and one well below the disposal pile which had an odor similar to that of shale oil and retort water showed that alkylpyridines were present in these waters at 30.8 and 4.1 micrograms per milliliter, respectively. Surface waters of the stream below the seep were found to contain trace concentrations of alkylpyridines. Alkylpyridines were not detected in a sample of surface sediment from the stream located adjacent to the seep discharge, but were found with depth in cores of subsoil collected adjacent to the well containing alkylpyridines. While alkylpyridines were detected in retort water and in an aqueous extract of shale oil, they were not detected in aqueous extracts of raw shale, in retorted shale, nor in Prudhoe Bay crude oil. The presence of alkylpyridines in these samples in which such other water-soluble compounds as organic acids and phenols were absent suggests that the alkylpyridines were less subject to sorption on the soil or were more persistent during hydraulic transport. These compounds may be unique to shale oils,

UNIV. OF ILL. URBANA-CHAMPAIGN

perhaps allowing their use as diagnostic indicators of water in contact with shale oils at sites of oil shale production and processing. (Carroll-FRC)
W82-00481

INCIDENCE OF VIBRIO ALGINOLYTICUS AND BACTERIA OF SANITARY SIGNIFICANCE IN THE BERING SEA,
Food and Drug Administration, Seattle, WA.
For primary bibliographic entry see Field 5A.
W82-00490

MICROPLATE TECHNIQUE FOR DETERMINING ACCUMULATION OF METALS BY ALGAE,
Syracuse Univ., NY. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W82-00492

EFFECTS OF MOISTURE CONTENT ON LONG-TERM SURVIVAL AND REGROWTH OF BACTERIA IN WASTEWATER SLUDGE,
BDM Corp., Albuquerque, NM.
For primary bibliographic entry see Field 5E.
W82-00493

SURVIVAL OF ENTEROVIRUSES IN RAPID-INFILTRATION BASINS DURING THE LAND APPLICATION OF WASTEWATER,
Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
For primary bibliographic entry see Field 5D.
W82-00496

TOXICITY AND ECOLOGICAL SIGNIFICANCE OF TRACE ELEMENTS IN AQUATIC ENVIRONMENTS,
Tennessee Univ., Knoxville.
E. V. Kalmaz.
Journal of Environmental Sciences, Vol 23, No 5, p 24-27, September/October, 1980. 1 Fig, 25 Ref.

Descriptors: *Toxicity, *Trace metals, *Contamination, *Water pollution, *Bioaccumulation, *Organic compounds, Stream pollution, Metals, Aquatic animals, Fish physiology, Food chains, Adsorption, Uptake, Ecosystems, Aquatic environment, Ecological effects.

The ecological signficance of trace elements in aquatic environments is discussed. To develop models for predicting the behavior of trace elements in aquatic systems, it is necessary to distinguish the various forms of chemical and physical states, such as solubility, adsorption capability, particle size, reactivity with other compounds and complex formation. Such characteristics determine the elements' availability to aquatic animals and plants. Sediment is a major source and sink for most trace elements. However, trace element concentrations vary over time and on a macro- and microgeographic scale. Bioconcentration factors tend to be higher for trace elements complexed with organic compounds and higher in aquatic than terrestrial systems. The present technology is not sufficient to quickly, inexpensively, and conclusively seek out a particular element, predict the effects of various dose levels and understand its behavior in aquatic environments. (Titus-FRC)
W82-00498

5C. Effects Of Pollution

TOXICITY OF MOUNT ST. HELENS ASH LEACHATE TO A BLUE-GREEN ALGA,
Geological Survey, Lakewood, CO. Water Resources Div.
D. M. McKnight, G. L. Feder, and E. A. Stiles.
Available from Branch of Distr., USGS, 604 Pickett St. Alexandria, VA 22304. Geological Survey Circular 850-F, 1981. 14 p, 6 Fig, 4 Tab, 9 Ref.

Descriptors: *Toxicity, *Cyanophyta, *Volcanoes, *Leachates, Algal toxins, Bioassay, Lakes, Organic compounds, Dissolved solids, Trace metals, Water quality, Chemical analysis, Water pollution effects, *Washington, *Mount St. Helens, Richland, Moses Lakes, *Volcanic ash.

This report describes laboratory studies with volcanic ash intended to aid the assessment of the possible effects of ash presence on the blue-green algal populations in lakes. Bioassays using leachate from volcanic ash of the May 18, 1980, eruption of Mount St. Helens, Wash., indicate that leachate derived from ash collected at Richland, Washington, is toxic to the blue-green alga Anabaena flos-aquae, whereas leachate from ash collected at Moses Lake, Wash., is not. The difference in the toxicity of the two leachates may be attributable to differences in concentration of cationic-exchangeable, dissolved, organic compounds. Seventeen percent of the dissolved organic carbon from the leachate from ash collected at Richland was retained on a cation-exchange column, whereas only six percent of the dissolved organic carbon from the leachate from ash collected at Moses Lake was retained. Anabaena flos-aquae cultures spiked with dilutions of 1 to 250 of leachate derived from volcanic ash collected at Richland showed toxic effects, whereas cultures spiked with a 1 to 25 dilution of leachate derived from ash collected at Moses Lake showed no toxic effects. The toxic components of the volcanic ash are nonuniformly distributed over the ash fall area. Preliminary data indicate that the toxic components may belong to one or more of the following classes of substances: (1) cationic organic compounds such as amines; (2) highly hydrophobic (sparingly soluble) organic compounds such as phenols that interact with and are retained by the cation-exchange-resin matrix; or (3) metal-organic complexes that are retained by interaction of the metal with the cation-exchange resin. (USGS)
W82-00001

EFFECTS OF THE MOUNT ST. HELENS ERUPTION ON THE BENTHIC FAUNA OF THE TOUTLE RIVER, MUDDY RIVER, AND PINE CREEK DRAINAGE BASINS, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
L. A. Fuste.
Available from the Branch of Distr., USGS, 604 Pickett St. Alexandria, VA 22304. Geological Survey Circular 850-H, 1981. 13 p, 3 Fig, 5 Tab, 6 Ref.

Descriptors: *Benthic fauna, *Volcanoes, *Ecosystems, Streams, Lakes, Sampling, Aquatic insects, Mayflies, Midges, Invertebrates, Aquatic habitats, *Washington, *Mount St. Helens, Toutle River, Muddy River, Pine Creek, Volcanic ash, *Ecological effects, *Surface water.

Benthic invertebrate samples were collected in the Toutle River, Muddy River, and Pine Creek drainage basins on March 28-30, 1980, to document pre-eruption conditions in watersheds surrounding Mount St. Helens in the event of a major eruption. A highly diverse fauna was present at all sampling sites. Mayfly and midge (chironomid) larvae were the most numerous organisms. An attempt was made to classify the streams studied according to the functional role of organisms in the processing of organic matter. It was hypothesized that many of the organisms exhibiting multiple functional roles in processing of organic matter were predominantly detritovores. This classification was then compared to a conceptual stream ecosystem model. The volcanic eruption of May 18 destroyed most, if not all, of the benthic fauna present at the sites sampled. The cataclysmic events that took place during the explosion modified the topography to the point of eliminating some of the watersheds, while in others the riparian vegetation was scoured out, along with the natural substrate of the streams. The potential for recolonization of stream benthos appears to be relatively high because of the creation of new habitats near backwaters and pools from springs which were exposed by the scouring action of the mudflows. It is believed that these 'seed habitats,' in conjunction with downstream drift from unaffected tributaries and aerial oviposition by winged adults of aquatic insects, will be the principal sources of stream benthos for the affected streams in the coming years. (USGS)
W82-00005

EFFECTS OF MOUNT ST. HELENS ERUPTION ON SELECTED LAKES IN WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2H.
W82-00006

RECONNAISSANCE OF THE EFFECT OF LANDFILL LEACHATE ON THE WATER QUALITY OF MARSHALL BROOK, SOUTHWEST HARBOR, HANCOCK COUNTY, MAINE,
Geological Survey, Boston, MA. Water Resources Div.
B. P. Hansen.
Geological Survey Open-File Report 80-1120, 1980. 13 p, 3 Fig, 5 Tab, 14 Ref.

Descriptors: *Landfills, *Leachates, *Water quality, Surveys, Water pollution sources, Path of pollutants, Ammonia, Dissolved oxygen, Benthos, Specific conductivity, Chemical analysis, *Maine, *Marshall Brook, Southwest Harbor, Hancock County.

This report presents the results of a reconnaissance of surface-water quality in the Marshall Brook basin in Southwest Harbor, Maine. A small stream (2.2-square-mile drainage area) receiving leachate from a landfill was studied from August through November 1979 to determine the impact of the leachate on water quality. The presence of unionized ammonia, considered toxic to some aquatic vertebrates, was indicated in samples taken from sections of the stream affected by leachate. Some dissolved oxygen values did not meet the criteria for the protection of aquatic life. Many other dissolved constituents were present in elevated concentrations in the leachate-influenced reaches of the stream. Flow-data comparisons indicate that streamflow less than that observed will occur approximately 20% of the time. Leachate-affected stream conditions may deteriorate further during such low streamflow. Several areas with the potential for large sediment yields are present in the basin. (USGS)
W82-00013

WATER QUALITY MANAGEMENT STUDIES, LAKE SEMINOLE, APRIL-NOVEMBER 1978.
Corps of Engineers, Mobile, AL. Mobile District.
For primary bibliographic entry see Field 6G.
W82-00051

ASSESSMENT OF 1978 WATER QUALITY CONDITIONS IN THE UPPER POTOMAC ESTUARY,
Environmental Protection Agency, Annapolis, MD. Annapolis Field Office.
L. J. Clark, S. E. Roesch, and M. M. Bray.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-212228, Price codes: A06 in paper copy, A01 in microfiche. Report EPA-903/9-80-002, March 1980. 102 p, 30 Fig, 12 Tab, 8 Ref, Append.

Descriptors: *Water quality, *Estuarine environment, *Water pollution effects, *Algal growth, Nitrogen, Phosphorus, Nutrients, Eutrophication, Dissolved oxygen, Effluents, Mathematical models, Chlorophyll a, Urban areas, Estuaries, *Potomac River estuary, District of Columbia area.

The challenge to improve the Potomac Estuary through reduction of point source pollutant loadings necessitates the periodic collection of field data to assess trends and the scope of existing water quality stresses. Ongoing efforts to improve and refine predictive mathematical models impose another need for extensive water quality information. The second successive intensive monitoring program in the Potomac Estuary was performed during the period July to September 1978. This program consisted of three distinct elements: slack tide sampling over a 65 mile reach of the upper estuary; sampling of the effluents at the eight major wastewater treatment plants in the Washington Metropolitan Area; and special field and labora-

tory studies which addressed specific aspects of the dissolved oxygen budget for mathematical modelling purposes as well as the chronic problem of eutrophication. The 1977 study occurred under low flows whereas the summer of 1978 was characterized by higher and more erratic flows, which were a major driving force in terms of water quality behavior. Comparing the 1977 and 1978 ambient N:P ratio data reveals that their rate of spatial decline, or the tendency for nitrogen to rate limit algal biomass production, appears to be a function of the bloom size as measured by chlorophyll a. Chlorophyll a concentrations in the Potomac during 1978 were low in comparison to 1977 observations and had considerably less variability. In September, blue-green algae comprised approximately 80% of the total population, and 87% of the blue-green population was identified as Pseudanabaena catenata. Blue Plains still constitutes, by far, the largest single point source in the Washington Metropolitan area, accounting for 85% of the BOD5, 77% of the TOC, and 58% of the inorganic PO4. (Moore-SRC)
W82-00052

THE AFTERMATH AT LONGVIEW,
Water Treatment Plant, Longview, WA.
L. E. Coplen.
Water/Engineering and Management, Vol 128, No 5, p 68-71, May, 1981.

Descriptors: *Volcanoes, *Water pollution effects, *Impaired water use, Disasters, Water treatment facilities, Alum, Costs, Suspended solids, Silt load, Temperature effects, Water supply, Longview, Washington, Mount St. Helens, Debris basins.

The effects of the eruption of Mount St. Helens on the Longview, Washington Water Treatment Plant are detailed. The eruption on May 18, 1980 caused logs and debris to clog the Cowlitz River, which is the plant's source of raw water. By Monday morning, May 19, the river water was steaming hot (90 degrees F) and the turbidity was above 70,000 JTU. The river was carrying millions of cubic yards of volcanic ash, pumice, silt, and wood debris. Water could not be treated at the Longview plant, so reservoir supplies were used, and water was also supplied by the nearby city of Kelso. Columbia River water was diverted to the plant from industrial sources. By Thursday the Cowlitz River water appeared treatable. Because the river water was constantly changing, alum feed rates had to be changed. Additional costs were encountered when sedimentation basins and mixing chambers began to fill once a month rather than once a year. Dredges had to work continuously to clean the river out. Also, additional personnel was required to meet increased operating and maintenance needs. (Small-FRC)
W82-00073

AN ANALYSIS OF FACTORS AFFECTING OXYGEN DEPLETION IN THE NEW YORK BIGHT,
Brookhaven National Lab., Upton, NY.
P. G. Falkowski, T. S. Hopkins, and J. J. Walsh.
Journal of Marine Research, Vol 38, No 3, p 479-506, 1980. 14 Fig, 4 Tab, 74 Ref.

Descriptors: *Oxygen, *Aquatic environment, *Organic loading, *Shellfish, Climatology, Carbon, Runoff, Precipitation, Zooplankton, Seasonal variation, Oxygen demand, Coastal waters, Hydrologic data, Water pollution effects, Climate, *Oxygen depletion, *New York Bight.

Historical data extending back to 1910 was analyzed in an attempt to distinguish between man-induced and natural causes of oxygen depletion in the New York Bight. Oxygen depletion is a common feature of areas of restricted flows. A causal chain of events led to the anoxic conditions observed in 1976. A warm winter with large runoff, a low frequency of spring storm events, a deep summer thermocline, persistent southerly winds with few reversals, a large autochthonous carbon load, and low grazing pressure all contributed to anoxia. Calculations suggest that anoxia could have occurred off the New Jersey coast in 1976 without any carbon loading from New York City, and that anoxia in this open shelf system can result from natural physical forcing and biological responses. (Titus-FRC)
W82-00106

AN AQUATIC RESPIROMETER FOR USE IN SUBLETHAL STUDIES,
Environmental Sciences Ltd., Vancouver (British Columbia).
W. S. Duval, R. P. Fink, and G. H. Geen.
Water Research, Vol 15, No 7, p 817-822, July, 1981. 4 Fig.

Descriptors: *Respiration, *Aquatic life, *Sublethal effects, Toxicity, *Toxins, Organic compounds, Respirometers, Oil, Water pollution effects, Fish, Salmon, Oxygen consumption, Bioindicators.

A computer-controlled respirometer system was developed to measure oxygen consumption of marine and fresh water organisms at regular intervals over a period of several days. It can be used to document physiological responses of aquatic organisms during and following exposure to sublethal concentrations of a toxicant. The apparatus consists of systems to supply seawater and toxicant, 5-liter glass respirometer vessels, a dissolved oxygen measurement system, light and temperature monitoring and control systems, and computer hardware and software. Tests conducted for several days on juvenile coho salmon (Oncorhynchus kisutch) showed that exposure to water containing 12.1 ppm aromatic hydrocarbons from a Prudhoe Bay crude oil fraction caused sharp increases in respiration rate at four hours exposure, followed by a return to normal at eight hours and subsequent depression. (Cassar-FRC)
W82-00122

RELATIONSHIP BETWEEN BIOTRANSFORMATION AND THE TOXICITY AND FATE OF XENOBIOTIC CHEMICALS IN FISH,
Medical Coll. of Wisconsin, Milwaukee. Dept. of Pharmacology and Toxicology.
J. J. Lech, and J. R. Bend.
Environmental Health Perspectives, Vol 34, p 115-131, February 1980. 10 Fig, 12 Tab, 75 Ref.

Descriptors: *Biotransformation, *Fish, Aquatic animals, Metabolism, Chemicals, Organic compounds, Water pollution, Polychlorinated biphenyls, Bioaccumulation, Toxicity, *Xenobiotic chemicals.

Some of the more recent developments in the study of the behavior of xenobiotic chemicals in aquatic species are reviewed. Specific examples are used to demonstrate the relationship between biotransformation and the toxicity, persistence and bioaccumulation of xenobiotic chemicals in fish. Many of the biotransformation reactions that have been described for xenobiotic substances in mammals have been demonstrated in fish, both in vivo and in vitro. Several of these reactions occur in fish at rates sufficient to exert significant effects on the toxicity and residue dynamics of selected chemicals. The inhibition of these reactions can lead to increased toxicity and bioaccumulation factors for certain chemicals. Several classes of compounds, including some polychlorinated biphenyls, are only metabolized slowly, and their disposition in fish may not be influenced to any great extent by biotransformation. Metabolites of compounds which are biotransformed rapidly may appear in certain fish tissues; in many instances these are not accounted for by conventional residue analysis methods. Microsomal mixed-function oxidases in several species of fish have been demonstrated to be induced by specific polycyclic aromatic hydrocarbons and by exposure of the fish to crude oil. Induction of these enzymes in fish can result in both qualitative and quantitative differences in the metabolic disposition of xenobiotics to which fish are exposed. (Baker-FRC)
W82-00186

TRANSFORMATION OF THE MOUSE CLONAL CELL LINE R846-DP8 BY MISSISSIPPI RIVER, RAW, AND FINISHED WATER SAMPLES FROM SOUTHEASTERN LOUISIANA,
Louisiana State Univ. Medical Center, New Orleans. Dept. of Microbiology.
W. Pelon, T. W. Beasley, and D. E. Lesley.
Environmental Science and Technology, Vol 14, No 6, p 723-726, June, 1980. 1 Fig, 4 Tab, 11 Ref.

Descriptors: *Public health, *Water pollution, *Drinking water, River water, *Raw water, Cultures, Human diseases, Mississippi River, Rivers, Carcinogens, Cell cultures, Organic compounds, Mutagens, Water analysis, *Mississippi.

A total of 118 river water, 70 raw water, and 115 finished water samples were collected over an 18-month period in Mississippi. Cultures of the mouse cell line R846-DP8 were exposed to the water samples. Nineteen of the samples (6%) induced morphological transformation of this cell strain. Transformation was noted with 7 (6%) Mississippi River samples, 7 (10%) raw water samples and 5 (4%) finished water samples. Transformations were not observed in less than four weeks of incubation. It is suggested that the small proportion of water samples which induced cell transformation was probably representative of a larger number which could have induced the changes, but were not detected either because of the limitations imposed by the methods employed or because of the criteria used for transformation. It is suggested that additional studies be made in this area, which could present a major public health problem. (Baker-FRC)
W82-00215

ANAEROBIC METHANE OXIDATION: OCCURRENCE AND ECOLOGY,
Wisconsin Univ.-Madison. Dept. of Bacteriology.
For primary bibliographic entry see Field 2H.
W82-00218

ISOLATION, ENUMERATION, AND CHARACTERIZATION OF AEROMONAS FROM POLLUTED WATERS ENCOUNTERED IN DIVING OPERATIONS,
Maryland Univ., College Park. Dept. of Microbiology.
R. J. Seidler, D. A. Allen, H. Lockman, R. R. Colwell, and S. W. Joseph.
Applied and Environmental Microbiology, Vol 39, No 5, p 1010-1018, May, 1980. 2 Fig, 4 Tab, 33 Ref.

Descriptors: *Rivers, *Aeromonas, Bacteria, *Anacostia River, Sediments, *District of Columbia, Human diseases, Temperature effects, Aeromonas hydrophila, Aeromonas sobria, Water pollution, Seasonal variations, Wastewater, Wastewater outfall.

This study documents the occurrence and seasonal fluctuations of Aeromonas in the Anacostia River in Washington, D. C., where increased incidences of gastroenteritis and wound infections have occurred in personnel undergoing diver training operations throughout the year. The numbers of Aeromonas cells in Anacostia River sediment and water increased during periods of elevated water temperature, to maxima of 400,000 cells per g of sediment and 300 cells per ml of water. Correspondingly, Aeromonas counts dropped 2 to 4 logs as the water temperature decreased to 0 to 0.5 degrees C. Cultures taken by sterile swabs from the ears and face masks of divers after a 30 minute swim yielded bacterial types and numbers similar to those found in the river. The nasal passages of the divers apparently did not become contaminated by swimming, possibly because of the protective effect of the face masks used by the divers. Properties associated with virulence in A. hydrophila and A. sobria strains isolated from the river, sediment, and divers were investigated. Nearly 40% of the strains of both species collected during the study produced cytotoxic activity for mouse Y-1 adrenal cells, as well as elastase. Enterotoxin activity, as detected by the Y-1 assay, was observed in 3% of the strains of A. sobria and in 6% of the A. hydrophila strains. Fluid accumulation in rabbit ileal loops induced by both species of Aeromonas varied greatly among the 17 strains examined.

UNIV. OF ILL. URBANA-CHAMPAIGN

Fluid accumulation of at least 0.4 ml/cm was correlated with positive cytotoxin- or enterotoxin-like response in the Y-1 tissue culture assay. (Baker-FRC)
W82-00224

IMPACT OF CONSTRUCTION OF A HYDROELECTRIC PROJECT ON THE WATER QUALITY OF FIVE LAKES IN NOVA SCOTIA,
Department of the Environment, Halifax (Nova Scotia).
D. M. Kelly, J. K. Underwood, and D. Thirumurthi.
Canadian Journal of Civil Engineering, Vol 7, No 1, p 173-184, 1980. 12 Fig, 3 Tab, 18 Ref.

Descriptors: *Water quality, *Erosion, *Environmental effects, Hydroelectric powerplants, Wreck Cove, *Nova Scotia, Construction, *Reservoir construction, Dam construction, Tunneling, Logging, Forest fires, Road construction, Vegetation effects, Lakes, Baseline studies, Monitoring.

Water quality of five highland lakes was monitored for 2.5 years during the construction of the Wreck Cove hydroelectric project, Nova Scotia, starting in February, 1975. Tunneling, dam construction, reservoir clear-cutting, slashing, burning, and building access roads had a pronounced impact on Surge Lake, and less on the other lakes--Big, Cheticamp, Gisborne, and Long. Ammonia and nitrate-nitrite concentrations in Surge Lake increased 833 and 7300%, respectively, following clear-cutting and initial construction activities; chlorophyll-a decreased by 1825%. Other water quality parameters which increased on the order of 50-450% were turbidity, suspended solids, conductivity, Ca, Mg, Na, K, and total and ortho-P. The following were more extreme in the Surge Lake watershed than in the other watersheds: slopes, intensity and length of construction, clear-cutting and burning, and a forest fire. In addition, soil was more erosive (less clay), and more vegetative cover, including roots, was removed. (Cassar-FRC)
W82-00227

ARE SIERRA LAKES BECOMING ACID,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
G. R. Bradford, A. L. Page, and I. R. Straughan.
California Agriculture, Vol 35, No 5/6, p 6-7, May/June, 1981. 1 Tab.

Descriptors: *Acidic water, *Air pollution, Lakes, Sierra lakes, Hydrogen ion concentration, *Acid rain, Water pollution sources, Sierra Nevada.

Sierra lakes, most of which have little buffering capacity, showed little change in acidity during the last 15 years. Sampling of 170 lakes in 1965 resulted in an average pH of 6.0 (range 4.7 to 7.3). The mean 1980 pH's measured in 114 randomly selected Sierra lakes in July and October were 6.1 and 6.5, respectively. The higher fall pH probably reflects the seasonal effect of increased residence time of the water in the lake and associated buffering by lake sediments. Ten additional lakes where fish kills had occurred had mean pH of 6.6. (Cassar-FRC)
W82-00231

BEHAVIOR OF TRIFLURALIN IN AQUATIC MODEL ECOSYSTEMS,
Environmental Protection Agency, Beltsville, MD. Pesticide Degradation Lab.
R. S. Yockim, A. R. Isensee, and E. A. Walker.
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 1, p 134-141, January, 1980. 5 Tab, 4 Ref.

Descriptors: *Ecosystems, *Pesticides, Trifluralin, Model studies, Ecology, Herbicides, Degradation, Fate of pollutants, *Water pollution effects.

The effects of trifluralin on the aquatic ecosystem were investigated in two different model ecosystems. In the first experiment the recirculating static model ecosystem was used. In the second experiment a continuous dosing system was designed to demonstrate the effect of direct application of trifluralin into the ecosystem. In both experiments organisms were sampled 1, 3, 7, 15, and 30 days after the start of the experiment. In the first experiment the amounts of trifluralin available for accumulation by the organisms depended on the rate of desorption from the soil. In the second, the actual water levels obtained were 0.8, 2.5, and 21.6 ppb in the 1, 10, and 100 ppb treatments, respectively, by day 30. The data indicated extensive variation that can be obtained when using different model ecosystem designs in studying the behavior of pesticides in the aquatic ecosystem. These differences were probably related to the rapid metabolism and degradation of soil-incorporated trifluralin in the first experiment and to the continuous input of trifluralin in the second experiment. A very important difference between the two ecosystems was the toxic effect of trifluralin on the algae and fish during the second experiment. It is concluded that the risks of trifluralin in the aquatic ecosystem are greatest when there is a continuous input of trifluralin. With occasional soil-incorporated input, the degradation processes would minimize the risk. (Baker-FRC)
W82-00233

EFFECT OF ESTUARINE SEDIMENT PH AND OXIDATION-REDUCTION POTENTIAL ON MICROBIAL HYDROCARBON DEGRADATION,
Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.
For primary bibliographic entry see Field 2L.
W82-00243

EFFECTS OF HALOGENATED ORGANIC COMPOUNDS ON PHOTOSYNTHESIS IN ESTUARINE PHYTOPLANKTON,
Environmental Protection Agency, Gulf Breeze, FL. Gulf Breeze Environmental Research Lab.; and Environmental Research Lab., Johns Island, SC. Bears Fluff Field Station.
S. J. Erickson, and C. E. Hawkins.
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 6, p 910-915, 1980. 6 Tab, 13 Ref.

Descriptors: *Estuarine environment, *Phytoplankton, *Chlorinated hydrocarbons, Toxicity, Water pollution effects, *Organic compounds, Cooling water, Photosynthesis, Wastewater treatment, Chlorination, Pentachlorophenol, Pentabromophenol, Phenols.

The effects of 15 organic compounds on photosynthesis in native estuarine phytoplankton were studied in outdoor aquaria. Some of the compounds tested are formed by chlorine biocides in cooling waters. Chloroform, bromoform, ethylene bromide, phenol, 4-bromophenol, and 2,4,6-trichlorophenol at concentrations up to 2.0 mg per liter did not affect C14 uptake by phytoplankton. Trichloroethylene stimulated C14 uptake at 0.5 to 1.0 mg per liter. Tetrachloroethylene inhibited uptake slightly at 2.0 mg per liter. C14 uptake expressed as % of control for concentrations of 0.5 to 2.0 mg per liter of other organic compounds were as follows: 2,4,6-tribromoanisole, 81-76%; 4-chlorophenol, 97-94%; 2,4,6-tribromophenol, 96-89%; pentachlorophenol, 39-2%; and pentabromophenol, 4 to -1%. Further tests with the two most toxic compounds, pentabromophenol and pentachlorophenol, at concentrations of 0.125 to 2.0 mg per liter showed that mixed phytoplankton were more sensitive to the chemicals than four individual phytoplankton cultures. Haloamines produced by metering NaOCl and NH4Cl into the aquaria were more inhibitory than either chemical separately. Chloramine T was not inhibitory to photosynthesis. (Cassar-FRC)
W82-00266

LETHALITY OF A SUSPENDED CLAY TO A DIVERSE SELECTION OF MARINE AND ESTUARINE MACROFAUNA,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
V. A. McFarland, and R. K. Peddicord.
Archives of Environmental Contamination and Toxicology, Vol 9, No 6, p 733-741, 1980. 4 Fig, 3 Tab, 21 Ref.

Descriptors: *Suspended solids, *Kaolinite, Water pollution effects, Suspended load, Silicates, Clay minerals, Invertebrates, Pollutants, Laboratory studies, *Estuaries, *Fauna, Macrofauna, Estuarine environment.

The impact of suspensions of processed kaolinite, a common sheet-silicate clay mineral, on marine and estuarine macrofauna was investigated. The use of kaolinite permitted a study of the lethal effect of suspended particles themselves rather than the combined physical and chemical effects of sediments in various conditions of contamination. The flow-through system of 16 hemispherical 75-L aquaria supplied with kaolin and dilution water at estuarine or oceanic salinity was employed. A wide range of sensitivities was noted. Blue mussels measuring 2.5 cm in length reached 10% mortality after five days. The tunicate Ascidia ceratodes was the most sensitive species tested. In none of the tests could the LC50 value be calculated from the LC20 or LC10 values. There may have been a correlation between normal habitat of the species and sensitivity to suspended kaolin, although no phylogenetic correlations were apparent. No species that restricted itself to soft muddy bottoms was sensitive. All those species that were sensitive to high kaolin concentrations were either invertebrates occurring predominantly on sandy bottoms or in fouling communities, or fish not intimately associated with the bottom. (Baker-FRC)
W82-00268

EVALUATION OF METHODOLOGIES FOR THE DETERMINATION OF ACUTE TOXICITY IN PULP AND PAPER EFFLUENTS,
Institute of Paper Chemistry, Appleton, WI.
For primary bibliographic entry see Field 5A.
W82-00297

PRIORITIZATION OF CHEMICALS ACCORDING TO THE DEGREE OF HAZARD IN THE AQUATIC ENVIRONMENT,
Dow Chemical Co., Midland, MI.
D. R. Branson.
Environmental Health Perspectives, Vol 34, p 133-138, February 1980. 3 Fig, 3 Tab, 15 Ref.

Descriptors: *Water pollution, *Priorities, Hazards, Assessments, Decision making, Planning, Regulations, Standards, Chemical analysis, *Water pollution effects.

As an alternative to arbitrarily listing or delisting chemicals for the purpose of priority control, this paper suggests a promising scientific approach to selecting priority chemicals based on the principles of hazard assessment for chemicals in the aquatic environment. According to the hypothesis employed, the highest priority chemicals are those with the smallest margin of safety, defined as the gap between the no-observable-effect concentrations and the ambient exposure concentrations. The no-observable-effect concentrations are based on the results of chronic or sensitive life stage tests with aquatic organisms and the acceptable daily intake rate for fish eaters. The ambient exposure concentrations are levels either measured in fish and water, or roughly estimated from a simple nomogram that requires only two of the following three factors: environmental release rate, ratio of dissipation to bioconcentration potential, or ambient residues in fish. The chemicals studied to illustrate this approach to prioritizing chemicals are: polychlorinated biphenyls, di-2-ethylhexyl phthalate, linear alkylbenzene sulfonate, and pentachlorophenol. (Baker-FRC)
W82-00300

THE SIGNIFICANCE OF THE SUBMARINE GEOLOGY OF UPPER SPENCER GULF, SOUTH AUSTRALIA, TO ENVIRONMENTAL DECISION-MAKING,
Adelaide Univ. (Australia). Dept. of Geology.
For primary bibliographic entry see Field 2L.
W82-00314

PROJECTED TILE EFFLUENT EFFECTS ON THE OLDMAN RIVER,

Department of Agriculture, Lethbridge (Alberta). Irrigation Div.
D. B. Harker.
Canadian Water Resources Journal, Vol 6, No 2, p 65-75, 1981. 2 Fig, 1 Tab, 8 Ref.

Descriptors: *Water quality, *Tile drainage, Rivers, Oldman River, River flow, Flow, *Effluents, *Alberta.

Possible negative effects that tile effluent might have on the water quality of receiving systems such as the Oldman River were evaluated. The Irrigation Division of Alberta Agriculture conducted a program for three years, 1977-1979, to monitor effluent discharge and chemistries from 20 tile drainage sites. Projections were made concerning the possible effect of tile effluent on the water quality. Extremes in both tile and river flows were considered. Under conditions of average river flow, tile effluent is expected to have a minimal impact on river water quality in the near future. However, during periods of low river flow, future high tile discharges might substantially degrade water quality. The recent government announcement of an intent to build a regulating dam on the Oldman River within ten years may negate low flow conditions. Another alternative would be to direct drainage waters to large evaportion basins such as are presently under use or consideration in the Western United States. These basins have the disadvantage of needing high evaporation rates proportional to the storage area required. At present, much of the receiving water carrying tile effluent within Alberta contains high quality irrigation return flow, water that should be returned to the river. Another alternative could be to dilute saline river waters via interbasin transfer from a purer system. (Baker-FRC)
W82-00333

DEVELOPMENT OF BIOASSAY PROCEDURES FOR DEFINING POLLUTION OF HARBOR SEDIMENTS,
Wisconsin Univ.-Superior.
D. A. Bahnick, W. A. Swenson, T. P. Markee, D. J. Call, and C. A. Anderson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-178261, Price codes: A09 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S3-81-025, June 1981. 4 p.

Descriptors: *Bioassay, *Toxicity, *Sediments, *Water pollution sources, *Dredging, *Aquatic life, Interstitial water, Invertebrates, Aquatic animals, Metals, Polychlorinated biphenyls, DDE, Sunfish.

Reliable, cost effective procedures for identifying the potential effects of sediment chemical contaminants on water quality and aquatic communities are needed because of the continuous dredging of large volumes of sediments by the Corps of Engineers. Procedures studied include 96-hr toxicity tests employing Hexagenia limbata, Daphnia magna and Pontoporea affinis as biological probes, monitoring cough frequencies of bluegill sunfish in interstitial water derived from sediments, chemical analysis of sediment-water systems, and chemical analysis of chironomids and H. limbata exposed to the sediments. Sediment-water systems caused little toxicity in 96-hr exposure tests, although Daphnia was the most sensitive of these animals to toxicants. Similar cough frequencies were found for bluegill sunfish in dechlorinated city water compared to sediment interstitial water-Lake Superior water mixtures but it was observed that broken operculer patterns occurred in the interstitial water-Lake Superior Water mixtures. Most of the sediments used in the bioassay tests would be considered polluted according to at least one chemical parameter. Studies on extracting chemical species from the sediments showed that only small amounts could be readily extracted with Lake Superior Water. Evidence was found that chironomids dwelling in harbor sediments bioaccumulated PCBs and p,p'-DDE and possibly some metals. (Moore-SRC)
W82-00387

NATURAL VARIATION IN ABUNDANCE OF SALMONID POPULATIONS IN STREAMS AND ITS IMPLICATIONS FOR DESIGN OF IMPACT STUDIES,
Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.
J. D. Hall, and N. J. Knight.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-198954, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S3-81-021, July 1981. 4 p, 1 Tab.

Descriptors: *Fish populations, *Water pollution effects, *Nonpoint pollution sources, *Salmon, Aquatic habitats, Environmental effects, Stream fisheries, Stream degradation, Ecosystems.

Salmonids are the principal fish species of economic importance affected by pollution in the Western United States. Assessment of damage to these fish populations cannot be undertaken without some understanding of the natural variation in abundance within and between populations. An extensive literature review relating to stock size and production of salmonid populations in streams was carried out to bring together data on the magnitude of natural variation in population size and to relate this variability to environmental conditions whenever possible. Temporal and spatial variation may be as high as several orders of magnitude, and are sufficient to mask significant perturbations caused by nonpoint source (NPS) pollutants. Environmental variables most closely associated with spatial variation are those relating to the quality of salmonid habitat, particularly physical characteristics such as cover. Streamflow and food abundance have been associated with both temporal and spatial variation. Considerable emphasis should be placed upon systems of rating habitat quality in attempts to minimize the effects of natural variation when evaluating the impact of NPS pollutants. As a means of more clearly separating natural variation from damage caused by NPS pollutants, more emphasis should be placed upon the study of basic processes in stream ecosystems and more extensive use should be made of paired comparisons in the design of impact studies. (Moore-SRC)
W82-00389

LONGITUDINAL SUCCESSION IN IMPACT ASSESSMENT OF RIVER SYSTEM FISH COMMUNITIES,
Argonne National Lab., IL.
R. M. Goldstein.
Water Resources Bulletin, Vol 17, No 1, p 75-81, February, 1981. 5 Fig, 2 Tab, 29 Ref. OWRT-A-052-CONN(21).

Descriptors: *Fish populations, *Environmental effects, *Rivers, Speciation, Longitudinal succession, Ecology, Aquatic habitats, Habitats, *Water pollution effects.

Longitudinal succession indicates an increase in diversity and species richness of fish communities with increasing river size. This is a result of increasing habitat complexity and environmental stability. Cultural impacts (agriculture, dam construction, pollution, introduced species) decrease the diversity, species richness, and evenness. Fish communities in 14 Connecticut and Rhode Island rivers were surveyed during the summer of 1974. Data was normalized to eliminate the bias caused by linear succession and compared with non-normalized data using regression analysis. The two sets of data were similar. Evenness, which is not affected by longitudinal succession, was the most sensitive parameter. Introduced species, such as centrarchids, cause errors because many increase in number with altered physical habitat. Ideally, impact should be evaluated with the original community as a baseline. In most cases, however, this information is unavailable. (Cassar-FRC)
W82-00399

EFFECTS OF SURFACE MINING ON WATER QUALITY IN A SMALL WATERSHED, SULLIVAN COUNTY, INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
J. G. Peters.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $8.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-543, June 1981. 61 p, 12 Fig, 15 Tab, 50 Ref.

Descriptors: *Water quality, *Coal mining, *Water pollution effects, *Acid mine drainage, Small watersheds, Geology, Strip mines, Hydrogen ion concentration, Dissolved solids, Alkalinity, Cation exchange, Heavy metals, Suspended solids, Sediment transport, Settling basins, Chemical stratification, Thermal stratification, Profiles, Algae, *Indiana, Sullivan County, Spencer Creek, South Lake.

The water quality in an unnamed tributary to Spencer Creek upstream and downstream from a surface mine and in South Lake adjacent to the mine were monitored during a 5-year study (1975-79) in the 1,210-acre watershed of the tributary. Compared with the background values, pH and concentrations of all major dissolved ions and dissolved, suspended, and streambed metals generally increased in Spencer Creek tributary downstream from the mine. Median dissolved-sodium and sulfate concentrations increased as much as eighteenfold and fourteenfold, respectively, and median dissolved-manganese and suspended aluminum concentrations increased as much as sevenfold and more than twofold. Concentrations of suspended metals decreased more than 50% after installation of sediment ponds by the mine operator. During high streamflow, concentrations of major ions at background and at mined sites on Spencer Creek tributary decreased, but dissolved- and suspended-metal concentrations increased downstream from the mine. South Lake exhibited seasonal stratification and mixing characteristics of other lakes at a similar latitude. However, the bottom 3 feet of the water column demonstrated persistent chemical stratification. Phytoplankton populations of the lake varied seasonally, and the population density patterns resembled those in other lakes at latitudes similar to that of South Lake. (USGS)
W82-00427

CLINICAL TESTS IN AQUATIC TOXICOLOGY: STATE OF THE ART,
Columbia National Fisheries Research Lab., MO.
For primary bibliographic entry see Field 5A.
W82-00464

CHLORINATED DRINKING WATER,
For primary bibliographic entry see Field 5F.
W82-00467

FIELD EXPERIMENTS ON RESPONSES OF A FRESHWATER, BENTHIC MACROINVERTEBRATE COMMUNITY TO VERTEBRATE PREDATORS,
Savannah River Ecology Lab., Aiken, SC.
J. H. Thorp, and E. A. Bergey.
Ecology, Vol 62, No 2, p 365-375, April, 1981. 6 Fig, 1 Tab, 31 Ref.

Descriptors: *Benthos, *Thermal stress, *Nuclear reactors, Nuclear powerplants, Powerplants, Temperature effects, Thermal water, Heated water, *Water pollution effects, *Thermal pollution, Waste heat.

Possible effects of thermal effluents from a nuclear production reactor and other environmental characteristics such as season and plot locality on predator-prey interactions were examined in the littoral zone of a soft-bottom reservoir near Aiken, South Carolina. Thirty-six predator (fish and turtle) exclusion cases were placed in shallow water at six locations along a thermal gradient in Par Pond, a 1100-ha cooling reservoir on the Savannah River Plant. Cages were in place during three, 3-mo test periods beginning in September of 1977. Relations between predator treatment and community response, such as changes in density and taxon richness, were generally unaffected by plot locality, temperature fluctuations from thermal effluent, or seasonal changes. When data from caged and control plots were pooled, however, both location and water temperature individually had direct impacts on the benthic community. (Baker-FRC)
W82-00477

TADPOLES AS INDICATORS OF HARMFUL LEVELS OF POLLUTION IN THE FIELD,
Nature Conservancy, Abbotts Ripton (England). Monks Wood Experimental Station.
For primary bibliographic entry see Field 5A.
W82-00478

UNDERSTANDING ACID RAIN,
For primary bibliographic entry see Field 5B.
W82-00479

TOXICITY AND ECOLOGICAL SIGNIFICANCE OF TRACE ELEMENTS IN AQUATIC ENVIRONMENTS,
Tennessee Univ., Knoxville.
For primary bibliographic entry see Field 5B.
W82-00498

5D. Waste Treatment Processes

WATER-RELATED ENVIRONMENTAL CONTROL REQUIREMENTS AT MUNICIPAL SOLID WASTE-TO-ENERGY CONVERSION FACILITIES,
Iowa State Univ., Ames.
J. C. Young, and L. D. Johnson.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/EV/0116, Price codes: A10 in paper copy, A01 in microfiche. Dept. of Energy Report DOE/EV-0116, Sept, 1980. 208 p, 62 Fig, 33 Tab, 46 Ref, Append.

Descriptors: *Waste disposal, *Municipal wastes, *Wastewater treatment, *Water use, Water conservation, Land disposal, Solid wastes, Fuel, Water pollution control, Cost analysis, Energy sources, Recycling, Water reuse.

A study was initiated to evaluate water use and wastewater production at municipal solid waste-to-energy conversion systems, to identify water pollution control technology requirements, and to identify water-related limitations to their design and commercialization. In many designs, water use can be reduced considerably and production of wastewaters often can be eliminated by using water for multiple purposes within a facility. Wastewater associated with waste processing and storage at mass-burning and at dry-process refuse-derived fuel (rdf) facilities usually are produced infrequently and in small quantities, or are essentially uncontaminated. The major point of wastewater production is associated with ash quenching or sluicing and disposal in landfills or ashponds. All water-related environmental concerns associated with these facilities can be satisfied by using available wastewater treatment technology, improved water use management and accepted landfilling practices. Developers of the wet-pulping process have stated that there will be no wastewater discharge from the processing facilities. Wastewaters produced by pyrolysis create the greatest potential for causing adverse environmental impacts because of their high organic content and the type of organic materials present. While satisfactory wastewater treatment can be accomplished, the associated costs may impact heavily upon commercial viability. (Moore-SRC)
W82-00037

ABSORPTION OF RADIUM AND THORIUM FROM NEW MEXICO URANIUM MILL TAILING SOLUTIONS,
Bureau of Mines, Salt Lake City, UT. Salt Lake City Research Center.
H. R. Beard, H. B. Salisbury, and M. B. Shirts.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-147431, Price codes: A02 in paper copy, A01 in microfiche. Report of Investigations 8463, 1980. 17 p, 1 Fig, 5 Tab, 8 Ref, Append.

Descriptors: *Radium, *Thorium, *Radioactive waste disposal, *Mine wastes, *Absorption, Wastewater treatment, Industrial wastes, Uranium, Desorption.

When uranium ore is processed, up to 5% of the radium is taken into solution. Most of this soluble radium passes through the uranium recovery operations to the tailing disposal system. Although the actual weight of radium and other soluble radionuclides is very small, the concentrations in the tailing pond solutions generally are far above the permissible levels. Tailing and soil samples from New Mexico were evaluated for their potential to absorb radium and thorium from tailing liquors. Absorption ranged from 0 to 97% from radium and 0 to 60% from thorium. Essentially all of the New Mexico samples absorbed some radium from the tailing solutions, but the thorium absorption was nil in most cases. Batch desorption tests using relatively dilute ammonium and sodium salt solutions showed desorptions ranging from essentially 0 to 75%. Soils, clays, and other materials can absorb large amounts of radium from uranium tailing solutions, but it has not been possible to relate the absorption to specific chemical or physical characteristics. An alpha spectrometric method was used to determine the radium and thorium concentrations in the solutions and solids. (Moore-SRC)
W82-00040

DEWATERING OF INDUSTRIAL CLAY WASTES,
Bureau of Mines, University, AL. Tuscaloosa Research Center.
A. G. Smelley, B. J. Scheiner, and J. R. Zatko.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-179954, Price codes: A02 in paper copy, A01 in microfiche. Bureau of Mines Report of Investigations 8498, 1980. 15 p, 3 Fig, 11 Tab, 6 Ref.

Descriptors: *Clays, *Industrial wastes, *Dewatering, *Flocculation, Wastewater treatment, Polymers, Solids, Slurries, Coal, Potash, Phosphates, Uranium, Talc, Titanium.

As a part of research conducted in its mission to effect pollution abatement, the Bureau of Mines is developing a dewatering technique that allows for disposal of clay wastes, for reuse of water now lost with clays, and for reclamation of mined land. The technique utilizes a high-molecular-weight nonionic polyethylene oxide polymer (PEO) that has the ability to flocculate and dewater materials containing clay wastes. In laboratory experiments, coal-clay waste, potash-clay brine slurry, phosphatic clay waste, uranium tailings, and talc tailings were successfully consolidated. Coal-clay waste was consolidated from 3.6 to 57% solids; potash-clay brine slurry was consolidated from 3.8 to 35%; phosphatic clay waste from 15.6 to 49%; uranium tailings from 15.4 to 67%; tailings from talc production from 9.7 to 53%; and an acidic titanium dioxide slurry from 1.68 to 30%. In most cases PEO with a molecular weight of 8 million was superior to a 5 million molecular weight polymer. (Brambley-SRC)
W82-00041

TREATMENT OF FLORIDA SURFACE WATERS FOR USE IN PHOSPHATE BENEFICIATION,
Bureau of Mines, University, AL. Tuscaloosa Research Center.
D. A. Stanley, B. J. Scheiner, and P. Brown.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-232407, Price codes: A02 in paper copy, A01 in microfiche. Bureau of Mines Report of Investigations 8535, 1981. 13 p, 3 Fig, 3 Tab, 8 Ref.

Descriptors: *Organic matter, *Surface water, *Industrial water, *Wastewater treatment, Flocculation, Filtration, Water quality, Impaired water use, Phosphates, *Phosphate mining, *Recycling, Water reuse, Florida.

In response to competition for water by other users, the phosphate mining industry has reduced its total water use by recycling, but lost water is generally replaced by deep well pumping from the Floridian aquifer. A potential alternative source of supply is surface water; however, humic products in central Florida surface waters interfere with the flotation beneficiation process. Laboratory-scale experiments were conducted to determine whether or not surface waters with a high organic content could be purified sufficiently to be used to replace the high-quality deep well water. Water samples were obtained from Oak Creek and Horse Creek located in Polk County. The color of the waters was 300 Pt-Co units. The water samples were flocculated with a cationic polyethylenimine polymer, and processed in a sand filter. This treatment removed most of the organic materials from the water. Untreated surface water, treated surface water, and distilled water were used to compare the flotation response of the acid insolubles in an amine flotation circuit. Surface water treated with PEI-1000 was shown to be as effective as distilled water for the acid-insoluble-flotation step. Flocculation and filtration can therefore produce water suitable for amine flotation of quartz, which would permit substitution of surface water for deep well water. (Moore-SRC)
W82-00048

DEWATERING FLORIDA PHOSPHATIC CLAY WASTES WITH MOVING SCREENS,
Bureau of Mines, University, AL. Tuscaloosa Research Center.
L. W. Brandt.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-104373, Price codes: A02 in paper copy, A01 in microfiche. Bureau of Mines Report of Investigations 8529, 1981. 19 p, 8 Fig, 4 Tab, 8 Ref.

Descriptors: *Dewatering, *Clays, *Industrial wastewater, *Mineral industry, Gels, Sedimentation, Slurries, Wastewater treatment, Attapulgite, Phosphates, Phosphate mining, Florida.

Phosphatic clay wastes from beneficiation plants are stored in large dammed areas to allow natural settling. Because they are colloidal suspensions, these wastes settle very slowly, only to about 20% solids in many years. A novel technique to effectively dewater phosphatic clay wastes was developed. The solids contained in the clay waste slurry are slowly compressed by moving wire mesh screens through the system. Slow compression rates gave best results, and the mesh size of the screen used was of secondary importance to the rate of compression. It is believed that the moving screens distort the gel structure of the phosphatic clay system and cause the release of water. Samples of 18 clay wastes, including a high-grade attapulgite from beneficiation plants of the Florida phosphate field, were studied using the method. Typical samples were concentrated from initial solids of 4.7 and 11.9% to 16.8 and 25.2%, respectively, in 3 1/2 days. The high-grade attapulgite sample was dewatered from 2.7% solids to 13% solids in the same period. In general, clay wastes with poor natural settling behavior give higher final solids by moving screen compaction than those that are better natural settlers. The work demonstrated that a different mechanism was operating in compaction than in natural settling because the high attapulgite samples responded well to screen compaction. (Moore-SRC)
W82-00049

PROCESS FOR THE REMOVAL OF INORGANIC SALTS FROM A WATER STREAM,
For primary bibliographic entry see Field 5F.
W82-00055

LAND RESTORATION FOLLOWING OIL-WELL DRILLING,
V. L. Dover, Jr.
U.S. Patent No. 4,234,421, 7 p, 1 Fig, 7 Tab, 11 Ref; Official Gazette of the United States Patent Office, Vol 1000, No 3, p 1106, November 18, 1980.

Descriptors: *Patents, *Waste treatment, *Separation techniques, Chemical reactions, Water pollution sources, Waste disposal, *Land reclamation, *Oil fields, *Drilling fluids, Water reuse, Energy conservation, Water recovery, Drill cuttings.

An admixture of waste (oil-well) drill cuttings, drilling fluid and by-products of rotary drilling are separated into good-quality water and high-density

solids by chemical and mechanical means in original earthen-mud storage and/or reserve pits. The treatment produces two useful benefits: (1) good-quality water (useful for agriculture or for drilling a new well) is recovered, and (2) resulting concentrated solids are of such a high density that the land area occupied by and containing such dewatered solids can be immediately leveled and restored to the same use it had before the well was drilled. The effect is a reduction in energy over the present method of hauling whole mud off by trucks to a commercial waste-disposal site. When environmental considerations do not require restoration of the site and reserve pits are allowed to weather to a point of collapse, this process reduces or eliminates surface pollution of nearby creeks, rivers and ponds by preventing release of drilling-fluid chemicals. It also effects a net reduction in energy by breaking the pollution chains. (Sinha-OEIS)
W82-00057

PROCESS FOR REMOVAL OF MERCURY AND MERCURY COMPOUNDS FROM AQUEOUS SOLUTIONS AND INDUSTRIAL WASTE LIQUORS,
Wacker-Chemie G.m.b.H., Munich (Germany, F. R.). (Assignee).
E. Falbesaner, J. Bichler, and E. Wimmer.
U.S. Patent No. 4,234,422, 4 Fig, 6 Ref; Official Gazette of the United States Patent Office, Vol 1000, No 3, p 1106, November 18, 1980.

Descriptors: *Patents, *Wastewater treatment, *Water pollution treatment, *Separation techniques, *Industrial wastes, Filtration, *Mercury, Sands, Filters, Mercury removal, Backwashing.

A process removes mercury and mercury compounds from aqueous solutions and, in particular, industrial waste waters, by reduction and filtration. After reduction, the waters are cleared by letting the mercury particles and dirt particles flow into a settling basin. Subsequently, the supernatant aqueous solution from the settling basin is subjected to filtration in a deep filter with a filtering agent having a grain size of 0.02 mm to 2 mm and preferably 0.04 mm to 0.6 mm, whereupon the mercury is returned by reverse rinsing the settling basin from the filter and is separated in the settling basin. (Sinha-OEIS)
W82-00058

ENERGY RECOVERY SYSTEM,
Department of Energy, Washington, DC. (Assignee).
A. S. Moore, and F. H. Verhoff.
U.S. Patent No 4,234,423, 6 p, 1 Fig, 12 Ref; Official Gazette of the United States Patent Office, Vol 1000, No 3, p 1106, November 18, 1980.

Descriptors: *Patents, *Wastewater treatment, Industrial wastes, Pollutants, Organic wastes, Oxidation, *Chemical oxygen demand, Scrubbers, *Coal gasification plants, Wet air oxidation.

The invention is directed to an improved wet air oxidation system and method for reducing the chemical oxygen demand (COD) of waste water used from scrubbers of coal gasification plants, with this COD reduction being sufficient to effectively eliminate waste water as an environmental pollutant. The improvement of the invention is provided by heating the air used in the oxidation process to a temperature substantially equal to the temperature in the oxidation reactor before compressing or pressurizing the air. The compression of the already hot air further heats the air which is then passed in heat exchange with gaseous products of the oxidation reaction for 'superheating' the gaseous products prior to its use in turbines as the driving fluid. The superheating of the gaseous products significantly minimizes condensation of gaseous products in the turbine so as to provide a substantially greater recovery of mechanical energy from the process. (Sinha-OEIS)
W82-00059

APPARATUS FOR THE PURIFICATION OF OILY EMULSIONS, SOLUTIONS, AND INDUSTRIAL WASTE WATERS,
R. F. Piepho.
U.S. Patent No. 4,234,424, 9 p, 5 Fig, 5 Ref; Official Gazette of the United States Patent Office, Vol 1000, No 3, p 1107, November 18, 1980.

Descriptors: *Patents, *Wastewater treatment, *Industrial wastes, *Separation techniques, *Oily water, Chemical reactions, Filtration, Filters, Equipment, Oil industry.

The invention relates to an apparatus for the purification of oily emulsions, solutions, industrial waste waters or the like. The apparatus includes a reaction container, at least one discharge connecting piece, an inflow trough and a band filter fitted with a fleece band, a filtrate container arranged under it and a sludge container provided at the discharge end of the band filter. The process for purification by chemical separation includes collecting the oily waste waters, adding a demulsifier if the oil content exceeds 2% and separating, or draining, the oil which floats to the surface. A powdered separating reagent may be mixed into the emulsion with adsorption occurring in a very short period of time. The apparatus can be transported to the site where the contaminated waste waters occur. A further object is to increase overall performance in waste water treatment by providing an apparatus with two treatment chambers so that one may operate while the second is being filled and by also providing that the sludge produced by the apparatus has an elongated drying path. (Sinha-OEIS)
W82-00060

PRESSURIZED OXYGENATION SYSTEM AND METHOD,
FMC Corp., San Jose, CA. (Assignee).
C. C. Pearson.
U.S. Patent No. 4,235,719, 9 p, 2 Fig, 9 Ref; Official Gazette of the United States Patent Office, Vol 1000, No 4, p 1532-1533, November 25, 1980.

Descriptors: *Patents, *Wastewater treatment, Sewage treatment, *Oxygenation, Oxygen, Pressure, Equipment.

A system for performing an oxygenation process within a body of sewage at atmospheric pressure includes an oxygen absorber coupled to an oxygen supply at superatmospheric pressure. A storage vessel has an elongate chamber which is oriented vertically in the system. Pipes and valves are coupled to the upper and lower ends of the chamber so that the chamber is alternately connected with the oxygen absorber and the body of sewage, thereby providing alternate high pressure and low pressure half cycles respectively. Initially, oxygenated liquor at superatmospheric pressure is in the oxygen absorber and the elongated chamber is filled with a quantity of oxygen content liquor at atmospheric pressure. The valves are then operated during the high pressure half cycle to admit oxygenated liquor into the elongate chamber through the lower end and to simultaneously expel liquor and undissolved oxygen from the upper end into the oxygen absorber. The valves are then operated during the low pressure half cycle to reduce the chamber pressure to atmospheric and to admit a quantity of liquor from the body of sewage into the elongate chamber through the top end while simulataneously expelling the oxygenated liquor from the bottom end into the body of sewage. Thus, oxygen which comes out of solution and collected as relatively large bubbles as the pressure in the chamber is reduced to atmospheric pressure, will be retained in the elongate chamber and returned to the oxygen absorber during the next high pressure half cycle. (Sinha-OEIS)
W82-00064

UNDERWATER AERATOR,
Hanshin Engineering Co. Ltd., Osaka (Japan). (Assignee).
R. Nakajima, Y. Takei, S. Kawauchi, and T. Fujita.
U.S. Patent No. 4,235,720, 6 p, 4 Fig, 15 Ref; Official Gazette of the United States Patent Office, Vol 1000, No 4, p 1533, November 25, 1980.

Descriptors: *Patents, *Wastewater treatment, *Water pollution treatment, *Aeration, Equipment, Circulation, Bubbles, Underwater.

An aerator comprises an air diffuser rotor for receiving air and forcing out the air through small perforations formed in its peripheral wall, and an agitator-pump unit placed immediately above the rotor. When the aerator is installed on the bottom of a waste water purifying tank, the agitator-pump unit raises water from the bottom of the tank and produces a circulating flow of water through the interior of the tank, while the air diffuser rotor forces out air bubbles into the circulating flow, whereby an improved areation efficiency can be achieved. (Sinha-OEIS)
W82-00065

HIGH CAPACITY WASTE WATER TREATMENT SYSTEM,
Bauer Bros. Co., Springfield, OH. (Assignee).
M. E. Ginaven.
U.S. Patent No. 4,235,724, 8 p, 5 Fig, 10 Ref; Official Gazette of the United States Patent Office, Vol 1000, No 4, p 1534, November 25, 1980.

Descriptors: *Patents, *Wastewater treatment, *Sewage treatment, *Separation techniques, Flow, Flow control, Screens, Storm water, Quiescent flow.

A system for treatment of waste water received from a sewer system comprises one or more lines of static inclined screen each of which lines is served by a single low lying infeed duct or conduit connected to receive waste water which is discharged from the associated sewage system. Each infeed duct includes longitudinally spaced outlets directed upwardly and vertically to provide a like delivery of waste water embodying solids to each of the screens. Each infeed duct is so designed and interrelated with the line of screen which it serves that each of the screens in the lines is provided with equal volumetric non-turbulent, quiescent flow which is ideal for separating purposes. This is achieved by stepping the cross-sectional area of the infeed duct to achieve a uniform flow velocity at each of its outlets. The system is capable of handling a high volume of turbulent waste water such as is found in a sewage systems infiltrated with large volumes of water due to heavy rains and/or flooding conditions. (Sinha-OEIS)
W82-00066

APPARATUSES FOR THE ANAEROBIC DIGESTION OF NATURAL ORGANIC WASTE,
Hamworthy Engineering Ltd., Fleets Corner (England). (Assignee).
D. L. Hawkes, R. Horton, and D. A. Stafford.
U.S. Patent No. 4,233,155, 6 p, 3 Fig, 13 Ref; Official Gazette of the United States Patent Office, Vol 1000, No 2, p 687, November 11, 1980.

Descriptors: *Patents, *Wastewater treatment, *Organic wastes, Sewage treatment, *Anaerobic digestion, Anaerobic conditions, Separation techniques, Equipment.

An apparatus for the anaerobic digestion of natural organic waste comprises a feed tank, a digester and an outlet tank. There is further provided feed means which feeds waste from the feed tank to the digester at an adjustable continuous rate. A gas pump may be used to recirculate from the top of the digester through a diffuser to the bottom of the digester. A suitable gas pump comprises a container partially filled with liquid so there is a space above the liquid surface and within the container sealed by the liquid from the exterior of the container. The pump is placed in the space. (Sinha-OEIS)
W82-00069

THE HORSE CREEK BASIN PROJECT,
Davis and Floyd Engineers, Inc., Greenwood, SC.
For primary bibliographic entry see Field 5G.
W82-00071

FACULTATIVE LAGOON EFFLUENT POLISHING USING PHASE ISOLATION PONDS,

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Environmental Protection Systems, Inc., Jackson, MS.
E. C. McGriff.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-205965, Price codes: A08 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-084, July 1981, 3 p, 1 Fig.

Descriptors: *Wastewater lagoons, *Wastewater treatment, *Phase isolation ponds, Effluents, Biochemical oxygen demand, Municipal wastewater, Rainfall, Algae, Suspended solids, *Clinton, *Mississippi.

The performance of phase isolation lagoons was investigated at Clinton, Mississippi, from May 1978 to May 1979. The study system consisted of two facultative lagoons arranged in series followed by two isolation ponds used alternately for final polishing. The isolation ponds were operated on a fill and draw basis with isolation periods varying from 20 to 44 days. It appears that the phase isolation process can, at times, produce an effluent that will meet the National Pollutant Discharge Elimination System (NPDES) limitations for Clinton. However, the process is not consistent in its performance and should not be considered as a final process unit. A significant correlation between the area rainfall and effluent BOD5 and TSS indicates sensitivity of the process to climatic and seasonal conditions. A correlation matrix showed a relationship between the effluent suspended solids, and in situ secchi depth, suspended solids, nitrate nitrogen, and total phosphorus. Microscopic examinations revealed that Chlorella appeared most often in both isolation ponds, with Oscillatoria, Ankistrodesmus, Pediastrum, and Ulothrix dominating to a lesser degree. (Moore-SRC)
W82-00092

WASTEWATER TREATMENT BY ROOTED AQUATIC PLANTS IN SAND AND GRAVEL TRENCHES,
Moulton Niguel Water District, Laguna Niguel, CA.
P. R. Pope.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-213241, Price codes: A03 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-091, July 1981. 6 p, 3 Fig, 2 Tab.

Descriptors: *Biological wastewater treatment, *Aquatic plants, *Raw wastewater, *Municipal wastewater, Wastewater treatment, Nitrogen removal, Phosphorus removal, Laguna, *California.

A patented process developed by the Max Planck Institute (MPI) of West Germany to treat industrial wastes was evaluated as an energy-efficient method to treat municipal wastewater. The major goal was to achieve effluents meeting the Federal Effluent Standards using this novel biological treatment process that requires a minimal amount of mechanical equipment and manpower for normal operation. The Moulton Niguel Water District of Laguna, California, constructed and operated an earthen trench system using rooted aquatic plants for the treatment of wastewater. Two trenches in series were planted with the reed Phragmites and the bulrush Scirpus, respectively. A 2-month study using conventional secondary effluent as the trench influent showed the system was not effective for removing nitrogen and phosphorus components. An 11-month study demonstrated that raw screened wastewater applied to the trench system at a rate not exceeding 95 cu m/d (25,000 gpd) could be treated to secondary effluent quality. Spatial requirements were about the same as for a septic tank system.
W82-00093

EVALUATION OF THE EFFECTIVENESS OF GRANULAR ACTIVATED CARBON ADSORPTION AND AQUACULTURE FOR REMOVING TOXIC COMPOUNDS FROM TREATED PETROLEUM REFINERY EFFLUENTS,
Robert S. Kerr Environmental Research Lab., Ada, OK.
J. E. Matthews.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-199374, Price codes: A04 in paper copy, A01 in microfiche. Project Summary EPA-600/S2-81-067, July 1981. 4 p, 4 Tab.

Descriptors: *Industrial wastewater, *Oil industry, *Activated carbon, *Adsorption, *Aquaculture, *Wastewater treatment, Biological treatment, Organic compounds, Advanced wastewater treatment, Hydrocarbons, Toxicity.

Activated carbon adsorption isotherms of prepared aqueous solutions of toluene, 2,4-dimethylphenol, naphthalene, benzo(a)pyrene, chrysene, pyrene, acenaphthene, phenanthrene, fluoranthene, and fluorene were determined by laboratory studies to estimate the optimum loading capacity under ideal conditions. Effectiveness of activated carbon and aquaculture for removal of organic compounds from a treated petroleum refinery wastewater was evaluated with a pilot-scale treatment system onsite at a refinery. Activated carbon was shown to be effective in removing selected organic compounds; however, there was a wide variation in the adsorption capacities of the compounds tested. In general, adsorption capacity of activated carbon appears to decrease with an increase in the complexity of the polynuclear aromatic molecule. It would require relatively high dosages of carbon to remove the five-membered aromatic ring compounds. Advanced treatment using activated carbon or aquaculture appears to significantly improve petroleum refinery wastewater with respect to toxicity reduction. A literature review of activated carbon treatment indicated considerable variation in estimates for both capital investments and annual operating costs. (Moore-SRC)
W82-00098

PHOSPHORUS DYNAMICS OF A FLORIDA FRESHWATER MARSH RECEIVING TREATED WASTEWATER,
Florida Univ., Gainesville. Center for Wetlands.
For primary bibliographic entry see Field 5E.
W82-00108

VIRUS REMOVAL IN WASTE STABILIZATION PONDS IN INDIA,
National Environmental Engineering Research Inst., Nagpur (India).
V. C. Rao, S. B. Lakhe, and S. V. Waghmare.
Water Research, Vol 15, No 7, p 773-778, July, 1981. 7 Tab, 19 Ref.

Descriptors: *Viruses, *Stabilization ponds, Ponds, *Wastewater treatment, Ammonia, *India, Biological oxygen demand, Seasonal variation.

Stabilization ponds, a low cost waste treatment method used in India and other tropical developing countries, removed 86-95% of viruses from sewage on a pilot scale and 88-98% on a full scale. In the pilot tests, the percentage of virus removed was not significantly affected by rate of loading (205-472 lb BOD5 per acre per day), percentage of BOD5 removal (50-85%), and season (20-26 degrees C in winter and 30-35 in summer). Three 1-celled ponds of varying depths (3,4 and 5 ft, respectively) removed 66, 89, and 81% of the viruses in winter and 89-98% in fall, summer and rainy seasons. Depths of 3, 4, and 5 feet gave overall (averaging all seasons) removal efficiencies of 86, 95, and 93%, respectively. The anaerobic activity, causing frequent sludge uplift, in turn removed colloidal organics and viruses. Viruses were also removed by adsorption to suspended solids and subsequent settling to the extent of 63%. The free ammonia concentrations of 1.5-22 mg per liter and pH above 8.0 also contributed significantly to virus inactivation. (Cassar-FRC)
W82-00121

ORGANIC MICROPOLLUTION INDICES OF EFFLUENTS AND RENOVATED WATERS,
Technion-Israel Inst. of Tech., Haifa. Environmental and Water Resources Engineering.
For primary bibliographic entry see Field 5A.
W82-00123

MODELING AMMONIUM EXCHANGE AND REGENERATION ON CLINOPTILOLITE,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
M. Semmens, J. Klieve, D. Schnobrich, and G. W. Tauxe.
Water Research, Vol 15, No 6, p 655-666, June, 1981. 14 Fig, 4 Tab, 6 Ref.

Descriptors: *Ammonium, *Ion exchange, *Computer models, Clinoptilolite, Model studies, *Wastewater treatment, Regeneration, Nitrogen compounds, Design criteria, Ammonium removal.

A computer model is presented to assist in the design of ammonium removal facilities in wastewater treatment plants. This predicts the exchange behavior of natural clinoptilolite, an ammonium selective ion exchanger, during service and regeneration. The regeneration model outputs may be used as inputs for the service model to evaluate the impact of alternative regeneration conditions on ammonium removal performance during service. The isotherms obtained in this study may be used to predict the influence of regeneration strengths between 0.2 and 0.4 M NaCl and ammonium concentrations of 5 to 40 mg per liter in influent wastewaters. (Cassar-FRC)
W82-00125

METHANE PRODUCTION FROM OZONATED PULP MILL EFFLUENT,
Purdue Univ., Lafayette, IN. Lab. of Renewable Resources Engineering.
C. E. Bremmon, M. F. Jurgensen, and J. T. Patton.
Journal of Environmental Quality, Vol 9, No 3, p 412-416, July-September, 1980. 2 Tab, 30 Ref.

Descriptors: *Pulp wastes, *Methane, Energy sources, Pulp and paper industry, Industrial wastes, Industrial plants, White water, Kraft mills, Sulfite liquors, Fermentation, Biodegradation, Anaerobic conditions, Sulfite mills, Sulfite liquors, *Waste treatment, *Secondary productivity.

The potential for producing methane from ozone-degraded spent sulfite liquor (SSL) by anaerobic fermentation was investigated. The ozonated SSL was fed continuously to three anaerobic fermenters for three months as the sole source of carbon and energy. The fermenters were inoculated with anaerobic bacteria obtained from sewage sludge and acclimated for one month in ozonated SSL prior to continuous fermentation. Chemical and biological parameters such as COD, BOD5, total sulfur content, redox potential, pH, fatty acid composition, and methane bacteria populations were monitored to determine changes in the SSL during fermentation. Methane production from ozone-treated SSL averaged 1.7 liters per liter, or 17 ml of methane produced per gram of volatile solids fed. Fatty acids analysis of fermenter effluent indicated a net production of 58 mM per liter of acetate during ozonated SSL fermentation. This acetic acid production shows future potential for further fermentation by protein-producing yeast. Although the rate of conversion of volatile solids to methane in this process was not competitive with domestic or agricultural waste digesters, the study did indicate the potential benefits of ozonating organic wastes for increased methane fermentation yields. (Baker-FRC)
W82-00155

SURVIVAL OF EGGS AND LARVAE OF SWINE NEMATODE PARASITES IN AEROBIC AND ANAEROBIC WASTE TREATMENT SYSTEMS,
Kansas Dept. of Health and Environment, Topeka.
O. G. Marti, C. V. Booram, and O. M. Hale.
Journal of Environmental Quality, Vol 9, No 3, p 401-405, July-September, 1980. 5 Tab, 17 Ref.

Descriptors: *Nematodes, *Waste recovery, Recycling, Waste treatment, Aerobic digestion, Anaerobic conditions, Temperature effects, Parasites.

Eggs and larvae of several genera of swine nematode parasites were studied in two experiments to determine their ability to survive aerobic and anaerobic treatment at two different temperature

levels, 12 and 22 degrees C. Swine feces containing eggs of Ascaris suum, Metastrongylus spp., Oesophagostomum dentatum, Hyostrongylus rubidus, and Strongyloides ransomi were used in both experiments. Treatment system fluids were sampled and examined periodically for parasite eggs and larvae. Cultures of fluids were prepared and examined for larvae after seven days of incubation at 25 degrees C. Ascaris eggs embryonated in 28 days in the 22 degree C aerobic system. Unembryonated Ascaris eggs in the other three treatment systems completed their development when transferred to two percent formalin at 25 degrees C. Metastrongylus eggs survived all treatment systems, but some larvae hatched and died. Oesophagostomum and Hyostrongylus larvae survived well under 12 degree aerobic conditions, but were destroyed in 11 days at 22 degrees C. Eggs of Strongyloides hatched rapidly under aerobic conditions, but survived at least seven days under anaerobic conditions in both experiments. The development of free-living adults of Strongyloides and the survival of third-stage larvae were favored in 22 degree C conditions. Knowledge of the parasite genera present in a swine herd and of the responses of eggs and larvae to different temperatures and treatments is significant for the effective management and safe recycling of waste materials. (Baker-FRC)
W82-00161

LEACHATES FROM SOLID WASTE RECOVERY OPERATIONS,
Brice, Petrides, and Associates, Inc., Waterloo, IA.
A. D. Rademaker, and J. C. Young.
Journal of the Energy Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EY1, p 17-29, May, 1981. 5 Fig, 7 Tab, 5 Ref.

Descriptors: *Wastewater treatment, *Leachates, *Waste recovery, *Wastewater renovation, Leaching, Heavy metals, Biological wastewater treatment, Biological treatment, Percolation, Soil types, Sludge, Pollutant identification, Organic wastes, Solid wastes.

A two phase study was conducted to determine the nature of residues produced at urban waste-to-energy conversion facilities and to evaluate leachates produced from the residues. Leachate samples were collected daily and analyzed weekly to see if heavy metals and organic priority pollutants could be leached in sufficient quantities to pose a potential environmental hazard. The effects of soil on the character of the resulting leachate produced from the selected waste residues were also examined. Bench scale column tests revealed that levels of effluent constituents declined gradually from a peak early in the leaching period to essentially zero at 5-7 weeks. Although no organic priority pollutants were found in ash residues, they were present in sludges from the biological treatment of pyrolysis waste waters. Soil columns were successful in removing most base-neutral extractable organic compounds, but not acidic extractable compounds. Some metallic priority pollutants were also removed upon contact with the soil. More research is required into better techniques for removing compounds from solid residues, the identification of organic priority pollutants, and designing models to describe the leaching of priority pollutants from landfills. (Geiger-FRC)
W82-00167

REFUSE-TO-ENERGY WASTEWATER TREATMENT,
Montgomery (James M.), Inc. Pasadena, CA.
G. P. Treweek.
Journal of the Energy Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EY1, p 1-16, May, 1981. 4 Fig, 5 Tab, 22 Ref.

Descriptors: *Fuel, *Wastewater treatment, *Wastewater renovation, Incineration, Anaerobic digestion, Biological treatment, Trace metals, Organic wastes, Waste recovery, Waste characteristics, Waste disposal, Wastewater disposal, Pilot plants, Wastewater facilities, Biological wastewater treatment.

A two step procedure consisting of preprocessing and conversion is described for processing wastewater refuse into useable fuel. Preprocessing consists of a series of physical steps to size, classify, and separate the refuse, while conversion is carried out by combustion, pyrolysis, anaerobic digestion, or methanation, depending upon the process used for preparing the municipal solid wastes (MSW). Wastewaters from combustion processes consist mainly of site drainage and wash waters, quench and sluice waters, boiler blowdown, and scrubber effluent. The first three wastewaters may be handled by sanitary sewers. The treatment of scrubber wastewater may involve the removal of trace metals before discharge into sanitary sewers. Pyrolysis of preprocessed MSW results in the production of a gas, an oily or liquid fraction, and a solid char fraction. Wastewaters produced during pyrolysis contain high levels of organic priority pollutants. Anaerobic digestion of MSW is still in the development stage, and a test site at Pompano Beach, Florida anticipates wastewater streams from storage pit drainage and liquid effluent generated from dewatering the digested sludge. Projected treatment facilities and recommended pilot plant studies for the handling of wastes for fuel conversion are described. (Geiger-FRC)
W82-00168

FOAM CONTROL IN AERATION TANKS,
Los Angeles County Sanitation Districts, Whittier, CA.
W. W. Hoffmaster.
Water/Engineering and Management, Vol 128, No 5, p 84, 89, May, 1981. 1 Fig, 2 Tab.

Descriptors: *Foam separation, *Foaming, *Aeration, *Wastewater treatment, Pumps, Sprays, Mechanical equipment, Performance evaluation.

A mechanical foam breaker was tested at an activated sludge wastewater treatment plant. Foam control for aeration tanks in Los Angeles County Sanitation Districts consists of foam sprays and vacuum pumps. Foam sprays are a set of nozzles spaced about 6.5 ft apart. These physically break up the bubbles. Greater control is provided by the vacuum pumps. The pumps suck the foam off the surface of the tanks and thus limit foam production by removing it. During the tests of the rotating brush type breaker, the 37.5 mgd plant, which consisted of 12 aeration tanks, was being operated in a contact stabilization mode. The depth of foam was approximately six to eight in. The unit reduced the foam cover by 223 sq ft in 95 min when the tank was baffled at 32.5 ft. Eighty-four percent of the foam was reduced within 10 minutes. In an unbaffled tank running continuously, the foam splitter maintained a difference of 3.4 ft of uncovered foam. A thin layer of scum was a by-product of the system, but the splitter was much cheaper than a suction device which would eliminate the scum. (Small-FRC)
W82-00171

GREECE WON'T BE LETTING WASTEWATER PROBLEMS SLIDE.
Water and Sewage Works, Vol 127, No 2, p 54, 59, February, 1980.

Descriptors: *Greece, Athens, *Wastewater facilities, Wastewater management, Wastewater treatment, Municipal wastewater.

Several recent events in Greece have led that country to take action in the water pollution field. The first municipal wastewater treatment plant had been built in the central part of the country. Athens, the largest city, with nearly 1 million people in the greater metropolitan area, expects to get underway with a design for its first treatment plant as well. The extremely heavy direct disposal of untreated wastes into offshore waters has severely harmed the fishing industry, on which the country depends heavily. Greece will also need to achieve some level of compliance with the EEC pollution control standards before becoming a full member of the common market. Shortly after World War II, a start was made toward the fine, well-engineered, constantly expanding water system enjoyed in Athens today. Athens receives good quality mountain stock water in plentiful supply; it is subjected to treatment such as coagulation with alum, filtration and chlorination at 7 ppm. (Baker-FRC)
W82-00182

TOTAL ORGANIC HALOGEN AS A PARAMETER FOR THE CHARACTERIZATION OF RECLAIMED WATERS: MEASUREMENT, OCCURRENCE, FORMATION, AND REMOVAL,
Karlsruhe Univ. (Germany, F.R.). Dept. of Water Chemistry.
M. R. Jekel, and P. V. Roberts.
Environmental Science and Technology, Vol 14, No 8, p 970-975, August, 1980. 2 Fig, 5 Tab, 23 Ref.

Descriptors: *Chemical analysis, *Organic compounds, *Reclaimed water, Water use, Water analysis, Measuring instruments, Water pollution control, Drinking water, Halogens.

A method is described for the determination of total organic halogen whereby purgeable and nonpurgeable fractions are measured separately. The detection limits are 0.03 micromol/liter halogen for the purgeable fraction and 1.0 micromol/liter halogen for the nonpurgeable fraction. Precision is 5%. Data are presented from two water-reclamation facilities in California. The treated wastewater (secondary effluent) contains 1.0 to 10 micromol/liter total organic halogen, mostly in the nonpurgeable fraction. The mole ratio of organic halogen to organic carbon is about 0.4 to 1.2%. Nonpurgeable halogenated organics are formed during chlorination. The halogenated compounds are removed in several treatment steps: air stripping is effective in decreasing the concentration of the purgeable fraction; activated-carbon and reverse-osmosis treatment substantially reduce the concentration of the nonpurgeable fraction. The halogenated organics remaining after water reclamation appear to be highly mobile in the groundwater environment. Considering the potential health effects of halogenated organics in drinking water, their removal should be considered a major treatment objective in water reclamation. (Baker-FRC)
W82-00197

ASSIMILATION OF LEMONADE-PROCESSING WASTEWATER BY YEASTS,
New York State Agricultural Experiment Station, Geneva. Dept. of Food Science and Technology.
Y. D. Hang.
Applied and Environmental Microbiology, Vol 39, No 2, p 470-472, February, 1980. 2 Fig, 1 Tab, 11 Ref.

Descriptors: *Wastewater treatment, *Food processing industry, Food-processing wastes, Industrial wastes, *Yeasts, Fungi, Growth, Temperature effects, Acidity, Citric acid, Lemonade processing.

The ability of various yeasts to grow on the waste effluents generated during the processing of lemonade was investigated. Five species of yeasts were examined, but only Candida utilis and Saccharomyces fragilis reduced the BOD by greater than 60%. However, C. utilis settled very slowly. In contrast, S. fragilis settled very rapidly and compacted well, and up to 95% of the yeast solids settled in 15 minutes. For this reason in particular S. fragilis is a more desirable organism for treating lemonade-processing wastewater than C. utilis. S. fragilis competed successfully with the natural biota in the wastewater. There were no marked differences between yeast growth in the autoclaved and unautoclaved waste material. Biochemical changes during fermentation of lemonade-processing wastewater by S. fragilis were determined. The amount of yeast growth approximately paralleled the reduction of BOD in the waste water. Both yeast growth and BOD reduction increased rapidly between 12 and 24 hr and reached maxima in 32 hr. The BOD was reduced from 4,100 to 550 mg/liter, representing a reduction of about 87%. Concurrently, the titratable acidity calculated as citric acid was reduced from 0.52% to 0.012% and the pH was raised from 3.0 to 6.8. S. fragilis was able to grow rapidly over a wide range of temperatures, but the optimum temperature was 30 degrees C. Yeast cells grown at 23

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to 35 degrees C settled more rapidly than those grown at 40 to 45 degrees C. (Baker-FRC)
W82-00204

REMOVAL AND RECOVERY OF ORGANIC POLLUTANTS FROM THE AQUATIC ENVIRONMENT. 2. REMOVAL AND RECOVERY OF DODECYLBENZENESULFONATE FROM AQUEOUS SOLUTION BY CROSS-LINKED POLY(N-BENZYL-4-VINYLPYRIDINIUM HALIDE),
Kyoto Inst. of Tech. (Japan). Dept. of Chemistry.
N. Kawabata, and T. Morigaki.
Environmental Science and Technology, Vol 14, No 9, p 1089-1093, September, 1980. 4 Fig, 3 Tab, 5 Ref.

Descriptors: *Surfactants, *Resins, *Separation techniques, Organic chemicals, Water pollution control, Adsorbents, Chemical analysis, Anionic surfactants, Dodecylbenzenesulfonate.

An attempt was made to find a new polymeric adsorbent for removal and recovery of sodium dodecylbenzenesulfonate from aqueous solution, which would be more useful than those presently available. Vinylpyridine-divinylbenzene copolymer was used as a polymeric adsorbent for removing DBS from solution. BVP resin in the bromide form was found to have an excellent capacity for removing sodium dodecylbenzenesulfonate from solution. The breakthrough capacity of the resin with less than 1 ppm leakage in the effluent was greater than those observed with commercial anion exchange resins and porous styrene-divinylbenzene resin with no ion exchange functional group. The breakthrough capacity of the BVP resin for DBS adsorption was scarcely affected by the presence of sodium chloride, sodium sulfate, sodium hydroxide, and hydrochloric acid. Elution of the adsorbed DBS from the BVP resin was easily accomplished by a simple treatment with methanolic hydrochloric acid, and the BVP resin was efficiently regenerated as the chloride form. DBS was concentrated into 20-25 wt% solution. The BVP resin in the chloride form showed much the same ability for the adsorption of DBS as the resin in the bromide form. (Baker-FRC)
W82-00217

EVALUATION OF THE OVERLAND RUNOFF MODE OF LAND WASTEWATER TREATMENT FOR VIRUS REMOVAL,
Army Medical Bioengineering Research and Development Lab., Fort Detrick, MD.
For primary bibliographic entry see Field 5B.
W82-00220

TREATMENT OF POTATO-PROCESSING WASTE WATER BY AN ANAEROBIC LAGOON-FILTER SYSTEM,
New Brunswick Univ., Fredericton. Dept. of Civil Engineering.
K. C. Lin, and G. J. Brown.
Canadian Journal of Civil Engineering, Vol 7, No 2, p 373-383, 1980. 9 Fig, 2 Tab, 12 Ref.

Descriptors: *Anaerobic lagoons, *Potato wastes, *Food processing industry, *Wastewater treatment, Biological treatment, Lagoons, Filters, Industrial wastewater, Organic loading.

A laboratory-scale model of an anaerobic lagoon followed by anaerobic filtration was very efficient in treating potato processing wastewater. At 20 degrees C, pH 7, and organic loading rates of 0.149, 0.290, and 0.719 kg BOD per cu meter per day, overall removals of COD and suspended solids were 97-98% and 89-97%, respectively. The system operated well under shock loads and under zero loads. Most BOD and suspended solids were removed in the bottom part of the reactors. Optimum load to the lagoon and filter were 0.3 and 0.4 kg BOD per cu meter per day, respectively. pH was maintained at 7 by sodium bicarbonate addition. Sludge buildup was estimated at less than 30% of the lagoon volume in 50 years. Therefore, no sludge removal would be required during the normal design period. Filter clogging is also unlikely. (Cassar-FRC)
W82-00226

AMES' MUTAGENIC ACTIVITY IN RECYCLED WATER FROM AN ISRAELI WATER RECLAMATION PROJECT,
Johns Hopkins Univ., Baltimore, MD. Dept. of Environmental Health Sciences.
I. Neeman, R. Kroll, A. Mahler, and R. J. Rubin.
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 1, p 168-175, January, 1980. 2 Fig, 1 Tab, 16 Ref.

Descriptors: *Recycling, *Water shortage, Water demand, Waste recovery, *Water reuse, Mutagenic activity, Eutrophication, Algae, Wastewater treatment, Carcinogens, *Israel.

A project using eutrophication of sewage water has recently reached the final stages of development at a major facility located south of Tel Aviv, Israel, as part of that country's attempts to reclaim water for human and agricultural uses. Samples of water were collected from two sites in the polishing ponds and from a well located adjacent to the polishing ponds. A non-polar resin was also used to concentrate potential mutagenic materials in the water collected from the polishing pond at the terminal end of the reclamation project. The water samples and the concentrated samples were tested by the Ames assay system. The results reveal the presence in recycled water of low levels of one or more pro-mutagens that require activation by mammalian host factors prior to exhibiting mutagenic activity. The data indicate an absence of a response to unconcentrated water in one tester strain, TA 98, with a positive response in a second strain, TA 100. This coupled with a marked response in both strains to concentrated water extracts. In any case the demonstration of pro-mutagenic activity in various water samples drawn from the recycling facility is clear. The source of this lipophilic pro-mutagenic activity may be directly from industrial or agricultural pollutants or indirectly from microbial action on the myriad organic chemicals present in the oxidation ponds. (Baker-FRC)
W82-00234

CONCENTRATION OF POLIOVIRUS IN WATER BY MOLECULAR FILTRATION,
Environmental Monitoring and Support Lab., Cincinnati, OH.
For primary bibliographic entry see Field 5A.
W82-00246

ANAEROBIC TREATMENT OF HUMAN WASTE IN NORTHERN COMMUNITIES,
Toronto Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W82-00249

DESIGN GUIDELINES FOR INCOMPLETELY MIXED OR AEROBIC-ANAEROBIC AERATED LAGOONS,
Nova Scotia Technical Coll., Halifax. Dept. of Civil Engineering.
D. Thirumurthi.
Canadian Journal of Civil Engineering, Vol 7, No 1, p 27-35, 1980. 7 Fig, 3 Tab, 12 Ref.

Descriptors: *Aerated lagoons, *Design criteria, *Aerobic-anaerobic lagoons, Lagoons, *Wastewater treatment, Municipal wastewater, Biological oxygen demand, Organic loading.

Incompletely mixed (aerobic-anaerobic) aerated lagoons can be designed using the Thirumurthi chart, which graphically depicts the Wehner-Wilhelm equation for biological wastewater treatment applications. The biological factors (temperature and wastewater quality) are delineated by a first-order BOD removal coefficient; the physical-hydraulic regimes (mixing pattern and depth-width ratio of lagoon) are represented by a dispersion index. The key to the design is the standard BOD removal coefficient (K), 0.29 per day, for municipal wastewater at a standard temperature of 20 degrees C and organic loading of 20 kg per cu meter per day. Equations for correcting K are provided for actual cases where temperature and organic load differ from the standard. An example design (an aerated lagoon operating in winter) illustrates the design procedure, which should be verified by monitoring the field installation. (Cassar-FRC)
W82-00250

POLLUTANT TREATABILITY: A MOLECULAR ENGINEERING APPROACH,
Environmental Protection Agency, Washington, DC.
For primary bibliographic entry see Field 6E.
W82-00252

RECOVERY OF INDIGENOUS VIRUSES FROM WASTEWATER SLUDGES, USING A BENTONITE CONCENTRATION PROCEDURE,
Texas Univ. Center for Applied Research and Technology at San Antonio.
C. A. Turk, B. E. Moore, B. P. Sagik, and C. A. Sorber.
Applied and Environmental Microbiology, Vol 40, No 2, p 423-425, August, 1980. 2 Tab, 6 Ref.

Descriptors: *Viruses, *Sludge, *Wastewater treatment, Adsorption, Bentonite, Monitoring.

An adaptation of the bentonite virus concentration procedure to sludges has been developed. The results were obtained by the distilled water elution-bentonite concentration procedure in viral monitoring of liquid sludges undergoing land application at six sites in the United States. Plaque assays for indigenous and seed viruses were performed with confluent monolayers of HeLa cells grown in 100-mm petri plates. Several sludge dispersion techniques, isolating indigenous viruses, were evaluated on primary raw and digested sludges. Bentonite adsorption was accomplished by adding 200 mg bentonite clay per liter, previously expanded by vigorously mixing 1 g of bentonite in 100 ml of distilled water for 1 hr, to the sludge eluate. Calcium chloride was added to give a final concentration of 0.02 M, the pH was adjusted to 6.0 with 1 N HCl, and the sample was mixed for 30 min. Bentonite was recovered by centrifuging the sample at 3,000 x g for 10 min. Levels of enteric viruses detected in field samples ranged from a high value of 215 plaque-forming units per g total suspended solids to a low of 0.2 plaque-forming unit per g. During the monitoring program a total of 64 samples were handled, with 97% yielding viruses by the methodology described. Sample volume reductions expressed as a concentration factor generally exceeded 15. Thus the versatility of the bentonite concentration procedure was demonstrated by the recovery of indigenous virions from primary raw sludges during lab testing and from anaerobically digested and lagooned sludges during field monitoring. (Baker-FRC)
W82-00271

THE ALPHA-BETA-GAMMA'S OF WASTEWATER TREATMENT,
Standard Oil Co., Chicago, IL.
J. F. Grutsch.
Environmental Science and Technology, Vol 14, No 3, p 276-281, March, 1980. 5 Fig, 1 Tab, 6 Ref.

Descriptors: *Wastewater treatment, *Activated sludge, Petroleum industry, Organic compounds, Activated carbon, Adsorbents, Carbon, Sludge, Oil refineries, Refinery wastes.

Operation at high sludge age and further enhancement by using high concentrations of powdered activated carbon (PAC) commingled with the activated sludge are two approaches used by the petroleum refining industry to improve the performance of activated sludge processes for the removal of organics from wastewater. The key to operating the activated sludge process (ASP) in the high-sludge-age mode is to recognize the impact of influent solids on the physical properties of the activated sludge, specifically the zeta potential probability distribution. High-sludge-age ASP data indicate that the bacteria use food resources sequentially. First, the cell's energy requirements are met. Then, if pool resources remain, the macromolecules are synthesized. Sequential utilization of

food resources is not unexpected, as the energy resource must exist to construct and locate the macromolecules. In studies where a municipal plant operated at exceptionally high sludge age, the solids equilibrated and the plant operated for 3+ months with no sludge wastage, and about 4 mg/liter solids were lost to the effluent. The hydraulic design of the ASP has a striking impact on which metabolic route of the substrate is used - the biosynthetic fate (alpha) or maintenance energy (beta). (Baker-FRC)
W82-00275

A 201 POLLUTION CONTROL PLANNING TRAGEDY,
For primary bibliographic entry see Field 6E.
W82-00285

THE CONSULTANT'S VIEWPOINT ON ALTERNATIVE DISINFECTANTS,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W82-00286

SLUDGE SETTLING HAMPERED BY INDUSTRIAL DISCHARGE,
Williamsport Sanitary Authority, PA.
M. H. Gerardi.
Public Works, Vol 112, No 6, p 95-97, June, 1981. 1 Tab, 11 Ref.

Descriptors: *Sludge conditioning, *Sludge digestion, *Bulking sludge, *Industrial waste, *Biochemical oxygen demand, Sludge, Biodegradation, Digestion, Sludge filters, Organic compounds, Flow discharge, Bacteria, Wastewater, Wastewater treatment, Settleable solids, *Williamsport, Pennsylvania.

In Williamsport, Pennsylvania, poor sludge settling due to gas entrapment by mixed-liquor filamentous organisms was attributed to discharge of a fatty acid derivative waste from food emulsifiers. Filamentous bulking is a major operation nuisance for many activated sludge wastewater treatment plants. The nuisance bacteria possess three outstanding metabolic properties: production of filaments under low dissolved oxygen concentrations, rapid assimilation of organic compounds into lipids, and conversion of nitrites to nitrogen during microbiological denitrification. Treatment measures that have been practiced with some success include the use of return sludge chlorination, decreased mean cell residence time, decreased mixed liquor suspended solids concentration, and return of anaerobic digester supernate. In Williamsport, equalized flow discharge from the manufacturer improved settleability. Pretreatment with ferric chloride and calcium hydroxide followed by dissolved air flotation has been proposed as an alternative control measure. (Titus-FRC)
W82-00290

EFFECTS OF ALPHA, BETA AND THETA FACTOR UPON THE DESIGN, SPECIFICATION AND OPERATION OF AERATION SYSTEMS,
California Univ., Los Angeles. School of Engineering and Applied Science.
M. K. Stenstrom, and R. G. Gilbert.
Water Research, Vol 15, No 6, p 643-654, 1981. 3 Fig, 4 Tab, 80 Ref.

Descriptors: *Aeration, *Design criteria, *Wastewater treatment, Dissolved oxygen, Oxygen transfer, Turbulence, Surfactants, Mass transfer, Bubbles, Alpha factor, Beta factor, Theta factor, Variability, Suspended solids, Temperature, Research priorities, Literature review.

This literature review on alpha, beta, and theta factors in wastewater aeration is the result of work by a subcommittee of a joint EPA-American Society of Civil Engineers group in developing a manual of practice for aerator testing and specifications. The variability of the alpha factor has produced values in the literature from 0.3 to 2.0. It depends on many factors: wastewater quality, mixing, suspended solids concentration, bubble diameter, scale, and especially the method of aeration. An alternative approach to determining the alpha factor, using a synthetic anionic surfactant in the test water, is suggested for further development. The beta factor, or ratio of the saturation dissolved oxygen concentration in clean water, may be measured by the Winkler method if no chemical interferences exist. Otherwise, it should be calculated from a total dissolved solids measurement. Values for the beta factor are about 0.95 for domestic wastewater. Values for the beta factor are about 0.95 for domestic wastewater, 0.77-0.97 for pulp mill wastes. Determination of the beta factor also produces a diversity of values. Temperature correction factors have been reported over the range 1.008 to 1.047 and are dependent on turbulence. A theta factor of 1.024 is suggested for most applications. The many uncertainties involved in the use of these three factors show a need for research on the subject, giving high priority to explanations of the effects of turbulence on alpha and beta factors and analysis of scale-up effects on changing surface tension and oxygen diffusivity. (Cassar-FRC)
W82-00291

ROLE OF HYDRODYNAMIC FACTORS IN AMMONIA DESORPTION BY DIFFUSED AERATION,
New York State Dept. of Health, Albany. Div. of Lab. and Research.
E. Shpirt.
Water Research, Vol 15, No 6, p 739-743, 1981. 5 Fig, 1 Tab, 13 Ref.

Descriptors: *Ammonia, *Aeration, *Hydrodynamics, *Wastewater treatment, Mass transfer, Mathematical equations, Turbulence, Air-water interfaces, Bubbles.

The rate of ammonia removal from water by diffused aeration was described by an equation derived from dimensional analysis and the theory of models. This is relevant to stripping of ammonia from wastewater. The mass transfer process was correlated with hydrodynamic variables reflecting the geometry of the system, the air flow, and the liquid properties (diameter and velocity of the rising bubbles in the water, depth of submersion of the diffusers, and the rate of aeration). Experiments were done at water column levels of 30, 50, and 100 cm and at 3.38, 6.75, 13.50, and 27.0 cu meters per sq meter per hour using tap water at 20 degrees C. Fine bubble aeration was twice as efficient in ammonia removal as coarse bubble aeration. (Cassar-FRC)
W82-00293

THE OPERATION OF A WASTE TREATMENT PLANT. PROCESS DYNAMIC CONSIDERATIONS,
Westvaco Corp., Laurel, MD.
R. P. Wilcox, and J. S. Hudgins.
Tappi, Vol 63, No 2, p 115-117, February, 1980. 5 Fig.

Descriptors: *Pulp and paper industry, *Settleable solids, *Wastewater treatment, Industrial wastewater, Model studies, Kraft mills, Wood wastes, Activated sludge process.

A simple dynamic flow model was developed to predict how materials are propagated through a waste treatment plant. The dynamics were evaluated by treating each of the plant units (primary clarifier, aeration basin, secondary clarifier) as a mixing tank and using Laplace transforms to represent the transfer functions for it. The overall transfer functions are given by the product of the individual transfer functions. Two concentrations were of principal interest: the concentration of the material in the aeration basin (important because of possible inhibiting effects on microorganisms) and the concentration in the secondary clarifier, because of effects the material may have in directly altering settleability. The model was applied to a treatment plant in a southern kraft paper mill. Uses of the model include estimating the maximum entering composition of a material which will not exceed plant capacity. Results apply mainly to nonbiodegradable material such as lignin or inorganics. Substances contributing to BOD are degraded by biological action in an aeration basin and can be included in the model with an additional term. (Cassar-FRC)
W82-00298

LUXURY UPTAKE OF NITROGEN IN FLOCCULATING ALGAL-BACTERIAL SYSTEM,
Government Engineering Coll., Trichur (India). Dept. of Civil Engineering.
K. R. Nambiar, and S. D. Bokil.
Water Research, Vol 15, No 6, p 667-669, 1981. 1 Fig, 1 Tab, 16 Ref.

Descriptors: *Nitrogen removal, *Algae, *Bacteria, Biomass, *Wastewater treatment, Nitrogen compounds, Flocculation.

Investigations were conducted, aimed at increasing nutrient removal from fertilizer manufacturing wastewater by a mixed algal-bacterial biomass. Although algae and bacteria nitrogen uptake rates are usually 8-12%, a 16% uptake (luxury uptake) was obtained with added carbon source and added N. In four 3-liter batch reactors fed with 700 mg per liter ammonia-N, 300 mg per liter urea-N, glucose, and phosphate, the flocculating algal-bacterial biomass decreased during the 10-day test, but biomass N remained in the 500 mg per liter range. A C:N:P ratio of 10:10:1 (as against the stoichiometric ratio of 30:10:1) is the optimum for biomass stability and total N removal efficiency. (Cassar-FRC)
W82-00307

SMALL IS ENVIRONMENTALLY ACCEPTABLE . . .,
Water Pollution Research Lab., Stevenage (England).
M. J. D. White.
Water, No 33, p 15-17, July, 1980.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, Anaerobic digestion, Fluidized bed process, Fluidized beds, Dewatering, Separation techniques.

Increasing environmental pressure and space restrictions have led to greater interest in methods for intensifying wastewater treatment processes. Biological degradation and solid/liquid separation comprise the two major types of sewage treatment processes. Both are amenable to intensification options. Biological treatment can be intensified by increasing the number of microorganisms per unit volume. This may be accomplished by increasing the quantity of oxygen supplied during aeration prior to separation in a settlement tank or by using small filter media with a larger surface area rather than traditional filters with mineral media. Biological fluidized beds provide potential for achieving concentrations of microorganisms which are five to ten times greater than those achieved by conventional activated sludge processes. However, subsequent aerobic treatment requires a high rate of oxygen input due to the high concentrations of microorganisms, resulting in high operating costs. The fluidized bed process can be used for anaerobic treatment of industrial wastes containing carbohydrate but not much ammonia or other pollutants. Concentration of sludge prior to anaerobic digestion can reduce the retention period by as much as 65% and results in reduced volume to be treated. The potential for intensification of the separation processes used in sewage treatment appears to be rather limited. Such measures as are feasible are relatively expensive either to construct or to operate. (Carroll-FRC)
W82-00311

PILOT SCALES TESTS ON THE FLOTATION OF ABATTOIR WASTES BY DEEP U TUBES,
Manchester Inst. of Science and Technology (England).
A. D. Wheatley, and S. J. Denham.
Effluent and Water Treatment Journal, Vol 20, No 6, p 274-277, June, 1980. 2 Fig, 8 Tab, 5 Ref.

Descriptors: *Meat processing industry, *Flotation, Animal wastes, Recycling, *Wastewater treatment, Pilot plants.

UNIV. OF ILL. URBANA-CHAMPAIGN

A portable pilot plant was used to test treatment of strong and variable abattoir wastes (up to 3294 mg per liter COD) using the flotation method. The distinguishing feature of the plant was a U-tube shaft. With recycle, total suspended solids removals were over 95%. Without recycle, several problems prevented good results--interference of gas transfer, coagulation by the strong effluent, and inadequate gas precipitation. Corrective measures included increasing residence times in the flotation tank by 2 or 3 times, raising the temperature, adding new particulate matter, and addition of coagulants directly to the shaft. Several experimental procedures--providing gas bubbles as nucleation sites and preaeration prior to entering the shaft--produced no improvement in results. Experiments to selectively remove protein were unsuccessful using sodium hexametaphosphate as a coagulant at low pH, a recycle ratio of 4:1, and a reduced flow rate. (Cassar-FRC)
W82-00322

A REALISTIC ASSESSMENT OF THE EFFECT OF SETTLEMENT ON SEWAGE,
T. Stones.
Effluent and Water Treatment Journal, Vol 20, No 3, p 119, 121, March, 1980. 5 Tab, 4 Ref.

Descriptors: *Chemical oxygen demand, *Flocculation, Biological oxygen demand, Nitrogen compounds, Suspended solids, *Wastewater treatment, Industrial wastewater.

Total oxygen demand (COD plus nitrogenous oxygen demand) is a more realistic measure of the effect of settlement in sewage than previously used methods. Samples of domestic sewage, both natural and sterilized, were allowed to settle for 18 hours. Of the total reduction in oxygen demand, 91.2% was due to carbonaceous matter and 8.8% due to nitrogenous matter. Overall, 30.3% of the reduction arose from biological activity. Settlement resulted in a reduction of 35.8% of the initial COD, which is equivalent to a reduction of 29.3% of the initial TOD; and a reduction of 15.7% of the initial nitrogenous oxygen demand, which is equivalent to 2.8% of the initial TOD. Data for settlement of industrial sewage showed a marked suppression on the proportion of the reduction of the COD from biological activity because of toxic materials in the sewage. (Cassar-FRC)
W82-00324

CHEMISTRY OF SEPTICITY,
Severn-Trent Water Authority, Birmingham (England).
N. Harkness.
Effluent and Water Treatment Journal, Vol 20, No 1, p 16, 18-19, 21, 23, January, 1980. 2 Fig, 9 Ref.

Descriptors: *Septicity, *Hydrogen sulfide, *Anaerobic conditions, *Odors, Sulfur compounds, Chemical reactions, Sulfides, Organic compounds, Sewer systems, Bacteria, Sulfates, Industrial wastes, Domestic wastes, Amines, Amino acids, Organic matter.

Malodors in sewage result from a variety of biochemical reactions taking place in the absence of free or combined oxygen. The most common, hydrogen sulfide, arises under anaerobic conditions from the breakdown of sulfur-containing organic compounds in a reduced state and from sulfate-sulfur. Examples are amino acids, vitamins, taurine, arylsulfate acids, steroid sulfates, and sulfomucopolysaccharides. These compounds may enter a sewer system from domestic sources (1.0-1.5 g S per person per day), potable water, surface and infiltration water, and industrial effluents. Pomeroy's Z formula allows estimation of the likelihood of sulfide formation in gravity sewers, considering BOD, temperature, slope of sewer, sewage flow, and ratio of pipe wall perimeter to surface width of flow. Low pH, high temperature, and turbulent flow enhance hydrogen sulfide liberation into the atmosphere. Molecular H_2S comprises half the soluble sulfide at pH 7 and 15C, increasing with decreasing pH; at 20C the atmospheric equilibrium concentration is 130 ppm for 0.5 mg per liter H_2S in solution. Other malodors possible in sewage are volatile fatty acids, alcohols, ketones, and amines. (Cassar-FRC)
W82-00325

ADVANCED BIOLOGICAL TREATMENT OF TANNERY WASTEWATER,
D. R. Refling, M. G. Biesinger, and L. K. Barber.
Industrial Wastes, Vol 27, No 3, p 16-18, May/June, 1981. 2 Fig, 4 Tab.

Descriptors: *Wastewater treatment, *Tannery wastes, Industrial wastes, Primary wastewater treatment, Oxidation ponds, Advanced wastewater treatment, Aeration, Aerators, Winchester, New Hampshire.

Wastewater from tanneries is a complex mixture of organic and inorganic chemicals. It is high-strength and extremely variable in nature. Nearly all of the wastewater from the A. C. Lawrence Tannery in Winchester, New Hampshire, is discharged from 3 am to 7 pm, with the peak occurring about 11 am. The permit issues for this discharge specified that effluent concentrations should not exceed: suspended solids, 60 mg/l; BOD, 15 mg/l; ammonium-nitrogen, 1.5 mg/l; FOG, 15 mg/l; and chromium, 1.0 mg/l. Treatment at the plant consists of a primary chemical treatment system followed by an advanced biological secondary system. In the primary system the wastewater is dosed with 1,000 mg/liter alum and 800 mg/liter lime. Wastewater pH is controlled between 7.5 and 8.5. Wastewater then flows through a dispersed air device and a vortex coagulation cell and on to an electro-flotation tank where small gas bubbles attach to the floc particles and float them to the tank surface, where they are removed by skimmers. Polyelectrolyte is injected at a dose of 12 mg/liter just prior to flotation. The biological treatment uses an aeration and mixing system called Carrousel, which is essentially a modification of the Pasveer oxidation ditch concept using low-speed surface aerators instead of horizontal rotors. The effluent produced has been determined to be of extremely high quality, with average effluent BOD values of 5 mg/liter in summer and 6 mg/liter in winter. Effluent ammonia nitrogen values are 1 mg/liter in summer and 4 mg/liter in winter. Over 99% of the raw influent BOD was removed, and nitrogen removal efficiencies were 85.2-89.8%. (Baker-FRC)
W82-00337

RECENT DEVELOPMENTS IN WATER POLLUTION CONTROL,
Toronto Univ. (Ontario). Dept. of Civil Engineering.
J. G. Henry.
Canadian Journal of Civil Engineering, Vol 7, No 2, p 264-272, 1980. 40 Ref.

Descriptors: *Wastewater treatment, *Water pollution control, *Ontario, *Canada, Performance evaluation, Process control, Automation, Activated sludge process, Oxygen, Biological treatment, Rotating biological contactors, Deep shaft process, Fluidized bed process, Land application, Physicochemical treatment, Anaerobic digestion, Incineration, Sludge disposal, Sludge dewatering, Dewatering, Research priorities.

This paper examines the current status of municipal wastewater technology in Ontario, Canada, and recent developments in plant performance, secondary treatment, and sludge processing. These are reviewed with respect to limitations and suitability for Canada. Still in a primitive stage are dynamic design, mathematical modeling for unit processes, and automatic process control. Secondary treatment processes which show promise are the oxygen activated sludge process for large plants, fixed film reactors (such as the rotating biological contactor) for small municipalities, the deep shaft process, and the fluidized bed technique. Land treatment and physical-chemical treatments (activated carbon) are considered impractical for Canada. Sludge processing, which accounts for 40% of wastewater treatment costs, presents many problems. Anaerobic digestion is difficult to operate, and land application is severly restricted. Possible answers to sludge problems are incineration, new dewatering devices such as belt filters, and polymeric sludge conditioners. Research and development on water treatment in Canada must increase. (Cassar-FRC)
W82-00340

TEXTILE EFFLUENTS LOSE THEIR COLOR.
Canadian Chemical Processing, Vol 64, No 2, p 75, March, 1980.

Descriptors: *Color removal, *Textile mill wastes, *Activated carbon, Dyes, *Wastewater treatment, Industrial wastewater.

An activated carbon system was installed in the Harding Carpets factory to treat a highly variable effluent containing textile dyes and other chemicals. A 14.2 cu m holding tank equalizes the waste load. Each carbon bed is 0.9 m in diameter and 3.2 m long and can handle 0.19 cu m per hour of effluent. The entire system, with a 326 cu m per day capacity, removes 95.4% of the color. Significant reductions in total organic carbon, chemical oxygen demand, and biological oxygen demand of the effluent are effected. (Cassar-FRC)
W82-00342

PULP COMPANIES FACE BILLION DOLLAR CLEANUP.
Canadian Chemical Processing, Vol 64, No 1, p 18-19, February 6, 1980.

Descriptors: *Pulp and paper industry, *Water pollution prevention, *Bleaching wastes, Kraft mills, Canada, *Wastewater treatment, Industrial wastewater, Effluents, Regulations, Recycling, Chlorination, Costs.

Spending on pollution control in the Canadian pulp and paper industry will increase from the traditional 5-10% of capital expenditures as environmental guidelines become stricter. Methods used to reduce pollution costs include the closed-cycle kraft mill concept, contercurrent methods, recycling spills, burning toxic materials, improved housekeeping, increased use of chlorine dioxide, oxygen bleaching, and reducing bleach volumes by the dynamic bleaching process. (Cassar-FRC)
W82-00343

AVOIDING AN ENVIRONMENTAL HANGOVER.
Canadian Chemical Processing, Vol 64, No 2, p 29-30, March, 1980.

Descriptors: *Brewery industry, *Aerated lagoons, Lagoons, *Wastewater treatment, Industrial wastewater, Food processing industry.

Brewery wastes at Molson's Barrie, Ontario, plant are treated on site before release into the municipal treatment system. The plant generates 0.5 to 1 million gal per day of effluent with BOD of 1500-2000 ppm. The wastes are treated in two 2 million gallon lagoons equipped with conventional paddle surface aerators and a Penberthy aerator with a Venturi system. Effluent from the lagoons passes through two clarifiers. Sludge is collected, dewatered to 14% solids concentration, and disposed at a municipal site. Treated effluent is discharged to the municipal system at less than 300 ppm BOD and 350 ppm suspended solids. (Cassar-FRC)
W82-00344

RAPID GROWTH FORECAST FOR PEROXIDE.
Canadian Chemical Processing, Vol 64, No 1, p 21-22, February 6, 1980.

Descriptors: *Hydrogen peroxide, *Hydrogen sulfide, Oxidation, Odor control, *Wastewater treatment, Sludge conditioning.

The United States currently uses 20,000 tons per year of hydrogen peroxide for industrial or municipal wastewater and water treatment. Hydrogen peroxide is primarily a pretreatment agent, degrading many toxic materials (phenolics, refractory organics, cyanide, sulfur compounds, etc.) before the

biological oxidation step. It is also useful as a source of supplemental oxygen during spills, aerator outages, or excess organic loading, and as a sludge conditioner. Hydrogen sulfide can be controlled with hydrogen peroxide without the corrosion and toxicity problems common to carbon adsorption or chlorination. (Cassar-FRC)
W82-00345

FINAL ENVIRONMENTAL IMPACT STATEMENT FOR WASTEWATER TREATMENT FACILITIES; CITY OF OLATHE, JOHNSON COUNTY, KANSAS.
Environmental Protection Agency, Kansas City, MO. Region VII.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-243131, Price codes: A21 in paper copy, A01 in microfiche.
Report EPA-907/9-81-002a, March, 1981. 484 p, 21 Fig, 27 Tab, 118 Ref, 7 Append.

Descriptors: *Environmental Impact Statement, *Olathe, Kansas, *Wastewater treatment, *Wastewater facilities, *Sewer systems, Environmental effects, Sewage districts, Economic aspects, Environmental protection.

This Final Environmental Impact Statement examined 11 alternatives for providing sewerage facilities for the Upper and Little Cedar Creek basins in and near the City of Olathe, Johnson County, Kansas. All alternatives were also intended to relieve existing overloading at Olathe's Harold Street treatment plant. Based on a comparative analysis of both monetary and nonmonetary impacts of the alternatives a preferred project has been selected. It consists of a 2 mgd wastewater treatment plant with a gravity interceptor, one major lift station, a force main and attached flow equalization basins. The gravity interceptor is generally aligned with Little Cedar Creek. The major lift station would pump around the east side of Ernie Miller Park. Recommendations are made for measures to reduce adverse effects of the project. The EPA intends to fund only a limited portion of the originally proposed project. (Brambley-SRC)
W82-00357

FINAL ENVIRONMENTAL IMPACT STATEMENT; BEMIDJI WASTEWATER TREATMENT SYSTEM, BELTRAMI COUNTY, MINNESOTA.
Environmental Protection Agency, Chicago, IL. Region V.
Report, May, 1981. 144 p, 11 Fig, 17 Tab, 106 Ref, Append.

Descriptors: *Environmental Impact Statement, *Bemidji, Minnesota, *Wastewater treatment, *Wastewater facilities, Lakes, Eutrophication, Cost analysis, Water quality, Waste disposal, Land disposal, Social aspects, Tertiary wastewater treatment, Water pollution control, Phosphorus removal.

The effluent discharged from the wastewater treatment plant at Bemidji significantly affects the quality of the culturally and economically important lakes on the Upper Mississippi River downstream from the outfall sewer (Lakes Bemidji, Wolf, Andrusia, and Cass). A permanent solution to the wastewater disposal problem has been sought for more than 12 years, primarily because of the continued search for a means to eliminate a surface water discharge. Numerous land application search efforts have been conducted, and numerous geotechnical investigations and engineering reports have been completed during the past ten years. This Environmental Impact Statement addresses this long alternatives development process. At this time it appears that the only technically feasible, environmentally and socially acceptable, and cost-effective solution to the problem is the construction of a new tertiary wastewater treatment plant at the site of the existing plant in Bemidji with discharge to the Mississippi River channel to Lake Bemidji. It also appears that an effluent phosphorus concentration limitation of 0.3 mg/l (the most practical treatment) will protect Lake Bemidji from accelerated eutrophication and may contribute to improved water quality in the downstream Upper Mississippi River Chain of Lakes. (Brambley-SRC)
W82-00358

FINAL ENVIRONMENTAL IMPACT STATEMENT; WASTEWATER TREATMENT FACILITIES, SOUTH SHORE LAKE TAHOE BASIN.
Environmental Protection Agency, San Francisco, CA. Region IX.
Report, May, 1981. 217 p, 6 Fig, 15 Tab, 10 Ref.

Descriptors: *Environmental Impact Statement, *Lake Tahoe, California, *Wastewater treatment, *Wastewater facilities, Environmental effects, Social aspects, Secondary wastewater treatment, Irrigation water, Agriculture, Growth rates.

This Final Environmental Impact Statement on the wastewater treatment programs proposed by the South Tahoe Public Utility District and the Douglas County Sewer Improvement District No. 1, contains EPA's recommendations, and revisions and additions to the Draft Environmental Impact Statement. Based on the impact analysis of various growth scenarios and commitments to mitigate primary and secondary adverse impacts, EPA recommends for South Tahoe Public Utility District a 7.5 mgd maximum daily flow wastewater treatment plant which produces secondary treated and filtered effluent for agricultural irrigation in Alpine County, California. Possible plant expansion is contingent upon approval by various local and regulatory agencies and adequate performance under the mitigation program. The environmental parameters considered were water quality, biology, noise and air quality, and visual resources. The social parameters considered include land use, housing, transportation, recreation, public services/fiscal concerns, utilities, and cultural resources. The final environmental impact statement for Douglas County Sewer Improvement District No. 1 has been postponed because of lack of progress in developing a mitigation program. (Brambley-SRC)
W82-00359

FINAL ENVIRONMENTAL IMPACT STATEMENT; REHABILITATION OF WASTEWATER FACILITIES, STREATOR, ILLINOIS.
Environmental Protection Agency, Chicago, IL. Region V.
Report, February 1981. 283 p, 11 Fig, 19 Tab, 101 Ref, 4 Append.

Descriptors: *Environmental Impact Statement, *Streator, *Illinois, *Wastewater treatment, *Wastewater facilities, Nitrification, Chlorination, Combined sewers, Effluents, Pit recharge, Water pollution control, Water quality, Pollution load, Leachates.

A Facilities Plan was developed for Streator, Illinois, which recommended substantial upgrading and expansion of the existing system, with separation of the existing combined sewer system, and treatment facilities which would reduce discharges to the Vermilion River. The Final Environmental Impact Statement proposes action on a reduced scale. The three major interceptor sewers in the combined sewer system would be replaced. The treatment plant would be upgraded to include nitrification and chlorination, to obtain effluent levels of 10 mg/l BOD5 and 12 mg/l suspended solids. Combined sewer flows in excess of the plant's capacity would receive primary treatment and chlorination prior to discharge to the river. The mines beneath Streator would be recharged with wastewater and stormwater to maintain present water levels. The proposed action would reduce substantially the pollutant loads to the Vermilion River, so water quality downstream should be improved, especially at low flow periods. Pollutant loads to the mines would be reduced, thus reducing leachate from them. Before any further action is taken it is necessary to determine the feasibility of the less stringent effluent levels, the recharge to the mines, and the sewer rehabilitation; the level of treatment under these conditions; and the most appropriate financing. (Brambley-SRC)
W82-00361

FINAL ENVIRONMENTAL IMPACT STATEMENT; ALTERNATIVE WASTEWATER TREATMENT SYSTEMS FOR RURAL LAKE PROJECTS; CASE STUDY NO. 1: CRYSTAL LAKE AREA SEWAGE DISPOSAL AUTHORITY, BENZIE COUNTY, MICHIGAN.
Environmental Protection Agency, Chicago, IL. Region V.
Report, July 1980. 169 p, 7 Fig, 3 Tab, 7 Append.

Descriptors: *Environmental Impact Statement, *Crystal Lake, Michigan, *Wastewater facilities, *Wastewater treatment, *Water pollution control, Rural areas, Groundwater movement, Septic wastewater, Leachates, Pollution load, Phosphorus, Sewer systems, Case studies.

A Facilities Plan for the Crystal Lake area, which proposed a centralized collection and treatment system for the area, was followed by a Draft Environmental Impact Statement (DEIS), which recommended a Limited Action Alternative. Additional studies were conducted on groundwater flow patterns, septic leachate in Cold Creek, and aquatic productivity in effluent plumes and administrative procedures were clarified. The new studies generally confirmed the earlier ones. Groundwater flow patterns were clarified; under extreme conditions septic tank systems might contribute 6.7% of the lake phosphorus loads projected in the DEIS; and almost all of the dry-weather nutrient load was coming from a small tributary of Cold Creek. The recommended action is essentially that which was recommended in the DEIS, as follows: construction of connecting sewers and a new 0.33 mgd rotating biological contractor plant for Frankfort and Elberta; evaluation surveys and rehabilitation of their existing sewer systems; design and implementation of a small waste flow district for the remainder of the study area; site-specific environmental and engineering analyses of existing systems in the unsewered areas; repair and replacement of on-site systems as required; and cluster systems or other off-site treatment for portions of the shoreline. (Brambley-SRC)
W82-00362

FINAL ENVIRONMENTAL IMPACT STATEMENT; ALTERNATIVE WASTEWATER TREATMENT SYSTEMS FOR RURAL LAKE PROJECTS; CASE STUDY NO. 2: THE GREEN LAKE SANITARY SEWER AND WASTE DISTRICT, KANDIYOHI COUNTY, MINNESOTA.
Environmental Protection Agency, Chicago, IL. Region V.
Report, December 1980. 165 p, 9 Fig, 6 Tab, 4 Append.

Descriptors: *Environmental Impact Statement, *Green Lake, Minnesota, *Wastewater treatment, *Wastewater facilities, *Sewer systems, Cost analysis, Water pollution sources, Groundwater, Water pollution control, Trophic level.

In response to a Facilities Plan for the Green Lake area which proposed a centralized wastewater collection and treatment system, the EPA prepared a Draft Environmental Impact Statement, which proposed alternatives. The centralized collection and treatment system is neither needed nor cost-effective, and the elimination of on-site wastewater system on the shorelines of Nest Lake and Green Lake will not change the trophic status of the lakes. Nonpoint sources are the larger source of nutrients to Nest Lake, and this load subsequently enters Green Lake. The wastewater treatment needs can be met by use of on-site systems, including new and upgraded systems, and by provision of decentralized off-site systems (cluster systems). To ensure reliability of these systems the sites must be chosen carefully; the natural assimilative capacity of local soil and groundwater resources must be considered; and adequate community supervision must be provided. Spicer and New London will continue to use their existing collection systems with final treatment facilities to be determined, while the shorelines of Nest and Green Lakes will continue to be served by on-site systems. (Brambley-SRC)
W82-00363

UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

FINAL ENVIRONMENTAL IMPACT STATEMENT; ALTERNATIVE WASTEWATER TREATMENT SYSTEMS FOR RURAL LAKE PROJECTS; CASE STUDY NO. 3: SPRINGVALE-BEAR CREEK SEWAGE DISPOSAL AUTHORITY, EMMET COUNTY, MICHIGAN.
Environmental Protection Agency, Chicago, IL. Region V.
Report, December 1980. 133 p, 6 Fig, 3 Tab, 9 Ref, 6 Append.

Descriptors: *Environmental Impact Statement, *Springvale - Bear Creek, Michigan, *Wastewater treatment, *Wastewater facilities, Water pollution control, Sewer systems, Septic tanks, Leachates, Eutrophication, Water quality.

Essentially the same action is recommended as in the Draft Statement, prepared in response to a Facilities Plan which called for a sewage collection system around Crooked Lake and Pickerel Lake with conveyance to a central wastewater treatment plant at Petoskey. There are localized shoreline water quality problems, so a Limited Action plan is recommended. The plan proposes the design and implementation of a small waste flows district; site-specific environmental and engineering analyses of existing on-site systems; repair and replacement of on-site systems as required; and cluster systems or other off-site treatment for Ellsworth Point and Botsford Landing. The site analyses should start with Ellsworth Point, Botsford Landing, and those individual systems that were found to be malfunctioning and a source of septic leachate plumes and high densities of Cladophora in the lakes. (Brambley-SRC)
W82-00364

FINAL ENVIRONMENTAL IMPACT STATEMENT; ALTERNATIVE WASTEWATER TREATMENT SYSTEMS FOR RURAL LAKE PROJECTS; CASE STUDY NO. 4: STEUBEN LAKES REGIONAL WASTE DISTRICT, STEUBEN COUNTY, INDIANA.
Environmental Protection Agency, Chicago, IL. Region V.
Report, January 1981. 157 p, 5 Fig, 5 Tab, 7 Append.

Descriptors: *Environmental Impact Statement, *Steuben Lakes, Indiana, *Wastewater treatment, *Wastewater facilities, *Sewer systems, Septic tanks, Cost analysis, Water pollution sources, Leachates, Water quality, Population dynamics, Case studies.

A Facilities Plan proposed a centralized collection and treatment systems for the communities in the Steuben Lakes area. Because of the cost, the uncertainty of the water quality improvements, and the potential for induced growth, the EPA conducted studies for a Draft Environmental Impact Statement. These studies showed that a few on-site treatment systems were having an impact on water quality although many did not comply with the Steuben County Sanitary Code. A Limited Action Alternative was selected which included decentralized systems for the entire area, and a program to replace and rehabilitate on-lot systems. This alternative will constrain future population growth, and result in development patterns that are more scattered and at a lower density than that which could be accommodated by a centralized treatment plant. This alternative will not incur a severe financial burden on most of the residents. (Brambley-SRC)
W82-00365

FINAL ENVIRONMENTAL IMPACT STATEMENT; ALTERNATIVE WASTEWATER TREATMENT SYSTEMS FOR RURAL LAKE PROJECTS; CASE STUDY NO. 5: OTTER TAIL COUNTY BOARD OF COMMISSIONERS, OTTER TAIL COUNTY, MINNESOTA.
Environmental Protection Agency, Chicago, IL. Region V.
Report, November 1980. 202 p, 8 Fig, 4 Tab, 8 Append.

Descriptors: *Environmental Impact Statement, *Otter Tail County, Minnesota, *Wastewater treatment, *Wastewater facilities, *Sewer systems, Septic tanks, Cesspools, Groundwater level, Groundwater pollution, Leachates, Water quality control, Water pollution sources, Coliforms, Case studies.

A Facilities Plan for centralized sewage collection and treatment for Otter Tail County, Minnesota, was rejected in the Draft Environmental Impact Statement (DEIS) because of its cost, uncertainty of water quality improvements, and potential for population growth. Subsequent groundwater hydrology and septic leachate surveys, and analyses of soils, groundwater and aquatic plants led to the Modified Limited Action Alternative. In this plan greywater/blackwater separation will only be used in individual dwellings where it will provide benefits; all cesspools will be replaced with on-site systems; holding tanks will be converted to receive only waste from very low flow toilets; all defective or undersized septic tanks will be replaced; dosed mound systems will be used where high groundwater prevents use of soil absorption systems; and half of the resort units will be served by cluster systems. This plan offers a low-cost solution to the wastewater problems of Otter Tail County - soil, lot size, and groundwater table conditions which make on-site treatment inadequate, high coliform counts in Otter Tail Lake, and high groundwater nitrate concentrations. (Brambley-SRC)
W82-00366

STATE-OF-THE-ART OF LIQUID WASTE DISPOSAL FOR GEOTHERMAL ENERGY SYSTEMS: 1979,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5E.
W82-00375

LIMESTONE-LIME TREATMENT OF ACID MINE DRAINAGE - FULL SCALE,
Peabody Coal Co., St. Louis, MO.
D. G. McDonald, and A. F. Grandt.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-172645, Price codes: A10 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S7-81-033, June 1981. 3 p, 1 Fig, 1 Tab.

Descriptors: *Acid mine drainage, *Wastewater treatment, *Chemical treatment, *Neutralization, *Lime, Limestone, Cost analysis, Sludge solids, Settleable solids, Sedimentation, Mine wastes.

A full-scale treatment plant was investigated to determine the most economical treatment of large volumes of highly acidic mine drainage and to characterize sludges from treatment processes as to settling behavior and solids content. Acid mine drainage was neutralized to pH 7.0 with a combination of limestone and hydrated lime, or with hydrated lime alone. The most economical treatment method was achieved through a combination of lime treatment on one line and limestone treatment on a second line, with recirculation on both lines. Both lime and lime-limestone treatment processes produced good settling behavior, with most of the sludges settling within one hour. Limestone treatment produced denser sludges with a higher solids content at pH levels above 4.5 than did the lime treatment. (Brambley-SRC)
W82-00377

PHYSICAL/CHEMICAL TREATMENT OF BLAST FURNACE WASTEWATERS USING MOBILE PILOT UNITS,
Rexnord, Inc., Milwaukee, WI.
R. Osantowski, A. Geinopolos, J. Kane, and G. Rollinger.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-159386, Price codes: A15 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-80-107, May 1981. 4 p, 3 Fig, 5 Ref.

Descriptors: *Wastewater treatment, *Pilot plants, *Steel industry, *Industrial wastes, Chlorination, Ozonation, Reverse osmosis, Cost analysis, Water quality, Standards, Effluents, Metals, Organic compounds, Blast furnace wastewater.

This project was initiated to provide an evaluation of the effectiveness of existing treatment technology for upgrading steel mill wastewaters to Best Available Technology (BAT) Economically Achievable limits for Blast Furnace Category scrubber wastewaters. The wastewater tested was a blast furnace effluent from an operating steel mill treatment system that met 1977 Effluent Guidelines for Best Practical Control Technology (BPT) Currently Available. This wastewater contained residual concentrations of suspended solids, BOD, oils and greases, phenols, cyanides, fluorides, ammonia compounds, sulfides, and dissolved solids. The in-depth pilot plant study was performed using mobile facilities designed especially for treating steel plant wastes. Treatment processes evaluated during the study included: alkaline chlorination, chemical treatment, dual media filtration, magnetic filtration, reverse osmosis, ozonation and activated carbon. Alkaline chlorination, ozonation, and reverse osmosis were all effective at reducing metals to <10 microgram/l except for zinc and selenium, and organics to <10 microgram/l with the exception of bis(2 ethylhexyl)phthalate. Alkaline chlorination was the least-cost alternative, whereas ozonation required least space. (Brambley-SRC)
W82-00378

HIGH-LEVEL OZONE DISINFECTION OF MUNICIPAL WASTEWATER EFFLUENTS,
Metcalf and Eddy, Inc., Boston, MA.
E. L. Stover, R. N. Jarnis, and J. P. Long.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-172272, Price codes: A06 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-040, May 1981. 8 p, 5 Fig, 1 Tab.

Descriptors: *Municipal wastewater, *Disinfection, *Wastewater treatment, *Ozonation, *Coliforms, Effluents, Water quality standards, Secondary wastewater, Design criteria, Sanitary engineering, Cost analysis, Filtered wastewater.

A 20-month operating experimental program conducted at Marlborough, Massachusetts, evaluated the feasibility, engineering, and economic aspects of achieving high-level effluent disinfection with ozone. The ozone research pilot facility had a maximum flow of 4.4 L/s (70 gpm), and was designed to operate with a constant wastewater flow rate or diurnal flow characteristic. Two effluent qualities (filtered nitrified and filtered secondary) were evaluated to assess water quality impacts on disinfection performance with ozone. The required absorbed ozone concentration to achieve specific levels of disinfection depended on water quality. Absorbed ozone concentrations of 15 to 20 mg/L and 35 to 40 mg/L were required to achieve high-level disinfection of less than 2.2 total coliforms/100 mL and 5 to 8 mg/L and 15 to 20 mg/L to achieve disinfection to 70 total coliforms/100 mL with the Marlborough filtered nitrified and filtered secondary effluent, respectively. Impacts of carrier gas ozone concentration, carrier gas flow rate, gas-to-liquid ratio, and applied ozone dose on contactor transfer efficiencies with both effluent qualities were defined. Water quality, transfer efficiency, and absorbed ozone concentrations are key factors affecting disinfection performance that must be evaluated for efficient design of ozone disinfection systems. Generator and contactor monitoring or mapping procedures and results using both air and oxygen carrier gases are presented as an approach for determining the economical ozone generator operating range and optimal ozone transfer efficiency. (Author's abstract)
W82-00379

ASSESSMENT OF OIL SHALE RETORT WASTEWATER TREATMENT AND CONTROL TECHNOLOGY - PHASES I AND II,
Monsanto Research Corp., Dayton, OH.
For primary bibliographic entry see Field 5B.
W82-00390

JOINT DRY/WET WEATHER TREATMENT OF MUNICIPAL WASTEWATER AT CLATSKANIE, OREGON,

Whiteley-Jacobsen and Associates, Portland, OR.
A. H. Benedict, and V. L. Roelfs.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-187262, Price codes: A06 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-061, June 1981. 4 p, 3 Tab.

Descriptors: *Municipal wastewater, *Wastewater treatment, *Wastewater facilities, High flow, Low flow, Clarification, Activated sludge process, Dissolved air flotation, Effluents, Water quality, Cost analysis, Sewer systems, Capital costs.

The joint dry/wet weather wastewater treatment facility at the small community of Clatskanie, Oregon, underwent a 2-year evaluation. Wet weather flows (WWF), as much as 6 to 10 times dry weather flows, result from severe infiltration/inflow (I/I) to the collection system. Rather than undergo expensive sewer rehabilitation, the treatment facility was designed to process flows ranging from 0.13 to 1.25 mgd (490 to 4730 cu m/day) where average dry weather flow is 0.2 mgd. During dry weather, the plant operates up to 0.5 mgd with primary clarification and an activated sludge mode. For higher flows, the plant can be run in a contact-stabilization mode and the primary clarifier can be operated in a dissolved air flotation (DAF) mode. The waste activated sludge generated during dry weather operation is held as standby sludge for the contact-stabilization operation. Average TSS and BOD concentrations in the effluent of dry weather flows were 10 mg/l and 13 mg/l, respectively, and for WWF the respective concentrations were 2-39 mg/l and 6-20 mg/l. Operating criteria and performance capabilities were developed to assist in other potential applications. The capital cost of the DAF-contact stabilization capability was estimated to be 14% over the cost of a standard dry weather flow plant. The annual operation and maintenance cost was estimated to be 3% over the operation and maintenance cost of a standard dry weather flow plant. The results indicate that for other communities this treatment scheme may be more cost effective than extensive sewer rehabilitation provided the community is in the process of upgrading its treatment plant. For this approach to be a long-term solution to the I/I problem, however, the community must continue a sewer rehabilitation program, or an inflow control program, or both to keep pace with the growth of the city. (Brambley-SRC)
W82-00391

RECLAIMING AND REUSING WASTEWATER,
California Univ., Berkeley.
W. H. Bruvold, and J. Cook.
Water/Engineering and Management, Vol 128, No 4, p 65, 66, 68, 69, 71, April, 1981. 3 Tab, 11 Ref. OWRT-A-061-CAL(2).

Descriptors: *Reclaimed water, *Public opinion, Attitudes, Public health, Surveys, Wastewater treatment, Water treatment, Drinking water.

A study was performed to assess current public attitudes toward the use of reclaimed water for drinking, employing standard survey research procedures and a quantitative measure of attitudes. An assessment was then made of relations of the attitudes thus quantitated with sociodemographic and belief variables. The general recommendations resulting from the survey favored wastewater treatment and reuse comprising advanced waste treatment followed by beneficial reuse not involving a high degree of human contact. Public support for such proposals can be gathered in general by arguing that the public health is protected, that there is a need to conserve scarce water supplies, and that the environment will be protected from unnecessary degradation. Economic advantages of using reclaimed water could be of interest to the less affluent and more elderly population groups. Through such efforts the reuse of wastewater after treatment will gain support from the public, which is necessary if it is to be implemented. (Baker-FRC)
W82-00402

HIGH PH TREATMENT OF COMBINED WATER SOFTENING AND WASTEWATER SLUDGES,
Iowa Univ., Iowa City.
R. R. Dague, J. N. Veenstra, T. W. McKim, T. G. Ashenmacher, and J. M. Lannon.
Journal of the Water Pollution Control Federation, Vol 52, No 8, p 2204-2219, August, 1980. 24 Fig, 4 Tab, 32 Ref. OWRT-A-062-IA(1).

Descriptors: *Lime, *Bacteria, *Hydrogen ion concentration, *Disinfection, Sludge treatment, *Wastewater treatment, Coliforms, Water treatment, Activated sludge, *Water softening.

Water softening sludge combined with waste water sludge was studied in a 2-phase investigation of the effects of high pH on bacterial survival. From 99.44 to 99.98% of fecal coliforms in waste water sludge alone were killed at pH values between 11.0 and 12.2 at 20C and 35C after 1 hour. Total aerobes were slightly hardier--under the same conditions 98.58-99.87% were killed. Fecal streptococci were even more resistant: 93-96% died after 1 hour at pH 12.2, temperature 20C and 35C, and more survived at lower pH. Grow-back occurred at 20C and 35C, especially in fecal coliforms. After 48 hours, these bacterial counts exceeded baseline counts at all pH tested (5.8-12.2) except for pH 11.8 and 12.2 at 20C. Total aerobes showed slight grow-back at pH 11.8 from the 1 hour kill levels, increasing as pH decreased from that point. Fecal coliforms had the least tendency to grow back, showing larger than baseline counts only at pH 5.8. Adding chemical water softening sludges to primary waste water sludge somewhat reduced the amount of hydrated lime required to reach and maintain a pH of 12.0 for 15 days. The chemical quality of the combined sludge improved vacuum filter dewatering performance in terms of total cake solids and filter yields. However, when applied to mixtures of waste activated sludge and primary waste water sludge, high pH treatment increased COD, BOD, and total Kjeldahl nitrogen in filtrates from dewatering operations and produced no reduction in lime requirements. (Cassar-FRC)
W82-00403

DESIGN, EVALUATION AND EFFLUENT WATER QUALITY ANALYSIS OF THREE OYSTER SHELLSTOCK WASHERS,
Mitre Corp., McLean, VA.
S. S. Chang, and F. W. Wheaton.
Transactions of the ASAE, Vol 24, No 1, p 234-241, January-February, 1981. 4 Fig, 4 Tab, 17 Ref. OWRT-A-033-MD(2).

Descriptors: *Oysters, *Waste water treatment, *Food-processing wastes, Water quality control, Biochemical oxygen demand, Chemical oxygen demand, Waste water analysis, Hydrogen ion concentration, Water quality standards, Maryland, Industrial waste water, Disinfection.

Due to pressure from the Food and Drug Administration and state health officials, the washing of oyster shellstock in Maryland is becoming a more common practice in the oyster industries. Three techniques of washing oyster shellstock were evaluated for their effectiveness of cleansing oysters. The two methods giving the best cleaning results were examined for wash water quality to determine the need for waste water treatment in oyster processing plants. A rotary tumbler, a rotary brush washer, and a pressurized water spray washer were designed and constructed. Methods which gave the best results were examined for fifteen water quality parameters. Results of the water quality analysis showed that the effluent must be disinfected prior to discharge. It was also found that in some cases, the effluent pH should be lowered to comply with existing EPA standards and regulations set down by the state of Maryland. The practice of washing oyster shellstock will add biochemical oxygen demand, chemical oxygen demand, bacteria, suspended solids, filterable solids and settleable solids to the waste water of oyster processing plants. (Geiger-FRC)
W82-00406

CONTINUOUS BIOREGENERATION OF GRANULAR ACTIVATED CARBON DURING THE ANAEROBIC DEGRADATION OF CATECHOL,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
M. T. Suidan, W. H. Cross, and M. Fong.
Progress in Water Technology, Vol 12, No 6, p Tor 203-214, 1980. 5 Fig, 4 Tab, 13 Ref. OWRT-A-077-GA(2).

Descriptors: *Activated carbon, *Tertiary treatment, *Filters, *Waste water treatment, Organic wastes, Industrial wastes, Adsorption, Separation techniques, Methane, Chemical oxygen demand, Biodegradation, Biological treatment, Aromatic compounds, Anaerobic conditions.

An anaerobic activated carbon filter consisting of four jacket columns and three clarifiers was used to treat a synthetic waste water containing catechols. Catechol was removed from the feed solution mainly by adsorption onto the activated carbon during the initial acclimatization period. Following acclimatization, vigorous anaerobic activity took place, which generated a greater total carbon equivalent in the gaseous products than was removed as organic carbon during anaerobic bioregeneration of the activated carbon. When the period of vigorous anaerobic activity was finished, the production of gas returned to a level corresponding to the amount of organic carbon removed during the treatment process. Steady-state operating conditions were found at all three feed concentrations of catechol tested, which corresponded to 200, 400, and 1,000 milligrams/liter. With the present device, total organic carbon reductions exceeded 81%, while chemical oxygen demand removals of 95% were achieved. (Geiger-FRC)
W82-00408

PROCESSING NEEDS AND METHODOLOGY FOR WASTEWATERS FROM THE CONVERSION OF COAL, OIL SHALE AND BIOMASS TO SYNFUELS.
California Univ., Berkeley. Dept. of Chemical Engineering.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/EV-0081, Price codes: A09 in paper copy, A01 in microfiche. Department of Energy Report DOE/EV-0081, May 1980. 185 p, 1 Fig, 3 Tab, 17 Ref, 15 Append. DE-AT03-79EV10227.

Descriptors: *Process water, *Wastewater treatment, *Oil shale, *Coal gasification, *Biomass, Fuel, Industrial wastes, Water use, Water reuse, Pollution load, Pollutants, Effluents, Water pollution control, Sludge disposal, Water conservation.

This report stems from the workshop held at Germantown, Maryland, 14-15 June 1979, with the purpose of identifying needs to be accomplished by processing technology and evaluating the suitability, approximate costs and problems associated with wastewaters from the conversion of coal, oil shale and biomass to synfuels. Water usage may be very high, but can be reduced by recycling within the plant. Some possible effluent levels from pollutants are suggested. Costs are presented for gravity separation techniques, steam stripping, solvent extraction, bio-treatment, carbon adsorption, iron precipitation, ozonation, wet-air oxidation, ion exchange, incineration, deep-well injection, and concentration processes, with their technical advantages and disadvantages. The critical environmental control issues are identified as total dissolved solids, polynuclear aromatic hydrocarbons and nitrogen heterocyclics, ammonia or nitrate, color, arsenic and other heavy metals, boron, toxicity safeguard, disposal of sludges, carbon regeneration effluent, and secondary effluent. Water handling and treatment should be considered as an integral part of a specific fuel conversion process, and the possibilities of recycling and reuse explored to reduce water demand. Each appendix is an individual status report on wastewater processing and methodology. (See W82-00432 thru W82-00445) (Brambley-SRC)
W82-00431

ASSESSMENT OF ENVIRONMENTAL CONTROL TECHNOLOGY FOR COAL CONVERSION PROCESSES,
Oak Ridge National Lab., TN.
J. A. Klein.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/EV-0081, Price codes: A09 in paper copy, A01 in microfiche. In: Processing Needs and Methodology for Wastewaters from the Conversion of Coal, Oil Shale and Biomass to Synfuels, Department of Energy Report DOE/EV-0081, May 1980. p B1-B6, 1 Fig, 3 Ref.

Descriptors: *Coal, *Wastewater treatment, *Coal gasification, *Biodegradation, *Adsorption, *Ozonation, Bacteria, Organic compounds, Phenols, Hydrocarbons, Industrial wastes.

The effectiveness of various treatment systems for the cleanup of aqueous coal conversion wastes is being investigated. A flow sheet of a number of waste treatment units was developed, and three have been investigated as independent units. A tapered fluidized-bed bioreactor containing bacteria on a support of coal or sand has been used with and without oxygen. The bioreactor can reduce phenol to < or = 1 microgram/cu cm, thiocyanate to 1-5 microgram/cu cm and total soluble organics by 95%. Adsorption experiments have attempted to find a substitute for activated charcoal, and a Texas lignitic coal was found to reduce 90% of the polynuclear aromatic hydrocarbons (PAH) and 9% of the total organic carbon content of a hydrocarbonization water. Ozonation has been investigated as a final cleanup step, to remove those compounds which pass through biological treatment. Ozonation can reduce PAH and phenol levels by 95-98%, with contact times of 15 min or less. The most effective integration of these units with others has yet to be achieved. (See also W82-00431) (Brambley-SRC)
W82-00432

SLAGGING FIXED-BED GASIFIER (SFBG) WASTEWATER PRETREATMENT,
Department of Energy, Grand Forks, ND. Grand Forks Energy Technology Center.
W. G. Willson.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/EV-0081, Price codes: A09 in paper copy, A01 in microfiche. In: Processing Needs and Methodology for Wastewaters from the Conversion of Coal, Oil Shale and Biomass to Synfuels, Department of Energy Report DOE/EV-0081, May 1980. p C1-C4.

Descriptors: *Coal gasification, *Wastewater treatment, *Industrial wastewater, *Waste characteristics, Effluents, Zero discharge, Waste disposal, Economic aspects, Environmental effects.

The Grand Forks Energy Technology Center's 24-ton/day slagging fixed-bed gasifier (SFBG) is the only operable unit of its type in the United States, and affords many research opportunities in the coal gasification process. Commercially available waste water treatment processes appear to be applicable to coal gasification waste streams, but each treatment plant will need appropriately designed units to meet the specific technology and feedstock requirements and the environmental and economic constraints at each particular installation. The SFBG can be used with low-rank and bituminous coals to develop such specific information, and by sampling and analysis of waste streams to characterize gaseous, solid, and liquid effluents, and by testing of treatment processes, may establish the feasibility of zero discharge of liquids and safe disposal of solid wastes. The economics of the treatment processes must also be determined. (See also W82-00431) (Brambley-SRC)
W82-00433

TREATMENT OF COAL GASIFICATION PROCESS WASTEWATERS,
Carnegie - Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering.
R. C. Luthy.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/EV/0081, Price codes: A09 in paper copy, A01 in microfiche. In: Processing Needs and Methodology for Wastewaters from the Conversion of Coal, Oil Shale and Biomass to Synfuels, Department of Energy Report DOE/EV-0081, May 1980. p D1-D9, 2 Fig, 11 Ref.

Descriptors: *Coal gasification, *Process water, *Wastewater treatment, *Biological wastewater treatment, Effluents, Nitrification, Adsorption, Reverse osmosis, Ion exchange, Cyanide, Ammonia, Phenols, Economic aspects, Hydrocarbons, Chemical oxygen demand.

Biological treatment, alone or with physicochemical treatment is an important method of upgrading coal gasification wastewaters. Studies have been conducted using two different wastewaters and different dilutions to determine removal efficiencies and cell residence times. Nitrification was feasible with the slagging fixed-bed pilot plant effluent, but not with the Hygas pilot plant effluent. Nitrification efficiency with stripped wastewater was greatest at low COD removal rates. Up to 100 mg/l cyanide could be treated without difficulty. Both wastewaters required dilution or ammonia stripping to overcome ammonia toxicity. Phenol recovery by solvent extraction is believed to be technically feasible but economically uncertain. Ultimately the need to protect the biological reactor from shock organic loads and to remove refractory organic compounds may outweigh economic considerations. Ion exchange studies have shown good breakthrough characteristics and capacities for biological reactor effluent which had been pretreated by activated carbon adsorption for residual organic removal. Reverse osmosis was not as effective, and the membrane characteristics deteriorated rapidly. Powdered activated carbon tratment provided greater removal of COD and polynuclear aromatic hydrocarbons. (See also W82-00431) (Brambley-SRC)
W82-00434

ENVIRONMENTAL CONTROL TECHNOLOGY FOR THE FLASH HYDROPYROLYSIS OF COAL,
Brookhaven National Lab., Upton, NY. Process Sciences Div.
A. S. Albanese.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/EV-0081, Price codes: A09 in paper copy, A01 in microfiche. In: Processing Needs and Methodology for Wastewaters from the Conversion of Coal, Oil Shale and Biomass to Synfuels, Department of Energy Report DOE/EV-0081, May 1980. p E1-E7, 3 Ref.

Descriptors: *Coal gasification, *Water pollution sources, *Wastewater treatment, *Process water, Biological wastewater treatment, Filtration, Phenols, Ammonia, Suspended solids, Fluorides, Organic compounds, Runoff, Leachates.

The environmental factors and control technologies involved in the flash hydropyrolysis of coal for the production of gaseous and liquid hydrocarbon fuels and feedstocks are assessed. An aqueous phase is produced in the process which contains ammonia, phenols, cyanide and thiocyanate in proportions depending upon the original coal and the hydropyrolysis conditions. Facilities to treat these liquid wastes include a degasifier and condensate cooler, phenol remover, biological treatment reactor, and final wastewater treatment unit. Filtration to remove suspended solids and lime treatment to remove fluoride ions may also be required. Phenols can be removed by solvent extraction using isopropyl ether or oil. Biological treatment can be used to remove nitrogen, phosphorus and sulfur compounds and some organics, but not aromatic hydrocarbons or trace metals. Additional water pollution problems may arise from run-off from the coal before processing, and the leachate from disposal of the coal refuse. (See also W82-00431) (Brambley-SRC)
W82-00435

CHEMICAL RECOVERY FROM COAL CONVERSION WASTES BY CONCENTRATION,
Concentration Specialists, Inc., Andover, MA.
W. R. Killilea.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/EV/0081, Price codes: A09 in paper copy, A01 in microfiche. In: Processing Needs and Methodology for Wastewaters from the Conversion of Coal, Oil Shale and Biomass to Synfuels, Department of Energy Report DOE/EV-0081, May 1980. p F1-F6, 2 Fig.

Descriptors: *Coal gasification, *Wastewater treatment, *Wastewater renovation, *Water reuse, *Chemical recovery, Phenol, Ammonia, Freeze crystallization, Incineration, Cost analysis, Cooling water, Waste disposal.

A study was conducted to determine the feasibility of using concentration processes to recover chemical by-products from the gas liquor stream of a coal gasification plant and to produce reusable water. Large quantities of gas liquor are produced containing high concentrations of phenol and ammonia. Reverse osmosis and evaporation were investigated and rejected whereas freeze crystallization was practical and economically cost-effective. A three-stage freezing system was designed, in which pure water freezes first and is removed; continued cooling results in the precipitation of ammonium carbonate, and then of phenol. Each solid product is washed to remove surface contamination and the wash water returned to the gas liquor feed. The water obtained from the melted ice can be used as cooling tower water with some make-up water, and the remaining heavily contaminated water can be disposed of by chemical fixation, incineration, or return to the gasifier. Based on current, available costs, with the three-stage freezing process and incineration of the waste concentrate, a return of 80 cents/1000 gallons can be achieved. (See also W82-00431) (Brambley-SRC)
W82-00436

IMPROVED WATER MANAGEMENT OF COAL CONVERSION PROCESSES BY PRELIMINARY ABSORPTION OF HALIDES,
McKee (Arthur G.) and Co., Cleveland, OH.
W. A. Parsons.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/EV/0081, Price codes: A09 in paper copy, A01 in microfiche. In: Processing Needs and Methodology for Wastewaters from the Conversion of Coal, Oil Shale and Biomass to Synfuels, Department of Energy Report DOE/EV-0081, May 1980. p G1-G5.

Descriptors: *Coal gasification, *Wastewater treatment, *Halogens, *Condensates, Dissolved solids, Cost analysis, Incineration, Evaporation, Waste disposal, Desalination, Desalination wastes, Reverse osmosis.

The technical, economic and environmental advantages and disadvantages of single stage and two stage gas quenching at a producer gas installation were compared. Air-blown and oxygen-blown gasifier operations were used with a high halide Illinois coal and a low halide Montana coal. A first stage quench condensing 10 gallons of water/ton of coal by either a sieve tray absorber or a venturi scrubber was determined to be effective for absorption of halides. The secondary condensate was amenable to recovery as a low dissolved solids service water after processing by steam stripping and activated sludge treatment. The two stage quench system was cost effective with the Illinois coal whereas the single quench system was cost effective for the Montana coal. The dominant variable in determining the cost effectiveness was the halide content. For halide concentrations, expressed as chloride, above 0.15% and 0.16%, for air-blown and oxygen-blown gasifier operations, respectively, the two stage system is cost effective, while for lower halide concentrations the single quench system is cost effective. The preferred disposal concept for inorganic wastewater blown down from a high halide coal operation was incineration with disposal of salt cake at sea, using a two stage quench system in conjunction with desalination by reverse osmosis and thermal evapora-

tion. When low halide coal is used the preferred disposal concept was pond evaporation, using a single quench system in conjunction with desalination by reverse osmosis. (See also W82-00431) (Brambley-SRC)
W82-00437

SOLVENT EXTRACTION OF PHENOLS,
California Univ., Berkeley.
C. J. King, S. Lynn, D. N. Hanson, D. C. Greminger, and G. P. Burns.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/EV/0081, Price codes: A09 in paper copy, A01 in microfiche.
In: Processing Needs and Methodology for Wastewater from the Conversion of Coal, Oil Shale and Biomass to Synfuels, Department of Energy Report DOE/EV-0081, May 1980. p H1-H8, 3 Fig, 1 Tab, 2 Ref.

Descriptors: *Coal gasification, *Wastewater treatment, *Phenols, *Organic solvents, Solubility coefficient, Waste recovery, Molecular structure, Temperature, Hydrogen ion concentration, Diisopropyl ether, Methyl isobutyl kentone.

The Lurgi Phenosolvan process for solvent extraction from coke-oven waters using diisopropyl ether as the solvent has been suggested as a method of phenol removal from coal-conversion plant wastewaters. This may not be possible because of the significant quantities of polyhydric phenols in the coal-conversion wastewaters, and the high pH of the wastewater, and because of the need to simplify the Phenosolvan process and to determine the most appropriate temperature for the process. The presence of a carbonyl group increases hydrogen bonding with the hydroxy groups of the phenols, so based on its miscibility, volatility and stability properties methyl isobutyl ketone (MIBK) was selected as a test solvent. The distribution coefficients for 6 polyhydric phenols into MIBK were determined. The values obtained showed that MIBK extraction could be practical. The distribution coefficient for phenol into MIBK decreased with increasing temperature, suggesting that the extraction process could be carried out at low temperatures, which could favor vacuum stripping. For both phenol and resorcinol the distribution coefficient in diisopropyl ether decreases with increasing pH, and is significantly reduced in the pH range of coal-conversion wastewaters, whereas the distribution coefficient for phenols into MIBK is significantly higher at low pH. (See also W82-00431) (Brambley-SRC)
W82-00438

ASSESSMENT OF SOLVENT EXTRACTION FOR TREATMENT OF COAL GASIFIER WASTEWATER,
Missouri Univ.-Columbia.
R. H. Luecke.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/EV-0081, Price codes: A09 in paper copy, A01 in microfiche.
In: Processing Needs and Methodology for Wastewaters from the Conversion of Coal, Oil Shale and Biomass to Synfuels, Department of Energy Report DOE/EV-0081, May 1980. p I1-I8, 3 Tab, 8 Ref.

Descriptors: *Coal gasification, *Wastewater treatment, *Phenols, *Organic solvents, Pollutants, Capital costs, Operating costs, Cost analysis, Waste recovery, Octanone, Economies of scale.

Solvent extraction of organic pollutants from coal gasification plant waste streams may overcome some of the problems associated with other methods. To make the process efficient a dual extraction process is recommended, in which the wastewater is contacted counter-currently with a polar solvent and then in another contactor with a non-polar solvent. The solvent streams are processed in separate distillation systems, with the pollutants being recovered and the solvents recycled to appropriate extraction. A design for an extraction system using 2-octanone has five stages, which will remove hydroquinone at 75% efficiency, catechol at 95%, resorcinol at 99%, and phenol, cresols and xylenols at 99.99% efficiencies. The process is relatively complex and hence expensive. The capital investment for a plant to treat 100 gpm of wastewater is about $0.5 million, and for a 1000 gpm plant is $1.7 million. Operating costs range up to $6.50/1000 gallons, compared to about $0.40/1000 gallons for biological treatment, indicating that a sizeable return on the recovered pollutants is necessary to justify the solvent extraction wastewater treatment process. (See also W82-00431) (Brambley-SRC)
W82-00439

CONTROL TECHNOLOGY STRATEGIES FOR COAL PREPARATION WASTE DRAINAGES,
Los Alamos Scientific Lab., NM.
P. Wagner, J. M. Williams, J. P. Bertino, L. E. Wangen, and P. L. Wanek.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/EV/0081, Price codes: A09 in paper copy, A01 in microfiche.
In: Processing Needs and Methodology for Wastewaters from the Conversion of Coal, Oil Shale and Biomass to Synfuels, Department of Energy Report DOE/EV-0081, May 1980. p J1-J8, 5 Tab.

Descriptors: *Wastewater treatment, *Mine wastes, *Water pollution control, *Acid streams, Coal mining, Calcining, Wastedisposal, Bases, Chemical reactions, Leachates, Dissolved solids, Hydrogen ion concentration, Trace elements, Cost analysis.

Laboratory investigations were conducted into the options available for treating high-sulfur coal refuse materials by calcining to immobilize refuse constituents, codisposal of wastes with alkaline materials, and by treating the contaminated drainage from refuse dumps. A high-sulfur coal preparation waste was calcined at temperatures up to 1200C for 2h. Mineral conversion reactions took place which resulted in reductions of up to two orders of magnitude of toxic elements in the leachate. Addition of 3 and 10% by weight of lime to the same coal waste with subsequent drying and recrushing effectively reduced the acidity of leachates, and lowered the total dissolved solids and the trace element concentrations. Smaller lime additions were not effective. Contaminated refuse drainages from three plants were titrated with limestone, lime or sodium hydroxide to a predetermined pH. Raising the pH was associated with a reduction of total dissolved solids. All the methods are effective in reducing or abating trace element contamination of coal refuse drainage, but they differ significantly in cost, process complexity, treatment duration, by-products potential, permanency, and categorization of the waste for Resource Conservation and Recovery Act purposes. (See also W82-00431) (Brambley-SRC)
W82-00440

CHARACTERIZATION AND PROCESSING OF COAL CONVERSION PROCESS WASTEWATERS,
Department of Energy, Pittsburgh, PA. Pittsburgh Energy Technology Center.
G. E. Johnson, and C. J. Drummond.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/EV/0081, Price codes: A09 in paper copy, A01 in microfiche.
In: Processing Needs and Methodology for Wastewaters from the Conversion of Coal, Oil Shale and Biomass to Synfuels, Department of Energy Report DOE/EV-0081, May 1980. p K1-K14, 8 Fig, 2 Tab.

Descriptors: *Coal gasification, *Wastewater treatment, *Process water, Water pollution control, Phenols, Ammonia, Hydrocarbons, Oil, Activated carbon, Adsorption, Nitrification, Chemical precipitation, Biochemical oxygen demand, Oxidation.

A commercial coal gasification plant is expected to produce about 3 mgd of process waters containing phenols, ammonia, polynuclear aromatic hydrocarbons, and other pollutants, which must be treated. The Synthane process produces a byproduct char which has been partially activated, and has the properties of a low grade activated carbon. It can be used as an adsorbent for Synthane process condensates, either as a primary treatment step or as a tertiary polishing step following biochemical oxidation. The other units of the treatment system are nitrification, and oil and tar precipitation. Ammonia is removed to about 500 mg/l by batch stripping with nitrogen at 90C. Oils and tars are precipitated by acidification to pH 2.5 with phosphoric acid, followed by lime neutralization. A complete mix, continuous unit with sludge recycle has been produced for biochemical oxidation. The separate units have been integrated to produce a treatment sequence with a flow capacity of 6 gal/h. (See also W82-00431) (Brambley-SRC)
W82-00441

BIOLOGICAL OXIDATION OF AQUEOUS THIOCYANATE,
Pittsburgh Univ., PA. Dept. of Civil Engineering.
R. D. Neufeld, L. Mattson, and P. Lubon.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/EV/0081, Price codes: A09 in paper copy, A01 in microfiche.
In: Processing Needs and Methodology for Wastewaters from the Conversion of Coal, Oil Shale and Biomass to Synfuels, Department of Energy Report DOE/EV-0081, May 1980. p L1-L10, 7 Fig, 2 Tab, 12 Ref.

Descriptors: *Coal gasification, *Wastewater treatment, *Thiocyanates, *Biological oxidation, Effluents, Pollution load, Kinetics, Sludge volume index, Pilot plants, Steel industry, Industrial wastes.

Depending on the coal and the gasification conditions, coal gasification produces effluents containing 35-1250 mg/l of thiocyanate. Research has been conducted to develop a kinetic expression and material balance for nitrogen and sulfur for the biological oxidation of aqueous thiocyanates as found in coal conversion and steel industry wastewaters. Biochemical degradation of thiocyanate yields sulfate, sulfide, and ammonium ions. Experiments were conducted in fill and draw semicontinuous reactors with 3.5 or 8 1 working volumes, sludge age of 5-15 days, pH of 7 or 8, and an organism which used thiocyanate as the sole carbon source. Specific utilization of thiocyanate increases with substrate concentration up to about 550 mg/l, when it becomes inhibitory. A representative yield coefficient for thiocyanate degrading organisms was about 0.127 lb volatile suspended solids/lb thiocyanate. The biooxidation process seems to be unstable at sludge ages of less than four days. In this system 89-106% of the thiocyanate nitrogen was accounted for as ammonia, and 90-97% of the thiocyanate sulfur was accounted for as sulfate. Sludge settling rates and volume are considered good, and should pose no problems in clarification processes. (See also W82-00431) (Brambly-SRC)
W82-00442

WATER-RELATED ENVIRONMENTAL CONTROL REQUIREMENTS OF WASTE-TO-ENERGY CONVERSION,
Iowa State Univ., Ames.
J. C. Young.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/EV/0081, Price codes: A09 in paper copy, A01 in microfiche.
In: Processing Needs and Methodology for Wastewaters from the Conversion of Coal, Oil Shale and Biomass to Synfuels, Department of Energy Report DOE/EV-0081, May 1980. p M1-M5, 2 Tab.

Descriptors: *Wastewater treatment, *Water pollution control, *Water pollution prevention, *Fuel, Wastewater analysis, Water quality standards, Pollutants, Solid waste disposal, Biomass, Anaerobic digestion, Biological wastewater treatment, Leachates.

Laboratory-scale tests have been conducted with wastewaters from four waste-to-energy conversion processes to determine their treatability by conventional and advanced technology, their impact on biological treatment systems, and the leaching characteristics of their solid residues and sludges. Problems common to all the processes are the lack

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of dependable test methods for analyzing wastewaters for priority pollutants and other constituents, the lack of definite discharge standards for priority pollutants, and uncertainty over methods of solid residue disposal. Specific water related pollution technologies have been identified for each waste-to-energy conversion process. Physical and/or chemical treatment is suitable for controlling the inorganic compounds resulting from mass-burning. Dry processing of refuse derived fuel produces wastes which can be discharged to municipal sewers, if the ash sluice waters are recycled. The wastes from wet processing facilities can be treated by biological and chemical methods. Pyrolysis processes produce priority pollutants which may be treated by biological or chemical methods, but may not achieve reduction to permissible discharge levels. Priority pollutants from anaerobic digestion processes tend to be adsorbed to the residual solids, posing the problem of leachate from the ultimate disposal site. Biological or chemical methods can be used to treat the wastewater. (See also W82-00431) (Brambley-SRC)
W82-00443

ENVIRONMENTAL CONTROL TECHNOLOGY FOR SHALE OIL WASTEWATERS,
Battelle Pacific Northwest Lab. Richland, WA.
B. W. Mercer.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/EV/0081, Price codes: A09 in paper copy, A01 in microfiche. In: Processing Needs and Methodology for Wastewaters from the Conversion of Coal, Oil Shale and Biomass to Synfuels, Department of Energy Report DOE/EV-0081, May 1980. p N1-N14, 3 Fig, 5 Tab.

Descriptors: *Oil shale, *Wastewater treatment, *Water pollution control, *Pollution load, Ammonia, Organic compounds, Biochemical oxygen demand, Chemical oxygen demand, Suspended solids, Heavy metals, Cost analysis, Water reuse.

Studies have been conducted to assess current technology for the treatment and disposal of shale oil wastewaters to maintain acceptable quality levels in the receiving waters of the oil shale regions presently under development. The wastewaters are highly contaminated with ammonia, BOD, refractory organics, and salinity, a stable suspension of organic matter, and with toxicants such as arsenic which may interfere with biological treatment. Treatment by a series of units is necessary to obtain satisfactory reduction of pollutants. Raw retort water treated by suspended matter removal, ammonia removal, BOD removal, suspended solids removal, dissolved organics removal, and dissolved salts removal is of a quality suitable for discharge or reuse. Ammonia was removed by steam stripping; activated sludge and activated carbon were used to remove BOD and COD, respectively. Costs for the treatment range from $26-45.00/1000 gal. The water can be reused for steam generation or cooling purposes. (See also W82-00431) (Brambley-SRC)
W82-00444

POTENTIAL USES OF SPENT SHALE IN THE TREATMENT OF OIL SHALE RETORT WATERS,
California Univ., Berkeley. Lawrence Berkeley Lab.
J. P. Fox, and D. L. Jackson.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/EV-0081, Price codes: A09 in paper copy, A01 in microfiche. In: Processing Needs and Methodology for Wastewaters from the Conversion of Coal, Oil Shale and Biomass to Synfuels, Department of Energy Report DOE/EV-0081, May 1980. p 01-020, 5 Fig, 6 Tab, 8 Ref.

Descriptors: *Oil shale, *Wastewater treatment, *Organic carbon, *Adsorption, Specific conductivity, Hydrogen ion concentration, Inorganic carbon, Odor control, Color removal, Water pollution control.

Spent shale has two potential applications in wastewater purification - circulation of water through a spent in situ retort, and circulation of water through columns packed with spent shale from surface retorts. Batch and column studies were conducted with four samples of retort water and six of spent shale to determine the effects on dissolved organic carbon (DOC), dissolved inorganic carbon (DIC), conductivity and pH. In the batch studies reductions in DOC of up to 73% were achieved and up to 99% of DIC. Spent shales with the highest DOC adsorptive capacity are least effective in DIC removal and vice versa. The reduction in DIC levels is accompanied by a decrease in conductivity and an elevation in pH. In the column experiments the color and odor of retort water was almost completely removed by the spent shale, and some organic compounds were removed, but column breakthrough occurred before two pore volumes could be treated. If this problem is overcome, passage through spent shale could become a useful treatment process. It makes ammonia stripping easier by increasing the pH, and by reducing DIC, DOC and conductivity, it decreases the load on these treatment units. (See also W82-00431) (Brambley-SRC)
W82-00445

THE HARVEST OF MICROALGAE FROM THE EFFLUENT OF A SEWAGE FED HIGH RATE STABILIZATION POND BY TILAPIA NILOTICA. PART 1: DESCRIPTION OF THE SYSTEM AND THE STUDY OF THE HIGH RATE POND,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Agricultural and Food Engineering.
P. Edwards, and O-A. Sinchumpasak.
Aquaculture, Vol 23, No 1-4, p 83-105, April, 1981. 4 Fig, 3 Tab, 27 Ref.

Descriptors: *Stabilization ponds, *Wastewater treatment, *Phytoplankton, Algae, Experimental design, Design criteria, High flow, Growth.

A sewage-driven, two trophic level food chain involving phytoplankton produced in a high rate stabilization pond and herbivorous Tilapia nilotica raised in associated fish ponds was studied to determine factors affecting fish growth and to assess the fertilization potential of the fish pond effluent for maize cultivation. The waste treatment and recycling system consisted of a 200-square-meter high rate stabilization pond, a series of 4-cubic-meter concrete fish ponds, and a maize plot. The sewage fed to the stabilization pond was weak, with a mean 5-day biological oxygen demand of 45 mg per liter and a mean surface organic loading of 75 kg of 5 day biological oxygen demand per hectare per day. As a result, the pond was nutrient limited, not light-limited. The mean phytoplankton concentration was 94 milligrams per liter, with a detention time of 3 days, and the mean phytoplankton yield was 15.7 grams per square meter per day. It should be possible to achieve at least double this yield in a high rate stabilization pond in Thailand without nutrient limitation. The wide variety of dominant phytoplankton recorded in the high rate stabilization pond may have been due either to the weak sewage or to the lack of seasonal temperature changes. Although the phytoplankton community was generally stable, it collapsed on two occasions. There were no discernible seasonal variations in the composition of the phytoplankton community. (Carroll-FRC)
W82-00455

MANAGEMENT AND DESIGN IMPLICATIONS OF A MATHEMATICAL MODEL OF A RAPID GRAVITY SAND FILTER BACKWASH,
Rodbourne Water Pollution Control Plant, Swindon (England).
J. Hilton, and K. V. Whitehall.
Water Research, Vol 15, No 8, p 1013-1017, August, 1981. 3 Fig, 2 Ref.

Descriptors: *Mathematical models, *Backwash, *Gravity filters, Sand filters, Filtration, *Wastewater treatment, Water treatment, Design criteria.

A model of the hydraulic system of backwashing was developed and tested. The model assumes that above the media surface the direction of flow is horizontal towards the weir, that below the media surface flow is vertical, and that the two are instantaneous. The model is applied to the problem of sand loss in rapid gravity filters. This theory suggests a new remedy involving the reduction of the bed length. Also, it suggests the use of closely spaced longitudinal weirs. The model is also applied to investigate backwash times. An equation is presented to determine the minimum length of backwash required to obtain an acceptably clean bed. The model can determine the length of backwash necessary in order to obtain maximum removal of solids with minimum use of backwash water. (Small-FRC)
W82-00460

LOW TEMPERATURE REMOVAL OF NITRATE BY BACTERIAL DENITRIFICATION,
Trondheim Univ. (Norway).
G. Halmo, and K. Eimhjellen.
Water Research, Vol 15, No 8, p 989-998, August, 1981. 4 Fig, 7 Tab, 14 Ref.

Descriptors: *Denitrification, *Activated sludge process, *Bacteria, *Wastewater treatment, Biological treatment, Nitrates, Nitrification, Domestic wastes, Temperature effects.

Enrichments of psychrophilic denitrifying bacteria were tested to further understand the problems associated with low-temperature denitrification in wastewater treatment. Two denitrifying sludges enriched at 5 and 20 deg C were exposed to the same chemical and hydraulic conditions, and sludge efficiency was determined. In the range 0-17 deg C, the specific denitrification rate of the low temperature sludge was 1.5-4 times the high temperature sludge rate. Also, at 2 deg C under nitrate limiting conditions, 98% nitrate reduction was found at a hydraulic resistance time of 3.5 hr with an influent concentration of 0.8 mg N03-N per liter. Low temperature sludge also had better sedimentation characteristics. The low temperature sludge consisted predominantly of psychrotrophs/psychrophiles and had low concentrations of mesophiles. Low temperature sludges tested in a three stage biological process receiving domestic sewage gave 90% removal of total nitrogen at hydraulic residence times of 1.5, 9, and 4 hr for two aeration stages and an anaerobic stage, respectively. Overall nitrification/denitrification was 95%. (Small-FRC)
W82-00461

TESTING THE FLOCCULATION/COAGULATION OF WASTEWATER BY GRANULOMETRIC ANALYSIS OF SUSPENDED SOLIDS IN THE WATER USING A LASER DIFFRACTION METER,
Centre de Recherche de l'Omnium d'Assainissement, Colombes (France).
C. Casellas-Salha, F. Acobas, J. Bontoux, and H. Moreaud.
Water Research, Vol 15, No 8, p 969-975, August, 1981. 12 Fig, 1 Tab, 20 Ref.

Descriptors: *Flocculation, *Suspended solids, Measuring instruments, *Lasers, *Wastewater treatment, Performance evaluation, Coagulation.

The optimization and control of the flocculation/coagulation process were investigated, and a parameter which expresses the efficiency of flocculation was defined and measured. A granulometric analysis of the suspended solids in the flocculated supernatant revealed that the concentration of particles between 1.5 and 10 micrograms could be a satisfactory control parameter. A laser diffraction meter is capable of making this measurement and has the necessary sensitiveness, reliability, short response time, and ease of automation. The instrument was calibrated by measuring suspended solids remaining in supernatants using water of various qualities. The unit can be used for continuously controlling the quality of the effluent from a physical/chemical wastewater treatment plant. Also, it could be used to determine the quality of raw water for a water treatment facility. (Small-FRC)
W82-00463

DEEP WELL INJECTION OF INDUSTRIAL WASTES,

For primary bibliographic entry see Field 5E.
W82-00475

RESPONSE OF BACTERIA IN WASTEWATER SLUDGE TO MOISTURE LOSS BY EVAPORATION AND EFFECT OF MOISTURE CONTENT ON BACTERIAL INACTIVATION BY IONIZING RADIATION,
Sandia National Lab., Albuquerque, NM.
R. L. Ward, J. G. Yeager, and C. S. Ashley.
Applied and Environmental Microbiology, Vol 41, No 5, p 1123-1127, May, 1981. 2 Fig, 2 Tab, 15 Ref.

Descriptors: *Sludge, *Moisture content, *Enteric bacteria, *Wastewater treatment, *Bacteria, Sewage bacteria, Liquid sludge, Survival, Population density, Population dynamics, Sludge drying, Ionization, Gamma radiation, Irradiation.

The potential use of sand-bed drying for inactivation of sludge pathogens and subsequent use of ionizing radiation to further disinfect dried sludges raises questions concerning the separate and combined effects of the drying process and ionizing radiation on the survival of enteric bacteria. The survival of six fecally-associated bacteria grown separately in sterilized sludge and of bacteria indigenous to sludge was examined following sludge dewatering and dewatering with subsequent treatment by ionizing radiation. Initial phases of sludge dewatering resulted in stimulation of bacteria growth, but reductions in moisture content below about 50% by weight caused a proportional reduction in bacterial numbers, generally reaching one order of magnitude or less in comparison with the original sludge. The rate of inactivation of bacteria by ionizing radiation in sludge was usually modified to some degree by variations in moisture content. Reduced moisture levels provided some degree of protection from ionizing radiation for most bacteria. The radiation resistance of Salmonella typhimurium was about doubled in dried sludge. However, none of the bacterial species tested required an excessive amount of irradiation to inactivate 90% of their populations. The study results indicate that loss of water by evaporation is not an adequate method for reducing the bacterial population in sludge when used alone. Also, although the rates of bacterial inactivation by ionizing radiation in sludge can be altered by changes in moisture content, the amount and direction of alteration varies with bacterial species. Treatment with ionizing radiation appears to be a feasible method of destroying bacterial pathogens in both liquid and dewatered sludges. (Carroll-FRC)
W82-00489

SURVIVAL OF ENTEROVIRUSES IN RAPID-INFILTRATION BASINS DURING THE LAND APPLICATION OF WASTEWATER,
Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
C. J. Hurst, C. P. Gerba, J. C. Lance, and R. C. Rice.
Applied and Environmental Microbiology, Vol 40, No 2, p 192-200, August, 1980. 3 Fig, 7 Tab, 25 Ref.

Descriptors: *Enteroviruses, *Land disposal, Wastewater treatment, Infiltration, Infiltration rate, Poliovirus, Flooding, Wastewater disposal, Waste disposal, Effluents, Groundwater pollution.

The measurement of enterovirus downward migration through soil during rapid infiltration of sewage effluent was undertaken. Measurement was also made of enterovirus inactivation rates in soil of rapid-infiltration basins during periods of flooding and drying. The basins used in the study were part of a pilot system designed to study the high-rate land treatment of wastewater for water quality improvement and groundwater recharge. Two field studies were performed. After 5 days of flooding, the amount of seeded poliovirus type 1 that had migrated 5 to 10 cm downward through the soil profile was 11% of that remaining at the initial burial depth. The amount of echovirus type 1 determined to have moved an equal distance was at least 100-fold less. Migration of naturally occurring enteroviruses during infiltration of sewage effluent through soil could not be measured with accuracy because of the possibility of virus survival from previous applications of effluent. The rate of inactivation for seeded poliovirus 1 and echovirus 1 buried in the infiltration basins ranged between 0.04 and 0.15 log-10 units per day during the time the basins were flooded. Inactivation of these same seeded virus types and of indigenous enterovirus populations in the infiltration basins during the drying portion of the sewage application cycle ranged between 0.11 and 0.52 log-10 units per day. The rate of virus inactivation was dependent on the rate of soil moisture loss. These results indicate that drying cycles during the land application of wastewater enhance virus inactivation in the soil. (Baker-FRC)
W82-00496

5E. Ultimate Disposal Of Wastes

LAND RESTORATION FOLLOWING OIL-WELL DRILLING,
For primary bibliographic entry see Field 5D.
W82-00057

ELECTROPLATING WASTEWATER SLUDGE CHARACTERIZATION,
Centec Corp., Reston, VA.
J. W. Meredith, J. A. McCarthy, and A. Procko.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-190928, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-064, May 1981. 3 p.

Descriptors: *Electroplating, *Industrial wastewater, *Sludge, *Leaching, Hydrogen ion concentration, Heavy metals, Water pollution sources, *Land disposal, Runoff, Interstitial water.

The problem of disposal and handling of solid wastes from electroplating wastewater treatment systems has been difficult and complex. This three-phase project was initiated to provide information concerning the physical and chemical characteristics of electroplating wastewater treatment sludges and their performance in a leaching environment. Phase I physically and chemically characterized representative electroplating sludges, determined their response to the EPA extraction procedure (EP), and determined the sensitivity of the parameters in the EP. Phase II involved laboratory testing to determine the performance of electroplating sludges under less aggressive leaching conditions than those in the EP. Phase III experiments were designed to validate conclusions drawn from Phase II by conducting field tests on an actual segregated metal hydroxide landfill. Two variables were found to have a major effect on the results obtained by the leaching procedures tested during Phase I: the composition and amount of free and interstitial wastewater present in the sludge, and the pH of the final extract. Electroplating wastewater treatment sludges in general do not leach heavy metals at a significant rate when deionized water is used as a leaching medium. Mildly acidified leaching water results in higher rates of heavy metal leaching. A sample of combined leachate and runoff from a segregated hydroxide landfill was found by analysis to pass drinking water standards. (Moore-SRC)
W82-00095

CROPPING SYSTEMS FOR TREATMENT AND UTILIZATION OF MUNICIPAL WASTEWATER AND SLUDGE,
Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences.
B. G. Ellis, A. E. Erickson, and L. E. Leach.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-187254, Price codes: A10 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-065, July 1981. 9 p, 1 Fig, 5 Tab.

Descriptors: *Wastewater disposal, *Land disposal, *Sludge disposal, *Crop yield, Corn, Forages, Nitrogen removal, Heavy metals, Groundwater contamination, Cost analysis, Municipal wastes.

An attempt was made to develop a cropping system which would remove nitrogen from added wastewater for a longer period than the four weeks in which corn removes nitrogen. Corn was interplanted with red clover, alfalfa, birdsfoot trefoil, and ryegrass which gave satisfactory corn yields. Yields were drastically reduced when corn was grown with tall fescue or orchard grass, and were unchanged when the forage was rye, quackgrass or reed canary grass. All the interplantings were effective at removing nitrogen from the wastewater. A second experiment determined the effects of adding a metal contaminated sludge on these same forage-corn interplantings, and on corn alone. Sludge applied at 7 metric tons per ha gave little increase in nitrate in the soil, but nitrate levels were increased at application rates of 22 t/ha. Corn yields were increased at all sludge application rates, with the most economic rate being 11 t/ha; the highest yields were obtained when the sludge application was repeated each year. Zinc, copper, and nickel levels increased in the groundwater after sludge application, but only zinc levels were raised in the corn grain. Sludge application rates of less than 54 t/ha do not appear to be a hazard either to the crop or to the groundwater. (Brambley-SRC)
W82-00097

LINING OF WASTE IMPOUNDMENT AND DISPOSAL FACILITIES.
Matrecon, Inc., Oakland, CA.
Environmental Protection Agency Report SW-870, September 1980. 406 p, 46 Fig, 48 Tab, 52 Ref, 9 Append.

Descriptors: *Lining, *Waste disposal, *Waste storage, *Leachates, Solid waste disposal, Water pollution prevention, Groundwater pollution, Land disposal, Sludges, Absorption, Soil sealants, Clays, Municipal wastes, Solvents, Bacteria.

The use of man-made materials of low permeability to line waste storage and disposal impoundments has been demonstrated to be a feasible method of preventing leachate and waste liquid components from leaking from an impoundment and subsequently entering and polluting groundwater. This manual is intended to provide information and guidance in the selection, performance, installation, and maintenance of specific liners and cover materials for specific containment situations, based upon the current state of the art of liner technology and other pertinent technologies. Wastes in lined facilities include: municipal solid waste, hazardous industrial wastes, and other nonradioactive and special wastes. The linings include remolded and compacted soils and clays, admixes, polymeric membrane liners, sprayed-on-liners, soil sealants, and chemisorptive liners. Liners function by two mechanisms: to impede the flow of the pollutant and pollutant carrier, usually water, into the subsoil and thence into the groundwater; or to absorb or attenuate suspended or dissolved pollutants in order to reduce the concentrations. From the standpoint of pollution and need for containment, it is the waste fluids which are of primary concern. The complexity of waste fluids, which include water, dissolved organic and inorganic components, organic chemicals and solvents, and bacteria, magnify the problems of containment. (Moore-SRC)
W82-00099

PHOSPHORUS DYNAMICS OF A FLORIDA FRESHWATER MARSH RECEIVING TREATED WASTEWATER,
Florida Univ., Gainesville. Center for Wetlands.
T. J. Dolan, S. E. Bayley, J. Zoltek, Jr., and A. J. Hermann.
Journal of Applied Ecology, Vol 18, No 1, p 205-219, April, 1981. 2 Fig, 7 Tab, 40 Ref.

Descriptors: *Phosphorus compounds, *Secondary wastewater, *Tertiary wastewater treatment, *Marshes, Nutrients, Fate of pollutants, Wastewater disposal, Wastewater treatment, Wetlands, Vegetation, Effluents, Florida, *Phosphorus removal, *Wastewater disposal.

Phosphorus in secondary effluent, applied weekly for a year to a test plot, was over 97% assimilated.

Soil (peat, clay, and sand) was the major sink, with secondary sinks in the below-ground biomass and litter. Three 2000 sq meter plots received effluent at the rates of 1.3, 3.8, and 10.2 cm per week, with a control plot receiving 3.8 cm per week of freshwater. Vegetation present included Sagittaria lancifolia, Pontederia cordata, Panicum spp. and Hibiscus sp. The plot with the highest rate of effluent loading showed increases in net production of plant shoots, litter, root and rhizomes, and in P concentration in living and dead plant tissue, compared with the control plot. There was 38.03 g P per sq meter applied to the high effluent plot during the course of the study; 26.31, 8.81, and 1.97 g P per sq meter were stored in soil, roots, and rhizomes, and litter, respectively. Outflow from the plot was 0.94 g P per sq meter. The freshwater control plot received a total of 0.38 g P per sq meter, stored 0.21 g P per sq meter in the litter, and lost 0.17 g P per sq meter in the outflow. There was no evidence of a spring flush of P from any plot. (Cassar-FRC)
W82-00108

SLASH TREATMENT AFTER CLEARCUTTING LODGEPOLE PINE AFFECTS NUTRIENTS IN SOIL WATER,
Utah State Univ., Logan. Dept. of Forestry and Outdoor Recreation.
For primary bibliographic entry see Field 4C.
W82-00130

ODOROUS COMPOUNDS FROM POTATO PROCESSING WASTE EFFLUENT IRRIGATION FIELDS: VOLATILE ACIDS,
Science and Education Administration, Berkeley, CA. Western Regional Research Lab.
R. G. Buttery, and J. A. Garibaldi.
Journal of Agricultural and Food Chemistry, Vol 28, No 1, p 158-159, January/February, 1980. 1 Fig, 2 Tab, 8 Ref.

Descriptors: *Organic acids, *Food processing wastes, *Odor control, Organic compounds, Acids, Pollutant identification, *Potatoes, Industrial wastes, Waste disposal, Irrigation.

When potato processing wastes are run into crop growing fields, an offensive odor can develop, especially under anaerobic conditions. The free acid fraction of the volatile oil isolated from odorous soil contained the following acids: acetic, propionic, isobutyric, butyric, 3-methylbutyric, pentanoic, hexanoic, and phenylacetic. Some of these acids were found at many times their odor threshold limit: butyric 90-1000 times, pentanoic 7-20 times, 3-methylbutyric 1-24 times, and isobutyric 100-1800 times. Odors may be decreased by encouraging aerobic conditions in the field by preventing pond formation (wider distribution and time interval for effluent application), increasing soil porosity, and ensuring high percolation rates of wastewater into the soil. (Cassar-FRC)
W82-00156

NITROGEN AVAILABILITY FROM SEWAGE SLUDGE,
Vermont Univ., Burlington. Dept. of Plant and Soil Science.
F. R. Magdoff, and J. F. Amadon.
Journal of Environmental Quality, Vol 9, No 3, p 451-455, July-September, 1980. 4 Fig, 2 Tab, 14 Ref.

Descriptors: *Sludge, *Land disposal, *Nitrogen, *Crop yield, Corn, Hay, Mineralization, Nitrification, Municipal wastes.

Application was made of aerobically treated secondary liquid sewage sludge to both corn and hay which were growing on Hadley sandy loam and Nellis loam soils. The nine treatments consisted of a check, four ammonium nitrate levels (50, 100, 150, and 200 kg N/ha/yr), and four sludge levels which were chosen to supply amounts of available N similar to the ammonium nitrate rates. Under laboratory conditions about 54% of the organic N added to the sludge-amended corn soils was mineralized. The mineralized N was well correlated with a chemical test of N availability. While the corn and hay on the sludge-amended Hadley soil outyielded the N treatments, nitrate recovery to 1.2 meters in the corn plots indicated that the available N supplied by the sludge treatments was no greater than that supplied by ammonium nitrate. Other factors, such as increased K supply to both crops and residual N effect on second-year hay, perhaps caused the increased yield of crops to sludge over N. Little or no response was noted in corn yields to sludge or N on the Nellis loam. Hay responded more to N than to sludge on the Nellis loam. Estimates of mineralization of organic N from sludge applied to corn and hay averaged 55% for the first year of application. Recovery of N in the corn at harvest plus soil NO3-N to a depth of 1.2 meters was positively correlated with the estimated mineralization of organic N plus the inorganic N added. The autoclaving test of N availability appeared useful in predicting mineralization of organic N from sludge under field conditions. (Baker-FRC)
W82-00158

SOIL AS A MEDIUM FOR DAIRY LIQUID WASTE DISPOSAL,
Southern Illinois Univ. at Carbondale. Dept. of Plant and Soil Science.
S-Y. Yang, J. H. Jones, F. J. Olsen, and J. J. Paterson.
Journal of Environmental Quality, Vol 9, No 3, p 370-372, July/September, 1980. 3 Tab, 13 Ref.

Descriptors: *Dairy industry, *Land disposal, Effluents, Industrial wastes, Animal wastes, Farms, Water pollution, Water quality, Biological oxygen demand, Phosphates, Nitrates, Suspended solids.

Attempts were made to determine a design for an effective vegetative-soil filter for liquid dairy waste disposal in relation to the highest loading rate per unit area of land under the most adverse climatic conditions, the filtering action of the vegetation, and the water quality if surface runoff during rainfall and snowmelt, and ground water. The soil used was classified as a Hosmer silt loam with an impermeable dense fragipan layer at the 50 cm depth. The experimental area was in tall fescue and had a 3% north facing slope with an intermittent stream at the lower end. Soil moisture and climatic conditions were important parameters affecting land application rates of dairy liquid waste. Large amounts of dairy liquid waste were absorbed and used by the soil and plants in the summer when evaporation and transpiration were high. The most critical period for loading was when the soil was wet or frozen, from the standpoint of controlling runoff pollution from effluent applications. The highest loading rate for zero surface runoff under the most adverse conditions was 0.43 cm/day. The pollutants in the dairy effluent were not effectively removed by flowing over the vegetative-soil filter. BOD5 decreased by 41%, ammonia nitrogen by 36%, suspended solids by 69%, and phosphate phosphorus by 16%. The most probable pollutants of runoff from rainfall and snowmelt were BOD5, ammonium-nitrogen, and phosphate-phosphorus. The field study showed a 99% decrease in BOD5 and a 90% removal of phosphate-phosphorus from the effluent by the soil. (Baker-FRC)
W82-00165

LEACHING OF CALCIUM AND MAGNESIUM FROM SOIL COLUMNS AS AFFECTED BY FORM OF NITROGEN IN APPLIED SEWAGE,
California Univ., Davis. Dept. of Land, Air, and Water Resources.
D. Pal, and F. E. Broadbent.
Soil Science Society of America Journal, Vol 45, No 1, p 56-60, 1981. 5 Fig, 8 Tab, 3 Ref.

Descriptors: *Leaching, *Land disposal, *Soil columns, *Calcium, Nitrogen, *Magnesium, Soil solution, Wastewater disposal, Soil profiles, Leachates, Nitrification, Denitrification.

Synthetic sewage containing elevated levels of nitrogen in either the ammonium or nitrate form was applied to soil columns at a rate of 7.5 centimeters per week for 41 weeks. Effluents from the column treated with ammonium sewage had higher concentrations of calcium and magnesium than did those from the column treated with nitrate sewage. When soil columns were treated with treatment plant sewage augmented by the addition of ammonium or nitrate to bring the nitrogen level to about 4 milliequivalents (meq) per liter, ammonium-amended sewage removed 1.32 meq more calcium and 0.84 meq more magnesium per liter of effluent than did nitrate-amended sewage. A third experiment involved application of unamended secondary waste water to columns of two different soils, one lot prior to nitrification and the other after nitrification had proceeded to completion. Calcium elution in Panoche clay loam was the same under both conditions, while magnesium elution was greater when the sewage was nitrified. In tests with Columbia fine sandy loam, somewhat more calcium and slightly less magnesium were eluted by nitrified sewage. When soils received sewages with artificially elevated concentrations of nitrogen, removal of calcium and magnesium were measurably higher when the ammonium form of sewage was applied. However, consistent differences between forms of sewage were not observed at the lower nitrogen levels characteristic of normal sewages. It is concluded that the influence of nitrification on solubility of calcium and magnesium under normal conditions is not sufficient to justify modification of wastewater management practices to prevent increasing the hardness of groundwater as long as the sewage contains normal levels of nitrogen. (Carroll-FRC)
W82-00192

ANAEROBIC TREATMENT OF HUMAN WASTE IN NORTHERN COMMUNITIES,
Toronto Univ. (Ontario). Dept. of Civil Engineering.
G. W. Keinke, and D. Prasad.
Canadian Journal of Civil Engineering, Vol 7, No 1, p 156-164, January, 1980. 4 Fig, 8 Tab, 25 Ref.

Descriptors: *Anaerobic digestion, *Waste disposal, *Cold regions, *Waste treatment, Wastewater treatment, Methane bacteria, Bacteria, Coliforms, Domestic wastes, Underground waste disposal, Canada, Permafrost.

A laboratory scale waste pit was operated for 5.5 years at temperatures simulating a human waste disposal pit in the permafrost of northern Canada. Treatment of the concentrated wastes (average COD 110,360 mg per liter) did not occur. At the end of the study coliform bacteria had decreased to negligible numbers, 10 per ml, but total aerobic and anaerobic bacteria remained at 80,000 per ml each, a potential hazard to public health and the environment. Anaerobic digestion of these wastes (called honey bag wastes) proved possible at 20 degrees C, but was uneconomical for these isolated communities. It was possible to process the more dilute black water wastes (average COD 10,210 mg per liter, from vacuum sewers, pressure sewers, or holding tanks) at 20 degrees C and a minimum detention time of 30 days. Operation at lower temperatures may be possible if a high proportion of methane bacteria is maintained in the reactor, either by longer detention time or by the anaerobic contact process. (Cassar-FRC)
W82-00249

DISPERSAL OF ASPERGILLUS FUMIGATUS FROM SEWAGE SLUDGE COMPOST PILES SUBJECTED TO MECHANICAL AGITATION IN OPEN AIR,
Science and Education Administration, Beltsville, MD.
P. D. Millner, D. A. Bassett, and P. B. Marsh.
Applied and Environmental Microbiology, Vol 39, No 5, p 1000-1009, May, 1980. 4 Fig, 8 Tab, 22 Ref.

Descriptors: *Sludge, *Fungi, Wastewater, Aspergillus fumigatus, Composting, Atmosphere, Wind, Air pollution, Aerosols, *Fallout.

An aerometric survey was conducted to quantitatively characterize the airborne concentrations of Aspergillus fumigatus at a compost site. The study was conducted at a pilot-scale sewage sludge composting facility and two other selected test sites. Aerosols of A. fumigatus downwind from station-

ary compost piles were insignificant in comparison with those downwind from agitated piles. These aerosols were generated by a front-end loader moving and dropping compost. Aerial concentrations of the fungus at a distance downwind from the point of emission were used to determine an emission rate for A. fumigatus associated with the moving operations. The maximum emission rate, 4.6 million A. fumigatus particles per second, was used to calculate predicted concentrations in an unobstructed plume with restrictive, neutral, and dispersive atmospheric mixing conditions up to 1 km downwind from the emission source. While the dispersal tests were made only under a few different meteorological conditions, the results can be extended to a complete matrix of conditions by using the atmospheric dispersion model and statistical data from the National Weather Service. In evaluating the dispersal of microbial aerosols to locations around composting sites, the frequency distribution of meteorological factors, such as wind speed, wind direction, and atmospheric stability, which contribute to restrictive conditions, and which may be expected to occur in the subject locality, should be considered. (Baker-FRC)
W82-00273

COMPARATIVE ANALYSIS OF SLUDGE AND REFUSE LEACHATE: A PRELIMINARY REPORT,
Schneider Engineers, Bridgeville, PA.
D. S. Gilligan, and J. L. Pierce.
Public Works, Vol 112, No 5, p 89-93, May, 1981. 1 Fig, 3 Tab, 5 Ref.

Descriptors: *Landfills, *Sludge disposal, *Heavy metals, *Municipal wastes, Waste disposal, Land disposal, Pesticides, Color, Odors, Coliforms, Incineration, Leachates, *Allegheny County, Pennsylvania.

During the treatment of wastewater at the Allegheny County Sanitary Authority (ALCOSAN), Pennsylvania, several residual by-products are generated which require disposal, usually by landfill. About 60% of the dewatered sludge is incinerated to ash, which is sent to landfills, while the remainder is limed to a pH of 12-12.5 and co-disposed with municipal refuse to privately-owned refuse landfills. A year-long study was conducted to compare leachate characteristics of five simulated municipal sludge and municipal refuse landfill cells. Cells were placed in landfill strate comprising: cell 1, sewage sludge; 2, domestic refuse and sewage sludge in a 4:1 ratio; 3, domestic refuse alone; 4, limed sewage sludge; and 5, domestic refuse and limed sludge in a 4:1 ratio. Metal levels in leachate of cells 1, 2, 4, and 5 compared favorably with concentrations of cell 3, which contained refuse only. All levels of Pb, Cr, Cd, and Ag were 100 times less than extraction procedure toxicity levels. Cell 3 contained higher levels of total coliform, fecal streptococci, and fecal coliform than any of the other cells. No problems with color or odor occurred, and attraction of disease vectors (rodents, flies, etc.) was minimal in all the landfill sites. (Geiger-FRC)
W82-00287

VIRAL TRANSPORT THROUGH SOIL COLUMNS UNDER CONDITIONS OF SATURATED FLOW,
Texas Univ. Center for Applied Research and Technology at San Antonio.
For primary bibliographic entry see Field 5B.
W82-00295

STRATEGY FOR RADIOACTIVE WASTE DISPOSAL IN CRYSTALLINE ROCKS,
Geological Survey, Menlo Park, CA.
J. D. Bredehoeft, and T. Maini.
Science, Vol 213, No 4505, p 293-296, July 17, 1981. 6 Fig, 8 Ref.

Descriptors: *Radioactive waste disposal, *Crystalline rocks, *Groundwater pollution, Waste disposal, Granite, Barriers, Groundwater movement, Flow characteristics, Path of pollutants, Hydrology, Permeability, Saline water, Sedimentary rocks, Rocky Mountain Arsenal, Denver Basin, Illinois Basin, Maryland, Water pollution sources, Water pollution prevention, *Underground waste disposal.

The multiple barriers concept is used to evaluate possible sites for disposal of radioactive wastes. A satisfactory site would be a nonpermeable, crystalline rock mass (granite or gneiss) under a covering of sedimentary rocks whose groundwater flow characteristics are well understood. Under favorable circumstances the groundwater flow operates as an active barrier, preventing the pollutants from reaching the biosphere. In addition, the depository may be placed where groundwater is nonpotable or salty, minimizing the possibility of future human intrusion. Other barriers are the waste's form and encapsulation and a low-permeability, high-adsorption backfill. Sites having characteristics similar to those of the hypothetical situation are the coastal plain of Maryland, the Denver Basin Cretaceous shale sequence (except in areas of oil and gas production), and the Illinois basin. (Cassar-FRC)
W82-00299

FINAL ENVIRONMENTAL IMPACT STATEMENT; SLUDGE DISPOSAL AND LAND RECLAMATION IN FULTON COUNTY, ILLINOIS.
Environmental Protection Agency, Chicago, IL. Region V.
Report, January, 1981. 330 p, 43 Fig, 48 Tab, 129 Ref, 3 Append.

Descriptors: *Environmental Impact Statement, *Fulton County, Illinois, *Land disposal, *Sludge disposal, *Land reclamation, Environmental effects, Runoff, Erosion control, Sedimentation, Water pollution, Soil physical properties, Agriculture, Recreation, Employment.

The Metropolitan Sanitary District of Greater Chicago is applying sludge to strip-mined land in Fulton County, and this Environmental Impact Statement presents the observed and projected impacts of continued operations. The sludge is transported by barge and underground pipeline to holding basins, where it is mixed to a uniform consistency and 6% solid content before being pumped into the distribution system. Originally the sludge was sprayed onto the land, but following complaints of odor, the sludge is now disked into the soil. This method also decreases runoff and erosion problems. Some runoff has occurred and some of the retention basins were too small to allow effective siltation. There have been breaks in the sludge pipelines, resulting from expansion and contraction from changes in temperature, which have caused violations of water quality standards. The physical properties of the soils have improved and crop productivity has increased. Former agricultural land has been put back into use for agricultural and recreational uses. No adverse health effects have been reported, and they will be prevented by appropriate agricultural use of the land. The project has given employment to about 120 persons for 6-8 months each year. (Brambley-SRC)
W82-00360

STATE-OF-THE-ART OF LIQUID WASTE DISPOSAL FOR GEOTHERMAL ENERGY SYSTEMS: 1979,
Battelle Pacific Northwest Labs., Richland, WA.
L. J. Defferding.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/EV-0083, Price codes: A12 in paper copy, A01 in microfiche. Department of Energy Report DOE/EV-0083, June 1980. 252 p, 23 Fig, 12 Tab, 133 Ref, 3 Append. DE-AC06-76RLO 1831.

Descriptors: *Geothermal resources, *Resources development, *Wastewater disposal, *Liquid wastes, Injection wells, Evaporation pans, Surface water, Wastewater treatment, Legal aspects, Environmental effects, Economic aspects, Waste characteristics.

As geothermal resources are developed as energy sources, safe disposal methods must be found for the large volumes of wastes. Techniques currently in use are direct discharge into surface waters, deep-well injection, and ponding for evaporation. Additional techniques with little or only experimental use are treatment and release to surface water, consumptive secondary use, injection into a non-producing horizon, and treatment and injection. All the disposal methods have to be considered in relation to the technical, legal, environmental and safety aspects, and to their overall economics. Other considerations are the variability of the waste fluid properties and the site-specific variables of geology and environmental setting. With present legal and environmental constraints subsurface injection is the most popular disposal method, but it is an expensive method, there have been technical problems with equipment, and some treatment will probably be necessary. (Brambley-SRC)
W82-00375

ENGINEERING ASSESSMENT OF VERMICOMPOSTING MUNICIPAL WASTEWATER SLUDGES,
Camp, Dresser and McKee, Inc., Boston, MA.
J. Donovan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-196933, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-075, June 1981. 4 p, 1 Tab.

Descriptors: *Composting, *Sludge disposal, Vermicomposting, *Biological treatment, Economic feasibility, Municipal wastewater, Organic matter, *Biodegration, *Earthworm feeding.

Vermicomposting, the biological degradation of organic matter that occurs as earthworms feed on waste materials, has been advocated by some as a means of stabilizing and disposing of municipal wastewater sludges. Only two species of earthworms, Eisenis foetida and Lumbricus rebellus are commonly mentioned in the literature as suitable for use in waste-vermicomposting operations. These worms can thrive and reproduce in managed conditions and readily feed on high concentrations of organic matter. When these worms are added to shallow beds or windrows of sewage sludge, they feed on the sludge, digest a portion of the organic matter and expel the undigested remains as feces, or castings. The castings produced by worms that have been fed on sludge are dry, virtually odorless, and suitable for use as a soil amendment or low-order fertilizer. Based on review of available literature, dicussion with practitioners, and visits to sites where vermicomposting is being attempted on an experimental scale, the process has been found to be feasible and potentially competitive economically with conventional sludge stabilization techniques such as land spreading of liquid sludge and static pile composting. (Moore-SRC)
W82-00385

LIME STABILIZATION AND ULTIMATE DISPOSAL OF MUNICIPAL WASTEWATER SLUDGES,
Camp, Dresser and McKee, Inc., Boston, MA.
R. M. Otoski.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-198160, Price codes: A09 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-076, June 1981. 4 p, 2 Fig, 1 Tab.

Descriptors: *Lime, *Sludge disposal, *Wastewater treatment, *Sludge conditioning, Land disposal, Municipal wastewater, Hydrogen ion concentration, Odor control, Pathogens.

The process of lime stabilization involves adding lime to wastewater-derived sludge in quantities sufficient to raise the pH of the sludge to 12.0 for a contact period of at least 2 hours. The high pH reduces levels of pathogenic bacteria and viruses in the sludge and controls putrefaction and orders. Visits were made to 28 wastewater treatment facilities in New England and New York at which lime stabilization of sludge was reportedly being practiced on a permanent, interim or seasonal basis. In fact, true stabilization was not achieved at some of the plants visited; several routinely limed sludge to

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pH levels slightly below 12. Sludge stabilization with lime can be simple and inexpensive and can be used as a backup or interim system, or to upgrade a system, or instituted as a less costly system. The only lime stabilization method rated fully acceptable is the addition of lime to mixed batch tanks. Adding lime before dewatering with the use of equipment intended for sludge conditioning requires close operator attention. Adding lime directly to dewatered sludge cake has not yet been consistently effective in bacterial kills. Stockpiling provides flexibility in land-application schedules, but if pH drops, bacteria can regrow in the stockpiles. (Moore-SRC)
W82-00386

CHEMICAL RECOVERY FROM COAL CONVERSION WASTES BY CONCENTRATION,
Concentration Specialists, Inc., Andover, MA.
For primary bibliographic entry see Field 5D.
W82-00436

WATER-RELATED ENVIRONMENTAL CONTROL REQUIREMENTS OF WASTE-TO-ENERGY CONVERSION,
Iowa State Univ., Ames.
For primary bibliographic entry see Field 5D.
W82-00443

DEEP WELL INJECTION OF INDUSTRIAL WASTES,
A. S. Athavaley, R. J. Funk, R. G. Sweet, and W. A. Coffey.
Industrial Wastes, Vol 27, No 3, p 28-30, 33-34, May/June, 1981. 3 Fig, 2 Tab.

Descriptors: *Injection wells, *Oil industry, Industrial wastes, *Underground waste disposal, Acidic water, Wastewater treatment, Wastewater disposal, Corpus Christi, Texas.

Spent caustic from an olefins plant at Corpus Christi, Texas represents a problem wastewater stream for disposal. The concentration of the caustic can range from two to five percent. The wastewater pH is expected to run consistently at about 13. The sulfide content may range from 500 to 35,000 mg/liter. About 50,000,000 gallons of wastewater will have to be disposed of annually when the plant is in full operation. This represents a design average flow rate of about 100 gpm, with minima and maxima ranging from 40 to 100 gpm, respectively. The wastewater cannot be discharged to any watercourse due to its toxic and refractory characteristics. Treatment for surface disposal is not economically feasible, due to the tight restrictions imposed on levels of total organic carbon and chemical oxygen demand. A disposal well system for handling the caustic wastewater has been designed with a 20 year project life. It was designed to comply with regulations of the various government branches of Texas and the federal government as well. Both an operational and a standby disposal well were drilled, to give a combined, firm capacity of 200 gpm. Because the wastewater was incompatible with the reservoir formation water, it was necessary to develop a buffer placement program, which is a one-time operation. This prevents the formation of precipitates when the formation water component is contacted by the wastewater and provides a barrier which delays contact between injected wastewater and formation water. This helps avoid plugging of the injection well with precipitates. (Baker-FRC)
W82-00475

EFFECTS OF MOISTURE CONTENT ON LONG-TERM SURVIVAL AND REGROWTH OF BACTERIA IN WASTEWATER SLUDGE,
BDM Corp., Albuquerque, NM.
J. G. Yeager, and R. L. Ward.
Applied and Environmental Microbiology, Vol 41, No 5, p 1117-1122, May, 1981. 4 Fig, 10 Ref.

Descriptors: *Moisture content, *Sludge, *Enteric bacteria, Bacteria, *Wastewater treatment, Liquid sludge, Sewage bacteria, Survival, Population density, Population dynamics, *Sludge drying.

Although long-term storage is often used for pretreatment of wastewater sludge prior to land application, little is known about the effects of this form of treatment on the numbersof bacterial pathogens in sludge. The effects of moisture content of sludge on the inactivation rates of bacteria during long-term storage and on bacterial regrowth potential were investigated. Cultures of six strains of fecally associated bacteria grown in sterilized liquid sludge (5% solids) were all quite stable at this moisture level for over 90 days at 21C. Bacterial inactivation rates following evaporation occurring during long-term storage at this temperature were generally proportional to the moisture losses of the samples. However, in dried sludge containing more than 90% solids, all but one of the bacteria species studied were found to be extremely stable. Bacteria indigenous to sludge were also found to survive for long periods in dried sludge. Bacteria isolates in sterilized raw sludge were found to undergo regrowth rapidly at 37 degrees C in samples containing not more than 75% solids, but no regrowth occurred in samples containing more than 85% solids. Although seeded Salmonella typhimurium grew in the presence of indigenous bacteria in both liquid and dewatered raw sludges, the population densities attained were well below that found in sterilized samples of the same sludges. While the number of salmonella dropped below detectable limits within a few days in sludges containing viable indigenous organisms, little decrease occurred during this time with salmonella grown in previously sterilized sludges. (Carroll-FRC)
W82-00493

EFFECTS OF SEWAGE EFFLUENT APPLICATION ON LITTER FALL AND LITTER DECOMPOSITION IN CYPRESS SWAMPS,
Florida Univ., Gainesville. School of Forest Resources and Conservation.
G. S. Deghi, K. C. Ewel, and W. J. Mitsch.
Journal of Applied Ecology, Vol 17, No 2, p 397-408, August, 1980. 4 Fig, 5 Tab, 28 Ref.

Descriptors: *Swamps, *Land disposal, *Litter, Organic matter, Wastewater, Effluents, Decomposition, *Florida, *Wetlands, Forests, *Cypress swamps, Wastewater treatment.

Cypress domes, which are characteristic of ecosystems in Florida, are stillwater swamps dominated by pond cypress. The adaptation of vegetation and soils in cypress domes to saturated conditions and the absence of overland flow to other bodies of water has resulted in consideration of these sites for recycling of secondarily treated sewage effluents. The ability of cypress domes to absorb the nutrients and microbes in these effluents and the effects of treatment with sewage effluents on litter production and decomposition rates were studied at four sites in Florida over a two-year period. Although no increases in litter fall attributable to treatment with sewage effluent were found in the experimental domes, data from other studies indicates that this rate may increase. Phosphorus cycling in the cypress domes seemed to be speeded by treatment with effluent and with groundwater. The lower concentration of oxygen in the sewage treated domes did not hinder the decomposition process. Decomposition of cypress needles occurred more rapidly in wet areas than in dry sites, but there was no difference in decomposition rates between deep and shallow wet sites. Biomass losses appear to be dependent on temperature and moisture. Decomposition may proceed more rapidly in domes treated with sewage effluent than in untreated domes as a result of the increased nutrient levels in the substrate. Since increases in litter fall do not result in decreases in the decomposition rate, application of sewage effluent should not result in an increase in the normal accumulation of organic matter in the domes until a new steady-state level is reached. (Carroll-FRC)
W82-00499

5F. Water Treatment and Quality Alteration

CHEMICAL, PHYSICAL, AND RADIOLOGICAL QUALITY OF SELECTED PUBLIC WATER SUPPLIES IN FLORIDA, FEBRUARY-APRIL 1980,
Geological Survey, Tallahassee, FL. Water Resources Div.
B. J. Franks, and G. A. Irwin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-227910, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-31, 1981. 59 p, 4 Fig, 6 Tab, 13 Ref.

Descriptors: *Potable water, *Water quality, *Water supply, *Water treatment, Water quality standards, Water analysis, Chemical analysis, Surface water, Groundwater, Desalination, *Florida, Drinking water, Regulations.

Virtually all treated public water supplies in Florida meet the National Interim Primary and Secondary Drinking Water Regulations. These findings are based on a water-quality reconnaissance of 126 raw and treated public water supplies throughout the State during the period February through April 1980. Primary drinking water regulations maximum contaminant levels were rarely exceeded, although mercury (1 site), fluoride (2 sites), and radionuclides (3 sites) in water supplies were above established maximum contaminant levels. Dissolved solids, chloride, copper, manganese, iron, color, sulfate, and pH, were occasionally slightly in excess of the recommended maximum contaminant levels of the secondary drinking water regulation. The secondary regulations, however, pertain mainly to the esthetic quality of drinking water and not directly to public health aspects. (USGS)
W82-00010

PROCESS FOR THE REMOVAL OF INORGANIC SALTS FROM A WATER STREAM,
D. W. Coillet.
U.S. Patent No. 4,234,419, 11 p, 1 Fig, 1 Tab, 5 Ref; Official Gazette of the United States Patent Office, Vol 1000, No 3, p 1104-1105, November 18, 1980.

Descriptors: *Patents, *Water treatment, *Industrial water, Wastewater treatment, Water purification, *Ion exchange, Chemical precipitation, Brine disposal, Byproducts, Potable water, Salt removal, Dissolved solids, Regeneration.

Inorganic salts are removed from an unpotable water stream, particularly a salt-containing inland water stream. Such waters include ground water, including geothermal brine, waste waters, including field drainage and urban waste water, and aqueous waste from the operation of evaporative cooling towers and certain processes of industry and energy conversion. The stream is passed sequentially through anion and cation exchange beds. Periodically the anion exchange bed is regenerated with sodium hydroxide and the cation exchange bed with hydrochloric acid to form spent regenerant streams which are combined with hydrochloric acid in the presence of calcium ion to precipitate calcium salts of anions from the mixture. The soluble portion is then mixed with sodium hydroxide in the presence of carbonate ion to precipitate insoluble cations from the mixture as hydroxides or carbonates. The soluble portions, comprising essentially an aqueous sodium chloride stream, is separated into a more concentrated and less concentrated portion. The more concentrated stream is electrolzed to provide a source of hydrochloric acid and sodium hydroxide for the above steps, while the less concentrated stream is recovered as a source of potable water. (Sinha-OEIS)
W82-00055

FLUORIDATION SYSTEM,
J. N. Leo.
U.S. Patent No. 4,234,425, 4 p, 2 Fig, 8 Ref; Official Gazette of the United States Patent Office, Vol 1000, No 3, p 1107, November 18, 1980.

Descriptors: *Patents, *Water treatment, *Fluoridation, Public health, Equipment, Flow control, Venturi meters.

A fluoridation system includes a venturi capable of being inserted into a water line along its length.

The venturi includes a throughbore having a diminishing tapered section followed by an increasing tapered section in the direction of liquid flow and a passage which intersects the throughbore perpendicularly. A mechanism associated with the venturi withdraws water from the water line and a first conduit for transferring water from the withdrawing mechanism contains a flow rate measurer and flow control. The fluoride chamber is connected to the outlet end of the first conduit, and a second conduit connects the fluoride chamber with the perpendicular passage of the venturi. (Sinha-OEIS)
W82-00061

PROCESS FOR REMOVING ALKALINITY AND HARDNESS FROM WATERS,
Water Refining Co., Inc., Middletown, OH. (Assignee).
R. E. Wiegert.
U.S. Patent No. 4,235,715, 6 p, 2 Fig, 13 Ref; Official Gazette of the United States Patent Office, Vol 1000, No 4, p 1531, November 25, 1980.

Descriptors: *Patents, *Water treatment, *Water quality control, *Hardness(Water), *Alkalinity, Separation techniques, Industrial water, Ion exchange, Resins, Cation exchange, Chemical reactions, Boiler feed water, Regeneration.

Raw water is fed to a first column containing a weak acid cation exchange resin in hydrogen form where alkalinity causing ions and hardness causing ions to the extent of alkalinity are converted to carbonic acid. The carbonic acid, which hydrolyzes to dissolved carbon dioxide, is stripped from the water in a decarbonation unit by passing air countercurrent to the flow of water through the unit. The water is then fed to a second column containing a weak acid cation exchange resin in sodium form which removes residual hardness causing ions along with neutralization of any mineral acids or residual dissolved carbon dioxide. Both resins are substantially completely regenerated upon exhaustion to provide a process in which the maximum capacities of the resins are utilized, and the process is carried out with a minimum of monitoring and control. In terms of operating and investment costs, it is much more economical to treat raw feed water to remove hardness and alkalinity prior to introducing it into equipment. (Sinha-OEIS)
W82-00063

A/C PIPE - ASSESSMENT OR ADVOCACY,
A/C Pipe Producers Association, Arlington, VA.
J. F. Welch.
Water/Engineering and Management, Vol 128, No 5, p 44, 48, 54, 57-58, May, 1981. 1 Fig, 1 Tab, 29 Ref.

Descriptors: *Asbestos, *Asbestos cement, *Public health, *Drinking water, Water quality, Pipes, *Pipelines, Water transport, Water mains, Carcinogens, Evaluation.

A commentary is presented on the issue of asbestos in drinking water, with emphasis on the assessment of the safety of asbestos-cement (A/C) pipes. While it is known that asbestos-cement pipe will corrode, the extent has not been determined to which people are affected by this corrosion. No one knows exactly how many miles of A/C pipe are exposed to corrosive waters or what levels of asbestos in water are dangerous to people. Airborne asbestos has been known to cause health effects in exposed workers, but there is little scientific information on the effects of asbestos ingestion by man or laboratory animals. It is not known whether asbestos fibers cross the intestinal tract. There are no animal studies or epidemiological studies linking asbestos ingestion to cancer, and several studies have indicated that there is no cancer hazard. More research is needed before realistic water quality criteria can be set for asbestos fibers. (Small-FRC)
W82-00070

AN ALTERNATIVE SOLUTION TO THE THM PROBLEM,
Dallas City Manager's Office, TX.
I. M. Rice, and M. E. Bolding.
Water/Engineering and Management, Vol 128, No 5, p 59-60, 65-66, May 1981. 6 Tab.

Descriptors: *Trihalomethanes, *Drinking water, *Ammonia, *Pilot plants, Chlorination, Chlorine, Hydrogen ion concentration, Activated carbon, Water supply, Dallas, Texas.

Pilot plant studies evaluated the extent to which trihalomethane formation in drinking water could be reduced by reducing the ammonia content of prechlorinated water. Tests were undertaken using three levels of chlorine, three different pH values, and operations with or without ammonia present. The pentane extraction method was used for all trihalomethane tests. Results indicated that advance ammonia feed could reduce trihalomethane formation without sacrificing good bacterial water quality. Coliforms were uniformly removed from the treated water in every case where ammonia was employed. Application of ammonia followed by addition of chlorine at the intake to the plant was more effective in preventing THM formation than application of chlorine at later stages. There were daily and weekly fluctuations in precursor content. Thus, trihalomethanes in drinking water can be reduced without the installation of granulated activated carbon treatment. These studies were performed on water from the Dallas, Texas system. (Small-FRC)
W82-00072

HISTORY OF A WATER CHEMICAL,
R. W. Ockershausen.
Water/Engineering and Management, Vol 128, No 5, p 73-75, May, 1981. 1 Fig.

Descriptors: *Alum, *Aluminum sulfate, *Clarification, Chemical precipitation, *Water treatment, Drinking water, History, Phosphorus removal.

The history of the use of alum, aluminum sulfate, in water treatment is presented. One hundred years ago alum saw continuous daily use at the Somerville and Raritan Water Company in the New Jersey water filtration plant, and there is evidence that this chemical has been used for centuries to clarify water. Lump alum was popular at the turn of the century, and ground or granular alum came into use in the 1920's. Liquid alum became available in the 1940's and both liquid and dry are used today. Alum continues to be the major coagulant used in water and wastewater treatment. It can be used for clarification, phosphorus reduction, and impurity removal. Dry alum requires more manufacturing steps, so liquid is the least expensive. This factor is making it more popular during today's inflationary times. Raw materials of domestic origin give assurance that supplies will be plentiful in the future. (Small-FRC)
W82-00074

DISTRIBUTION AND BALANCE OF VOLATILE HALOGENATED HYDROCARBONS IN THE WATER AND AIR OF COVERED SWIMMING POOLS USING CHLORINE FOR WATER DISINFECTION,
Bremen Univ. (Germany, F.R.).
U. Lahl, K. Batjer, J. V. Duszeln, B. Gabel, and B. Stachel.
Water Research, Vol 15, No 7, p 803-814, July, 1981. 6 Fig, 10 Tab, 42 Ref.

Descriptors: *Swimming pools, *Public health, *Chlorination, Trihalomethanes, Chloroform, Water treatment, Disinfection, Organic compounds, Recreation, Ozonation, Ultraviolet radiation, Chlorinated hydrocarbons, *Fate of pollutants, *Indoor swimming pools.

Chlorination of water in covered swimming pools in Bremen, Germany, produced trihalomethanes (THM) (largely CHCl3, CHCl2Br, CHClBr2, and CHBr3) at total concentrations up to 1224 micrograms per liter. Comparing THM concentrations in inflow and outflow showed that there was a 20-30% increase after five hours. THM formation depended on the amount of free active Cl, concentration of organic precursors (fulvic acids, humic acids, urine), concentration of other compounds reacting with Cl, concentration of Br ions, and number of pool visitors. After water treatment methods were refined (less chlorine, elimination of surface waters as a source, more fresh water added) the total THM levels dropped from 800 micrograms per liter in December 1978 to about 100 micrograms per liter in February 1979 and remained at that level. The concentration of THM found in air above the pools varied widely with location and distance above the water surface; the highest measured level was 384 micrograms per cu meter, and the average 0.1 micrograms per cu meter. The maximum cancer risk, based on chloroform, was calculated at 1 cancer event per million visitors per year for weekly visits in a covered pool in Bremen. Alternative disinfection methods include ultraviolet radiation and indirect ozonation. (Cassar-FRC)
W82-00128

REACTIONS OF CHLORINE WITH SELECTED AROMATIC MODELS OF AQUATIC HUMIC MATERIAL,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
D. L. Norwood, J. D. Johnson, R. F. Christman, J. R. Hass, and M. J. Bobenrieth.
Environmental Science and Technology, Vol 14, No 2, p 187-190, February, 1980. 4 Fig, 2 Tab, 21 Ref.

Descriptors: *Chlorination, *Humic acids, Natural waters, Chloroform, Drinking water, Disinfection, Water treatment, Chemical reactions, Hydrocarbons, Decomposing organic matter.

Chloroform yields and chlorine demands were measured for structures representative of humic degradation products and to identify in selected cases other chlorinated end products. Several compounds designed to model the monomeric components of aquatic humic material were reacted with aqueous chlorine at pH 7. Chloroform production and chlorine demand were measured for each compound over varied time periods. All compounds studied produced measurable amounts of chloroform with resorcinol derivatives showing the greatest yields. In addition, the chlorination reactions of resorcinol and 3-methoxy-4-hydroxycinnamic acid were studied in depth with GC/MS. The resorcinol reaction was found to proceed through several chlorinated intermediates, of which the most abundant was 3,5,5-trichlorocyclopent-3-ene-1,2-dione, to chloroform and chlorinated acids. Chlorination of the cinnamic acid derivative produced chlorinated substitution products and chlorophenols, which broke down upon further reaction to chloroacetic acids. (Baker-FRC)
W82-00254

HYGIENE OF DRINKING WATER IN DEVELOPING COUNTRIES,
Amsterdam Water Works (Netherlands).
C. van der Veen.
Aqua, No 5, p 2-7, 1980. 4 Tab, 21 Ref.

Descriptors: *Developing countries, *Drinking water, *Rural areas, *Water treatment, Water quality control, Potable water, Human diseases, Public health, United Nations, Organoleptic properties, Water supply, Water quality.

The provision of safer drinking water supplies in developing countries is considered. Water-related diseases which pose problems of hygiene may be classified as waterborne diseases, water-washed diseases, water-based diseases, and diseases with related insect vectors. The relationships between a nation's availability of a good water supply and the health standard of its people are illustrated in data from various countries. Differences in methods of water procurement from urban and rural areas are mentioned, and technologies associated with spring water, groundwater, roof drainage and ground catchment, surface water, and artificial recharge are explored. Often attempts to supply public water to rural areas fail due to a lack of education of the users. Old water sources may serve holy functions, provide a place of social gathering, and are more familiar in taste to the native populations.

LIBRARY OF THE URBANA-CHAMPAIGN

Some people may use public water only intermittently, so that disease conditions still exist. Often, the people are too poor to pay for public water and therefore they discontinue using it. Water projects should be financially self supporting. In 1977, the United Nations (UN) launched a Water Decade which set as its goal the provision of adequate supplies of quality drinking water for all people and the proper disposal of waste waters by 1990. UN figures indicated that in 1975, 62% of the populations of developing countries were not served by safe water supplies. The International Water Supply Association (IWSA) has appointed a task force which plans to stimulate the water supply authorities in developing countries by availing them of the knowledge of present technologies. (Geiger-FRC)
W82-00269

DEVELOPMENT OF A RURAL WATER DISTRICT,
Corlew (M. B.) and Associates, Inc., Edwardsville, IL.
For primary bibliographic entry see Field 6A.
W82-00288

THE EFFECT OF BENTONITE CLAY ON OZONE DISINFECTION OF BACTERIA AND VIRUSES IN WATER,
Environmental Protection Agency, Atlanta, GA.
D. S. Boyce, O. J. Sproul, and C. E. Buck.
Water Research, Vol 15, No 6, p 759-767, 1981. 1 Fig, 7 Tab, 23 Ref.

Descriptors: *Viruses, *Bacteria, *Ozone, *Bentonite, *Disinfection, Wastewater renovation, Wastewater treatment, Coxsackie virus, Polio virus, Escherichia coli, Bacteriophage, *Clays, Water treatment, Pathogens, Turbidity, Adsorption.

The disinfection potential of ozone for viruses and bacteria adsorbed on bentonite clay particles suspended in water was determined. Viruses used were poliovirus (Sabin Type 1), coxsackievirus A9, and the f2 bacteriophage. Escherichia coli was treated under the same conditions as the virus--unadsorbed or adsorbed on 1 and 5 turbidity units (TU) of bentonite clay (particle size 3-8 mm), up to 0.53 mg per liter ozone, temperature 20 C, pH 7.0, and inactivation times of 10, 20, and 30 sec. Poliovirus, coxsackievirus, and E. coli associated with clay were inactivated at rates similar to the freely suspended organisms. The f2 bacteriophage was inactivated at a slightly slower rate than freely suspended phage. Typical results obtained were: 5 TU adsorbed poliovirus (140 plaque forming units (PFU) per ml), 0.016 mg per liter ozone, > 97% inactivated within 20 sec; 5 TU adsorbed coxsackievirus (220 PFU per ml), 0.019 mg per liter ozone, > 98% inactivated within 20 sec; 5 TU adsorbed f2 bacteriophage (15,000 PFU per ml), 0.061 mg per liter ozone, > 98% inactivated within 20 sec; 5 TU adsorbed E. coli (180 million CFU per ml), 0.038 mg per liter ozone, > 99% inactivated within 10 sec. (Cassar-FRC)
W82-00292

A 13-MONTH SURVEY OF NEMATODES AT THREE WATER TREATMENT PLANTS IN SOUTHERN ONTARIO, CANADA,
Waterloo Univ. (Ontario). Dept. of Biology.
J. B. Mott, G. Mulamoottil, and A. D. Harrison.
Water Research, Vol 15, No 6, p 729-738, 1981. 7 Fig, 3 Tab, 38 Ref.

Descriptors: *Drinking water, *Nematodes, *Water treatment, Aquatic animals, *Canada, Settling basins, Turbidity, Rainfall, Chlorination, Seasonal variation, River flow.

Nematodes were detected in almost every sample of treated water from three Canadian cities during a 13-month survey. In general, numbers at Brantford were lower (0 to 5.6 per liter) than at Cayuga (maximum 42.5 per liter) and Delhi (maximum 38.7 per liter). Brantford has the largest facility and most extensive water treatment (prechlorination, coagulation, settling, rapid sand filtration, postchlorination, and fluoridation). The water source is a slow-moving canal leading from the Grand River. At Cayuga and Delhi, water treatment is less extensive (coagulation, chlorination, and sand filtration). Water sources are direct from the Grand River and the North Creek, respectively. Nematode concentrations increased with high river flow, heavy rainfall, and high raw water turbidity. Lowest concentrations were found during the winter months. A settling tank or pond for raw water and high levels of prechlorination are recommended to reduce nematode counts. (Cassar-FRC)
W82-00294

CUTTING THE WATER LOSSES,
Northumbrian Water Authority, Gosforth (England).
B. Smith.
Water, No 33, p 2-4, July, 1980. 1 Fig.

Descriptors: *Water conveyance, *Leakage, *Maintenance, Water supply systems, Economic aspects, Technology, Reservoirs, Water mains, Pipes, Conveyance structures, *Great Britain.

There has been increasing public concern regarding leakage control policies of water supply systems in Great Britain as a result of increased opposition to the development of new water supply sources, particularly those involving the construction of impounding reservoirs. There are five main leakage control methods: passive leakage control (repairing only leaks which become self-evident), regular sounding, district metering with selective inspection, waste metering with selective inspection, and combined district and waste metering with selective inspection. Although the formation of pressure zones can be used with each of these control methods, there is no clear information on the magnitude of leakage reduction which can be expected from a specific reduction in pressure. Selection of the most economic leakage control measure in a given situation will be affected by such factors as the cost of producing water, the need for pumping, financial contraints, topography, and the overall extent of the leakage problem. The British Working Group on Waste of Water has developed a comprehensive procedure for determining a leakage control policy for any system, irrespective of current practice, in which the relevant local factors and constraints are considered. (Carroll-FRC)
W82-00310

TREATMENT WORKS--THE DESIGNER'S PROBLEMS,
Hill (G. H.), Manchester (England).
P. B. Connery, and J. B. Butler.
Water, No 30, p 7-9, January, 1980.

Descriptors: *Water treatment facilities, *Design criteria, *Planning, Site selection, Water treatment, Economic aspects, Monitoring, Water pollution control, Water quality management, Design standards.

Designers are responsible for the integration of the various treatment processes, structures, and equipment into a water treatment facility which will enable the operator to produce water or effluent of the required quality efficiently. Important aspects which the designer must consider include selection of the site, raw water parameters, standards for treated water quality, and type of facility required. Factors impacting on site selection include proximity to sources of treatable water and to users, elevation, site ground conditions, site topography, distance from chemical supply sources, and access for delivery vehicles. Energy conservation is playing an increasingly important role in site selection decisions. The development of information on sources of water likely to be exploited is creating a better basis for the evaluation of the raw water conditions which may be expected. Changing standards for treated water quality raise questions as to whether designs for new plants should include allowances for possible addition of other treatment processes at a later time. The inclusion of raw water storage facilities can significantly reduce the range of the quality of the water to be treated and can simplify treatment. The rapid advance of technology in water treatment also raises questions concerning the design life of facilities. Treatment facilities' designs should be flexible enough to permit expansion as additional capacity is needed and incorporation of additional processes or innovations at a future date. Controls should be selected to be compatible with the quality of monitoring available. (Carroll-FRC)
W82-00312

MATHEMATICAL EFFICIENCY CONCERNS IN WATER DISTRIBUTION NETWORK CONSIDERATIONS,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
S. Gupta, E. A. McBean, and J. R. Cousins.
Canadian Journal of Civil Engineering, Vol 7, No 1, p 78-83, 1980. 6 Fig, 2 Tab, 18 Ref.

Descriptors: *Network design, *Computer models, *Design criteria, *Water distribution, Mathematical models, Water supply systems, Comparison studies.

A comparison of three computerized methods for analyzing water distribution systems shows that the Newton-Raphson technique has a slight advantage over the Hardy-Cross method. Total costs of all three models in a 22-node system are about $30; for 68 nodes, about $60 for the Newton-Raphson and Hardy-Cross methods, and $135 for the linear algebra technique. To decrease modeling costs, schematization models representing the same network, but with fewer nodes, may be used for design studies, which require many repetitive runs. (Cassar-FRC)
W82-00339

SILICATES AS NONSPECIFIC ADSORBENTS OF BACTERIOPHAGE: A MODEL FOR PURIFICATION OF WATER FROM VIRUSES,
Israel Inst. for Biological Research, Nes Ziyyona.
R. Fass, Y. Straussman, A. Shahar, and A. Mizrahi.
Applied and Environmental Microbiology, Vol 39, No 1, p 227-232, January, 1980. 1 Fig, 4 Tab, 16 Ref.

Descriptors: *Water treatment, *Viruses, Purification, Drinking water, Potable water, Wastewater, *Silicates, Bacteriophages, Adsorbents.

Commerically available amorphous silicates having small size particles, large surface areas, and high adsorption capacity for organic compounds were investigated as virus adsorbents. The T4 bacteriophage was used in this study as a model due to its well-defined morphology and its stability towards agitation and temperature changes, as well as due to the availability of a convenient assay. Amorphous silicates were found to have a high nonspecific adsorption capacity for T4 bacteriophage, representing a promising tool and a model for purification of water from viral contamination. Investigations with Escherichia coli T4 bacteriophage showed adsorption capacity of up to 99.9% on different tested silicates. Optimal conditions for the adsorption of T4 bacteriophage on various commercially available silicates were determined. A continuous-flow adsorption of T4 bacteriophage on silicates appears to represent a model system for the removal of viruses from potable water and sewage. (Baker-FRC)
W82-00350

FIELD EVALUATION OF A SWIRL DEGRITTER AT TAMWORTH, NEW SOUTH WALES, AUSTRALIA,
G. J. Shelley, P. B. Stone, and A. J. Cullen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-187247, Price codes: A06 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-063, June 1981. 6 p, 2 Fig, 5 Ref.

Descriptors: *Water treatment, *Suspended solids, Field tests, *Pretreatment of water, Suspended load, Particle size, Flow rates, Cost analysis, Hydraulic engineering, Construction costs, Operating costs, Maintenance costs, New South Wales, *Australia.

The overall objective of this field evaluation program was to provide information on the behavior of a full-scale swirl degritter designed and constructed in accordance with the shapes and proportions developed during model studies. The swirl degritter was designed to pretreat river water before it enters into the rising main in order to reduce wear and tear on the raw water pumps and also to reduce the solids loading of the rising main and that of the balance tank of the water treatment works. Results of the solids removal had been evaluated in terms of three parameters: solids larger than 0.2 mm (the classical size aimed at in grit chambers); solids larger than 0.088 mm; and total settleable solids. In general, the tests proved the validity of the laboratory results, and at design flowrates, 98% removal efficiencies were achieved. Tests at flowrates higher than the design showed slightly better efficiencies than predicted. The field evaluation tests carried out at Tamworth, New South Wales, Australia, prove the validity of the system in terms of its hydraulic efficiency. When compared with a conventional, constant-velocity, longitudinal flow grit chamber, the construction cost is halved and operation and maintenance costs are considerably lower. (Author's abstract)
W82-00376

EFFECTIVENESS OF ACTIVATED CARBON FOR REMOVAL OF TOXIC AND/OR CARCINOGENIC COMPOUNDS FROM WATER SUPPLIES,
Michigan Univ., Ann Arbor.
W. J. Weber, Jr., and M. Pirbazari.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-187197, Price codes: A17 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-057, June 1981. 9 p, 11 Fig.

Descriptors: *Water treatment, *Activated carbon, Adsorption, Chlorinated hydrocarbons, Humic acids, Organic matter, Model studies, Biological degradation, Water supply, *Toxins, *Carcinogens, Magnesium, Calcium, Polychlorinated biphenyls, Benzenes, Dieldrin, Carbon tetrachloride.

Equilibrium, rate and continuous long-term adsorption studies were conducted for humic acids at raw water background concentrations and for carbon tetrachloride, benzene, two commercial mixtures of PCB's, dieldrin, and p-dichlorobenzene at representative trace concentration levels. Experimental breakthrough profiles were developed for each of the trace compounds alone and in the presence of background humic acid solutions to investigate competitive and/or chromatographic effects. The results indicate that trace compound adsorption is generally affected adversely by background organic matter. The adsorption capacity of activated carbon for humic substances was markedly enhanced by the presence and concentration of several common constituents of water supplies, including Mg and Ca ions. There was evidence from the work that enhanced removal of humic substances might also provide for more effective removal of associated organic molecules - such as PCB's and dieldrin - in water treatment operations. The Michigan Adsorption Design and Applications Model (MADAM) was generally able to simulate and predict the performance of fixed-bed adsorbers to remove the compounds investigated in the absence of the humic acids. With the strictly adsorption version of MADAM, reliable predictions were difficult because of the prolific biological growth in the adsorbers that received the humic acids. For such cases, biological degradation dynamics must be incorporated in the model. The single-solute version of MADAM was able, however, to simulate/predict independent pilot data provided by the EPA about the adsorption of 1,2-dichloroethane in the presence of naturally occurring background organics in Ohio River water. (Brambley-SRC)
W82-00383

UPFLOW WATER FILTRATION UNIT, TEST RESULTS,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
C. E. Rice, M. L. Magnuson, and J. E. Garton.
Transactions of the ASAE, Vol 23, No 5, p 1143-1146, October/November, 1980. 5 Fig, 5 Tab, 5 Ref. OWRT-A-060-OKLA(2), 14-34-0001-6037.

Descriptors: *Water purification, *Filtration, Upflow filtration unit, *Rural areas, Turbidity, Domestic water, Farm ponds, Water supply, *Home-operated filter systems.

A rural homeowner-operated water filtration system for purifying surface waters and water from farm ponds was tested. Two different upflow-type water filtration and treatment units were compared. The large automatic unit (3 feet X 7 feet tank) included chemical feeder pumps and storage tanks for alum and chlorine, a pump and tank for pressurized-treated water, and liquid level controls. Filter medium was hydrous aluminum silicate. At a flow rate of 92 liters per min per square meter of filter area, this unit produced finished water at a rate of 16 gallons per minute with a turbidity of 2 NTU or less. This unit is large enough to supply the water needs of several households. The small unit (tank 1 x 1 x 5 feet) produced 414 gallons per day at a low rate of 1.15 gallons per minute for 15 minutes each hour. Alum concentrations were critical for proper results, frequent back flushing of the filter was required, and a water storage unit was necessary. Neither system clarified water with turbidity of 80 NTU or greater without pretreatment. (Cassar-FRC)
W82-00407

OZONE TREATMENT OF POTABLE WATER - PART I,
C. Nebel.
Public Works, Vol 112, No 6, p 86-90, June, 1981. 7 Fig, 4 Tab, 27 Ref.

Descriptors: Ozone, *Ozonation, *Water treatment, *Water purification, *Potable water, Domestic water, Drinking water, Taste, Odor control, Disinfection, Bacteria, Chlorination, Chemical treatment, Organic compounds, Heavy metals.

The use of ozone for treating drinking water is discussed. Ozone oxidizes organic pollutants and has the ability to act as a sterilant. It increases the characteristics of settleability, removal of organic compounds causing tastes, odors, and color, destruction of algae, and oxidation of iron, manganese, and heavy metals. The dosage level required for disinfection depends largely upon the amount of organic material present as well as the bacteria count. Heavy metals which can be controlled by ozone oxidations include lead, zinc, cadmium, and nickel. No solubility reductions can be expected for barium or calcium, since they have only one oxidation state. (Titus-FRC)
W82-00451

OZONE TREATMENT OF POTABLE WATER--PART 2,
C. Nebel.
Public Works, Vol 112, No 7, p 68-71, July, 1981. 5 Fig, 11 Ref.

Descriptors: *Ozone, *Organic compounds, *Disinfection, *Water treatment, Chlorinated hydrocarbons, *Trihalomethanes, Potable water, Ozonation, Chloroform, Coagulation, Humic acids, Activated carbon, Oxidation, Chlorination.

Part 2 of this paper discusses the role of ozone in oxidation of organic compounds and in the control of trihalomethanes (THM) in water treatment. Ozonation of dissolved organic materials yields polar and charged molecules which are more easily removed by alum coagulation. Those compounds readily oxidized include phenolics, detergents, pesticides, chemical manufacturing wastes, humic acids, polycyclic aromatic hydrocarbons, proteins, and amino acids. Formation of THM's in treated water may be controlled by ozonation. Of 80 water supplies surveyed, the only ones with no trace of THM's were produced by treatment facilities using ozone as a unit process. Although there are methods for preventing or removing THM's or their precursors, ozonation is less expensive and more effective than most of the others. Ozone may be added at the front of the plant to increase organics removal by alum flocculation, at the end of the treatment process for removing humic acids and other dissolved organics, or by combining ozone-activated carbon in the biological activated carbon process (BAC). Some of the BAC units have operated for six years without the need for reactivation. Ozone dosage levels are in the range of 1.5-4 mg per liter. Ozone as the only disinfectant can rarely be applied because the system to be treated must meet the following criteria: (1) dissolved organic content low enough to provide little food for bacteria, (2) low water temperature, (3) clean, high quality distribution system with low residence time, and (4) no ammonia. (Cassar-FRC)
W82-00452

CHLORINATED DRINKING WATER,
C. A. Stewart, Jr.
Science, Vol 212, No 4499, p 1086-1087, June 5, 1981.

Descriptors: *Drinking water, *Chlorination, *Carcinogens, *Chloroform, Water treatment, Public health.

This letter to the editor discussed the suggestion that the presence of chloroform in drinking water may pose a public health risk. While it may be reasonable to conclude that chloroform might be a human carcinogen on the basis of test with rats and mice, it is not appropriate to conclude that chloroform is a human carcinogen. Occupational health standards indicate that exposures in the range of 0.1 to 10 grams per day pose a health risk. On the other hand, the exposure to chloroform from drinking water is 0.1 to 10 grams per lifetime. These data indicate that the number of excess cancers attributable to chloroform in drinking water is exceedingly small. The wide range of factors associated with the decision of to chlorinate water which have also been associated with cancer risk raises questions regarding any conclusion that increases in certain types of cancer are attributable to water chlorination. Finally, even if a clear association could be demonstrated, the question of whether the water was hazardous because it was chlorinated or chlorinated because it was hazardous would remain. (Carroll-FRC)
W82-00467

WATER TREATMENT MODEL FOR POLLUTANT EXPOSURE ASSESSMENT,
Environmental Protection Agency, Athens, GA.
K. F. Hedden.
Journal of Environmental Science and Health, Part A, Vol 15, No 4, p 285-305, 1980. 2 Fig, 2 Tab, 20 Ref.

Descriptors: *Organic compounds, *Risks, *Assessments, *Model studies, *Water treatment, Activated carbon, Public health, Sedimentation, Coagulation, Flocculation, Filtration, Aeration, Chemical oxygen demand, Chemical wastes, Water pollution prevention, Effluents, Polyaromatic hydrocarbons, Carcinogens, Insecticides.

This paper describes a model of municipal water treatment processes for use in predicting the degree of removal of a toxic substance. Under the Toxic Substances Control Act, this information must be provided before new chemicals may be marketed. The subroutines include sedimentation, coagulation-flocculation (2 versions), filtration, aeration (2 versions), chemical oxidation, and granular activated carbon adsorption treatment. The chlorination model needs further experimental data and, in all probability, chemicals will need to be modeled on an individual basis. If the number and distribution of the population at risk and the necessary human and toxicological data are available, the potential health hazards of exposure to a chemical can be assigned. A sample run shows the removal rates for 11 selected chemicals: p-cresol, quinoline, methyl parathion, benzothiophene, 9H-carbazole, benzoquinoline, dibenzothiophene, 7H-dibenzocarbazole, benzoanthracene, benzopyrene, and mirex. (Cassar-FRC)
W82-00500

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5G. Water Quality Control

QUARTERLY PROGRESS REPORT, NATIONWIDE URBAN RUNOFF PROGRAM.
Woodward-Clyde Consultants, San Francisco, CA.
Environmental Protection Agency Report, April 1980. 64 p, 3 Fig, 5 Tab, Append.

Descriptors: *Urban runoff, *Water quality control, *Water pollution control, Economic aspects, Pollutants, Water pollution treatment, Planning, Monitoring, Water use.

The progress and status of the Nationwide Urban Runoff Program for the first quarter of 1980 are summarized. Of the thirty prototype projects, ten are well underway and are yielding results, ten have approved work plans and adequate staffing, nine have submitted work plans which await approval, and one is still drafting a work plan scope. In fiscal year 1979 the projects spent a total of $6.22 million. Progress in each of the ten major tasks - program development, program management, 208 urban runoff status determination, agency program coordination, prototype project selection, work plan development, technical/management assistance, project monitoring/coordination, program assessment and evaluation, and nationwide assessment and report to Congress - is recorded. The appendix indicates the grantee, location, key staff, receiving waters, beneficial uses, suspected pollutants, impacts, candidate BMP's, budget, grant amount and status, project status, and problems, for each project. (Brambley-SRC)
W82-00044

WQM FIVE YEAR STRATEGY (FY 81-BASELINE).
Environmental Protection Agency, Washington, DC. Water Planning Div.
Report, January 1980. 62 p, 2 Fig, 5 Tab, 20 Ref, 3 Append.

Descriptors: *Water quality management, *Long-term planning, *Legislation, *Management planning, Information systems, Nonpoint pollution sources, Monitoring, Water quality standards, Water treatment facilities, Runoff, Groundwater pollution, Financing.

The purpose of this strategy is to provide long-range direction for the water quality management (WQM) program to assist EPA Regions, States, areawide agencies, and the participating public with program planning in fiscal year 1981 and beyond, and to provide descriptions of program needs and directions. The focus is on WQM activities defined by sections 106, 208, and 303(e) of the Clean Water Act. The three highest management priorities for the program in FY 81-85 are improved program management, completion of the 208 grant program, and building and transferring an information base for nonpoint source control. Program priorities for the states include management of publicly-owned treatment works, monitoring, permits and enforcement, water quality standards, emergency responses, and nonpoint source management. The national 208 priorities are nonpoint source problems with the greatest emphasis on urban storm runoff, agriculture, and ground water contamination. Funding projections are made, based on historical data. The trend is to reduce federal funding with state and local agencies providing more funding. Four emerging policy issues are: coordination of 106 and 208 grants; water quality, quantity, and conservation; coordination of 201 and 208 programs; and coordination of WQM and other agency ground water activities. (Brambley-SRC)
W82-00045

SELECTIVE OVERBURDEN PLACEMENT,
Bureau of Mines, Spokane, WA. Spokane Research Center.
G. G. Miller.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-135055, Price codes: A05 in paper copy, A01 in microfiche.
In: Surface Coal Mining Reclamation Equipment and Techniques, Proceedings: Bureau of Mines Technology Transfer Seminars, Evansville, IN, June 3, 1980, and Denver, CO, June 5, 1980. Bureau of Mines Information Circular 8823, 1980. p 54-59, 2.

Descriptors: *Water pollution control, *Ground water, *Coal mines, *Strip mines, Leaching, Trace metals, Mine wastes, Spoil disposal.

The current practice of identifying toxic ions of salts and trace metals at surface coal mining sites involves drilling on a 1 mile grid in unfaulted areas and on a 1/2 mile grid in faulted areas. Based on a study of a 100 acre premine site, a two-step drilling program is proposed. The overburden should be drilled on a 1/2 mile grid to identify which physiochemical parameters exist in inhibitory concentrations. Then the site should be drilled on a 100 to 200 foot grid to identify the extent of those parameters. It is desirable to suppress the leaching process in the presence of spoil containing inhibitory concentrations of trace metal or salts. This may be done in four ways: sealing with an impermeable layer; dilution through mixing; use of a topographic dome to divert surface water; and subsurface water can be consumed by plantlife. Clay capping was found to be effective as a barrier to saturated flow. Mixing of inhibitory spoil material with other clean spoil tends to dilute the concentration of inhibitory material to acceptable levels. A network of monitoring wells were placed in the overburden and spoil in a coal mine in Colstrip, southeastern Montana. Water levels and water quality measurements were taken. Data suggest that mining activities have had little effect on the overburden water levels at distances greater than 2,000 ft from the mine pit. No major changes in water quality have occurred owing to commercial mining at the site. (Moore-SRC)
W82-00053

METHOD AND APPARATUS FOR POLLUTANT SPILL CONTROL,
J. E. Turbeville.
U.S. Patent No. 4,234,420, 18 p, 7 Fig, 46 Ref; Official Gazette of the United States Patent Office, Vol 1000, No 3, p 1105, November 18, 1980.

Descriptors: *Patents, *Oil spills, *Oil pollution, Water pollution treatment, Water quality control, Adsorption, Equipment, *Water pollution control, Magnetic particles, Hydrocarbons.

Organic pollutant spills on aquatic bodies may be collected by a method comprising distributing buoyant magnetically susceptible, olephillic, hydrophobic, resilient sorbent particles on the surface of the pollutant, allowing the sorbent to attract and bind the pollutions, magnetically collecting the pollutant-bound surbent particles, compressing the pollutant-bound sorbent particles to expel the pollutant to a pollutant sump, allowing the compressed sorbent particles to recover from compression, and redistributing the sorbent particles on the surface of the remaining pollutant. An apparatus for the practice of the pollutant collecting method may be fabricated as a surface going aquatic vessel. (Sinha-OEIS)
W82-00056

MEANS AND METHOD FOR SWEEPING MATERIAL FLOATING ON WATER USING VIBRATIONAL ENERGY,
Ocean Ecology Ltd., Edmonton (Alberta). (Assignee).
J. N. Koblanski.
U.S. Patent No. 4,235,711, 6 p, 5 Fig, 3 Ref; Official Gazette of the United States Patent Office, Vol 1000, No 4, p 1530, November 25, 1980.

Descriptors: *Patents, *Water quality control, *Water pollution treatment, *Oil pollution, *Oil spills, Acoustics, Sound waves, Vibrations, Equipment.

An apparatus for sweeping contaminating material such as oil along the surface of a body of water uses acoustic waves as a propelling force. The vibrational waves are produced by a device supported below the water surface and aimed upwardly towards a peripheral edge of the oil spill. Vibrational waves generated when the device is activated strike the air above the water surface and as a result are compacted into a flattened and horizontally elongated zone of vibrational energy which exerts a driving force on the oil spill edge. The method uses acoustical energy to provide, in effect, a huge broom which can be wielded to sweep floating oil or the like into a confined area from where it can more readily be picked up by other means. (Sinha-OEIS)
W82-00062

PROCESS FOR REMOVING ALKALINITY AND HARDNESS FROM WATERS,
Water Refining Co., Inc., Middletown, OH. (Assignee).
For primary bibliographic entry see Field 5F.
W82-00063

THE HORSE CREEK BASIN PROJECT,
Davis and Floyd Engineers, Inc., Greenwood, SC.
E. I. Davis, and W. J. Day.
Water/Engineering and Management, Vol 128, No 5, p 90, 92, 95, May, 1981. 2 Fig, 2 Tab.

Descriptors: *Wastewater facilities, *Regional planning, *Stream pollution, Pipelines, Industrial wastes, Natural streams, Water pollution sources, Water treatment, Horse Creek Basin, South Carolina.

Water treatment plans for the grossly polluted Horse Creek Basin and its major tributaries were designed to meet Environmental Protection Agency requirements. Construction and operation of a single regional plant which used an extended aeration-type wastewater treatment system was planned. Construction of the plant and the trunk system to collect the water to be treated began in 1977. The longest trunk line was 12 miles long, with the first three miles being a force main. One industry discharged alkaline waste into the stream, while another discharged a high pH waste. Unlined concrete pipe was used for the system. The project was completed in 1980 and the Horse Creek has already returned to a multiple-use waterway. The project has permitted development of a once blighted area. (Small-FRC)
W82-00071

BASIN MANAGEMENT IN THE SAN BERNARDINO VALLEY,
East San Bernardino City Water District, CA.
For primary bibliographic entry see Field 4B.
W82-00075

PREDICTING RUNOFF POLLUTANT REDUCTION IN BUFFER ZONES ADJACENT TO LAND TREATMENT SITES,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W82-00141

ENVIRONMENTAL PLANNING FOR COAL STRIP MINING,
Loxton, Hunting and Associates, Gaberone (Botswana).
A. C. Venn, V. C. Barnes, N. Boegman, G. H. Grange, and J. F. V. Phillips.
Civil Engineer in South Africa, Vol 22, No 4, p 96-100, April, 1980. 1 Ref.

Descriptors: *Coal mining, *Water pollution control, Mining, Mine wastes, Acid mine drainage, Mine drainage, Acid streams, Planning, *South Africa.

Environmental planning and care of coal mining areas is viewed against the background that coal mining is a vital component of the national economy of South Africa. In general coal mining produces three water pollution problems: chemical pollution due to the well known pyrite oxidation reaction, which produces sulfuric acid and iron salts; washaways of coal slurry or coal fines which can produce serious suspended solids problems in

water, cause an oxygen demand, and lead to minor chemical pollution; and increases in the normal load of suspended solids which are more or less inert due to erosion of disturbed soil. The severity of these problems depends on locality with respect to rainfall surface water and underground water. Mining close to a river or stream creates specific problems in the prevention of pollution. The pyrite content of coal, the general slope of the workings, the method and direction of mining, and the method and degree of rehabilitation of the area attained after mining must also be considered. Current policies to attain a good degree of pollution control include the control of storm runoff, prompt removal of water from open-cast workings, arranging drains and sumps for rapid collection of groundwater, diversion of rivers, and control of seepage into and from open cast workings. Proper rehabilitation of the site is probably the most effective means of preventing water pollution from open-cast mining operations. (Baker-FRC)
W82-00214

GRAPHICAL EFFLUENT QUALITY CONTROL FOR COMPLIANCE MONITORING: WHAT IS A VIOLATION,
Illinois Environmental Protection Agency, Springfield.
D. J. Schaeffer, K. G. Janardan, H. W. Kerster, and M. S. Shekar.
Environmental Management, Vol 4, No 3, p 241-245, May, 1980. 1 Fig, 9 Ref.

Descriptors: *Sampling, *Effluent standards, *Regulations, Graphical methods, Monitoring, Water quality control, Water pollution control, Water sampling, Pollutant identification, Mathematical studies.

A graphical method is suggested to determine the mean value for compliance or non-compliance with pollutant discharge regulations. This avoids the problems of a too-narrow or too-wide allowable variation by eliminating 10% of the results from consideration. This proposed change would effectively double the allowable operating mean and the daily excursion point. Both regulators and dischargers would have a clear definition of satisfactory operation and multiple criteria (numerical compliance, expected variability, frequency, and magnitude of violations) for scoring compliance. Either composite or grab samples may be used. (Cassar-FRC)
W82-00261

STRATEGY FOR RADIOACTIVE WASTE DISPOSAL IN CRYSTALLINE ROCKS,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 5E.
W82-00299

DETERMINATION OF MARINE CONSENT CONDITIONS,
Clyde River Purification Board (Scotland).
D. Hammerton, A. J. Newton, and R. Allcock.
Effluent and Water Treatment Journal, Vol 20, No 6, p 261-262, 265-266, 269, June, 1980. 2 Fig, 1 Tab, 7 Ref.

Descriptors: *Water pollution control, *Effluent standards, *Industrial wastes, Tidal rivers, Ecological effects, Water pollution effects, Stevenston, Scotland.

A case study of the development of consent conditions for a large ICI organics and explosives complex at Stevenston, Scotland, is presented. This facility discharges a variety of pollutants from manufacture of nitroglycerine, nitrocellulose, pentaerythritol tetranitrate, silicone oils, ammonium nitrate, lead styphnate, and dyestuff intermediates. The original design was to discharge all effluents 2 km at sea. However, the 12 million pound cost estimate caused a modification of the system. Two of 10 existing Garnock River outfalls and 2 short sea outfalls would be retained, with a long sea outfall to be constructed. Since effluent and storm water is combined, sensors will monitor overflows. A table lists the agreed limits for flow and other parameters. (Cassar-FRC)
W82-00323

ROCKY MOUNTAIN PIPELINE PROJECT: ENVIRONMENTAL IMPACT STATEMENT,
Bureau of Land Management, Washington, DC.
G. R. Konwinski, and W. N. Palmquist.
Available from the National Technical Information Service, Springfield, VA 22161 as DE81-026112, Price codes: A07 in paper copy, A01 in microfiche. Federal Energy Regulatory Commission, Office of Pipeline and Producer Regulation Report FERC/EIS-0024, TIC 92, July 1981. 59 p, 6 Fig, 3 Tab, 9 Ref, 1 Append.

Descriptors: *Environmental impact statement, *Environmental effects, *Construction, *Pipelines, Groundwater, Flood plains, Sediments, Stream pollution, *Water pollution prevention, Sediments, Intermittent streams, Streambeds, *Rocky Mountain Pipeline Project, Planning, *Erosion control, Sediment transport, Forecasting.

The Rocky Mountain Pipeline Project (RMPP) is a proposed 610-mile long natural gas transmission system. The RMPP would potentially cross many intermittent and perennial streams. The major concern with a pipeline stream crossing is the disruption of the streambed and the increase in sediment movement. The distance that the construction-induced sediment would be transported depends upon construction techniques, the stream flow parameters, and the grain size distribution of the stream bed materials. The disturbance of the streams cross section and the increase in sediment would be short term (3 to 5 days). It is expected that the levels of contaminants, such as lubricants and fuels introduced by construction into the waters that are crossed, will exceed state standards for short distances downstream, and mixing will be rapid. At some stream, road, and utility crossings and in some other topographically low areas, ground water may be encountered, but effects on groundwater would be localized and temporary. The proposed pipeline system would cross a floodplain at every stream crossing, but no aboveground permanent facilities would be constructed within a 100-year floodplain. Since regulations require that the pipeline be buried below the maximum scour depth, there would be no effects on flood stage. The pipeline will be hydrostatically tested in sections. The test water will be discharged in an environmentally acceptable manner. (Moore-SRC)
W82-00394

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

CONCEPTUAL DESIGN OF A REGIONAL WATER QUALITY SCREENING MODEL,
Argonne National Lab., Argonne, IL.
M. J. Davis.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/EV/10151-T1, Price codes: A04 in paper copy, A01 in microfiche. Dept. of Energy Report DOE/EV/10154-T1, Jan, 1981. 57 p, 2 Fig, 7 Tab, 25 Ref, Append.

Descriptors: *Water quality, *Model studies, *Water pollution effects, *Model studies, Regional analysis, Environmental effects.

Various energy-related activities may result in water quality impacts of varying degrees of severity. There is a need for an improved capability to identify regions where negative impacts may occur. The purpose of this report is to present the background information and the conceptual basis needed for the design of a regional water quality screening model with such a capability. The model is intended for use in the Strategic Environmental Assessment System (SEAS) and also for use in assessments of water quality impacts in efforts such as the Regional Issue Identification and Assessment (RIIA) program. The proposed water quality model does not predict instream concentrations of pollutants for the present; measured concentrations are used to account for present conditions. The model does provide projections of future instream conditions based on some scenario for energy development and is intended for use in screening for potential problem areas. The model will allow existing flow and background concentration information for the Aggregated Sub-Area level to be used for studies at that scale. It will also allow smaller-scale studies to be done. The proposed model has a number of limitations: the neglect of localized effects having a spatial scale much smaller than that of the minimum spatial units used; the neglect of inputs from certain sources of water pollution; and the use of a simplified treatment of pollutant behavior. (Moore-SRC)
W82-00038

COMPUTER MODELING OF FLUID FLOW DURING PRODUCTION AND ENVIRONMENTAL RESTORATION PHASES OF IN SITU URANIUM LEACHING,
Bureau of Mines, Twin Cities, MN. Twin Cities Research Center.
R. D. Schmidt.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-160236, Price codes: A05 in paper copy, A01 in microfiche. Report of Investigations 8479, 1980. 72 p, 16 Fig, 1 Tab, 16 Ref, 4 Append.

Descriptors: *Computer models, *Leaching, *Groundwater movement, *Injection wells, Flow characteristics, Model studies, Groundwater pollution, *Uranium, Extraction, Pumping, Aquifers, Hydrologic models.

In situ leaching is one method that shows promise of being both economically and environmentally advantageous for extraction of uranium from low-grade ore deposits. This computer model is intended to describe the flow behavior of leachants and ground water during the development, production, and restoration phases of a leaching operation involving an arbitrary pattern of injection and recovery wells. The model enables an assessment of the effectiveness and acceptability of various well and pumping configurations, in terms of both fluid dispersion within the ore pod and fluid excursions into the surrounding aquifer. Different aquifer environments are modeled, using a closed-form solution to the partial differential equation that describes three-dimensional changes in piezometric head as a result of pumping from leachant injection and recovery wells. The computer program can model a maximum of 50 arbitrarily located wells. Numerical techniques involving difference quotients and Taylor expansions about time points are used to derive time, velocity, areal sweep, and fluid volume parameters associated with leaching hydraulics. These parameters are output by the program in graphic and tabular formats. (Moore-SRC)
W82-00043

WATER SUPPLY AND DEMAND IN AN ENERGY SUPPLY MODEL,
Los Alamos Scientific Lab., NM.
For primary bibliographic entry see Field 6D.
W82-00050

PLANNING STUDY TO MODEL AND MONITOR COAL PILE RUN-OFF,
TRC Environmental Consultants, Inc., Wethersfield, CT.
G. T. Brookman, J. A. Ripp, P. B. Katz, B. C. Middlesworth, and D. K. Martin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-152530, Price codes: A10 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S7-81-016, July 1981. 5 p, 3 Fig, 1 Tab.

Descriptors: *Coal, *Surface runoff, *Hydrologic models, *Water pollution prevention, Runoff models, *Runoff forecasting, Pollution load, Catchment areas, Water quality control, Precipitation, Infiltration, Erosion, Oxidation, Path of pollutants, *Coal pile runoff.

A model has been developed to aid in the prediction of the quantity and quality of coal pile runoff from utility sites. Quantitative data such as precipi-

tation, runoff/infiltration, percolation, snow-melt, and infiltration into ground water, are used in a hydrological model TRCH2O, and qualitative data such as pyrite oxidation, freeze/thaw of coal, gully erosion, and pollutant wash-off, are used in a qualitative model TRCCOAL. Output from TRCH2O combined with site specific data for TRCCOAL simulates the daily, monthly, and annual run-off flows and loadings of pollutants such as acid, iron, sulfate, and trace metals. A field program for model validation will be conducted. Once validated the model can be used in the design of runoff collection basins and treatment systems, with the object of achieving site-specific designs, rather than the current arbitrary designs. (Brambley-SRC)
W82-00091

WATER POLLUTION POTENTIAL OF COAL-SLURRY PIPELINES,
Montana State Univ., Bozeman, Dept. of Civil Engineering and Engineering Mechanics.
H. S. Peavy.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-187221, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S7-81-082, June 1981. 6 p, 2 Fig, 6 Tab.

Descriptors: *Coal, *Slurries, *Pipelines, *water pollution sources, *Chemical reactions, Hydrogen ion concentration, Minerals, Dissolved solids, Turbidity, Organic carbon, Alkalinity, Colloids, Planning.

Coal-slurry pipelines have been proposed as one economical means of transporting coal over long distances to specific markets. The objective of this research project was to characterize those contaminants associated with transport waters from coal-slurry pipelines. This was accomplished through tests using a rotating bench-scale reactor. Tests consisted of coal mixed with tap water, tap water with additives, synthetic saline water, and synthetic saline water with additives. Tests were performed for a period of 12 days each. The results indicate that chemical interactions do occur between water and coal-slurry pipelines. There was a decrease in pH of approximately two units (from approximately 8 to approximately 6). Dissolution of metals at a pH of 6 was not significant. An increase in mineral content of fresh water was observed. Alkalinity, total dissolved solids (as indicated by electrical conductivity), and sulfates each showed increases. Use of phosphorus-based chemical additives for corrosion control resulted in substantial concentrations of phosphate. Turbidity remained in the water after separation of the coal by centrifugation. Although some color may be present as a result of humic acids and manganese, colloidal particles appeared to be the main cause of turbidity. Dissolved organic carbon levels may be significant if reuse (either prior to or after discharge) requires chlorination. These organics are potential percursors of chlorinated hydrocarbons. (Brambley-SRC)
W82-00096

WATER, ENERGY AND LABOR REQUIREMENTS FOR FUTURE PACIFIC NORTHWEST IRRIGATION,
Oregon State Univ., Corvallis. Dept. of Agricultural Engineering.
L. D. King, and M. L. Hellickson.
Transactions of the ASAE, Vol 24, No 3, p 691-698, May/June, 1981. 8 Fig, 1 Tab, 14 Ref.

Descriptors: *Irrigation, *Planning, *Computers, Model studies, Costs, Economic aspects, Agriculture, *Pacific Northwest, Energy, Labor.

A computer model was developed to determine future water, energy and labor requirements for three projected levels of irrigation development. Irrigation systems were selected by minimizing irrigation costs by crop for each of 45 hydrologic basins in the region. Results indicate that per acre energy requirements will increase rapidly as per acre water and labor requirements decrease. The study area was located in the Pacific Northwest. Data collected included levels of irrigation development, water, energy, labor cost and trends, and capital investment of irrigation systems; irrigation system labor requirements, expected useful system life, and estimated changes in irrigation efficiency. Pump-back and similar technologies at present offer the possibility of both increasing application efficiency and conserving energy. However, they have the disadvantage of a high labor requirement. The relationships between applying water in quantities greater than required for crop consumption and late season in-stream flow augmentation and/or aquifer recharge are not well understood. However, they should be investigated before major changes are made in regional water-energy management schemes. (Baker-FRC)
W82-00143

FLOW RESISTANCE IN VEGETATED WATERWAYS,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W82-00152

THE LIMITATIONS AND USEFULNESS OF STREAMFLOW GENERATION METHODS: A CASE STUDY,
Saskatchewan Univ., Saskatoon. Dept. of Civil Engineering.
W. J. Stolte.
Canadian Journal of Civil Engineering, Vol 7, No 1, p 185-191, 1980. 2 Fig, 3 Tab, 9 Ref.

Descriptors: *Reservoir design, *Streamflow forecasting, *Probabilistic process, Design criteria, Dams, Red Deer River, *Alberta, Model studies, Stochastic process, Hydrology, Statistical analysis, Case studies.

The increasing complexities of probabilistic models have made the connections between models and the physical world more and more vague. As a result, engineering judgement tends to be deemphasized. The models' validity is assumed even when practical verification must await future events. Results of generated streamflow sequences for the dam and reservoir being constructed on the Red Deer River, Alberta were compared with 61 years of recorded data. Both a simple autoregressive model and a more complex autoregressive moving average model had similar deficiencies. The generated and recorded peak monthly flows and minimum flows were comparable, but the generated sequences reached minimum levels faster than did actual flows. The value of stochastic streamflow generation lies in predicting reservoir storage failure. However, it is not so reliable as recorded data as a basis for hydrologic design of reservoirs. (Cassar-FRC)
W82-00229

BASIN MANAGEMENT IN THE SAN BERNARDINO BASIN AREA,
San Bernardino Valley Municipal Water District, CA.
L. W. Rowe.
Ground Water, Vol 18, No 6, p 626-629, November-December, 1980.

Descriptors: *Management planning, *Drainage basins, *Computer applications, Hydrologic data, Monitoring, Project planning, Economic aspects, Data interpretation, Rainfall, Watersheds, Groundwater, Water supply, Pumps, *San Bernardino Valley, California, *Watershed management.

The San Bernardino Valley Municipal Water District was formed in 1954 to master plan the long-term water supply, including the importation of supplemental water for a portion of the Upper Santa Ana River Basin. As part of its function, the District has established a hydrologic data base. Development and selection of the alternative strategies is more effective with historic and real time hydrologic data. The updating of the operation economics associated with importation also benefits from availability of hydrologic data. Water quality data is obtained through an ongoing monitoring program. Eight service areas within the District investigate the feasibility of introducing supplemental water, either through groundwater recharge or direct filtration, to augment native supplies. Groundwater models are used in the development of management practices. The Cooperative Water Project is an arrangement between public and private water purveyors which provides a system for exchanging water credits during periods of short supply. The District also identifies excess pumpage and wheeling capacity within existing water systems, and engages in regional public participation programs. (Titus-FRC)
W82-00280

GROUND-WATER MODELING: RECENT DEVELOPMENTS,
GeoTrans, Inc., Reston, VA.
For primary bibliographic entry see Field 2F.
W82-00281

THE CONSULTANT'S VIEWPOINT ON ALTERNATIVE DISINFECTANTS,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
M. L. Tittlebaum, J. L. Pavoni, B. F. Maloy, and T. L. Kochert.
Public Works, Vol 111, No 1, p 40-41, January, 1980. 1 Fig, 6 Ref.

Descriptors: *Disinfection, *Chlorination, *Decision making, Planning, Wastewater treatment, Residual chlorine, Aquatic life, Public health, Toxicity, Chlorinated hydrocarbons, Environmental effects, Water quality.

A decision-making tree for choosing wastewater disinfection alternatives is described. High priority is given to water quality and environmental effects, in particular, eliminating hazards from pathogens and halogenated organic compounds and protecting aquatic life from residual chlorine toxicity. Possible disinfection methods include chlorine, chlorine dioxide, ozone, ultraviolet radiation, bromine chloride, and dechlorination. However, most of the disinfectants currently being considered for wastewater treatment have serious limitations, so potential applications must be considered on a case-by-case basis. (Cassar-FRC)
W82-00286

DEVELOPMENT OF A RURAL WATER DISTRICT,
Corlew (M. B.) and Associates, Inc., Edwardsville, IL.
P. M. Corlew, and G. F. Harris.
Public Works, Vol 112, No 5, p 86-87, May, 1981. 1 Fig.

Descriptors: *Rural areas, *Water distribution, *Water treatment facilities, Water demand, Water treatment, Water supply systems, Water conveyance, Pipelines, Water mains, Water use, Water shortage, Farms, *Madison County, Illinois.

A successful rural water district plan was developed in Madison County, Illinois with the aid of Farmers Home Administration (FmHA) funding. The design of the total water system, which would provide water to drought-stricken farms previously supplied by wells, included 78 miles of water main, an elevated and a ground storage tank, two booster pump stations, telemetry and appurtenances. The project was built to handle 550 users with a 35% growth factor. The city of Edwardsville contracted to supply one million gallons of water per month to the Northeast Central County Public Water District (NCCPWD) in turn for monies to help upgrade their current treatment facility. The operations of the new NCCPWD system are diagrammed, and special provisions for large family dwellings and pipeline safety when laid beneath roadways are discussed. Early installation of house services allowed the district to receive revenue from the project six months prior to its completion in July of 1980. The director of the FmHA attributes the success of this water district project to the accurate assessment of water demand, the capability and flexibility of the contractor, the close communication between the Board of Trustees and residents, and the project's

innate designs to easily accommodate expansion. Total cost of the project was about $3 million, of which a little less than $1.4 million was borrowed. (Geiger-FRC)
W82-00288

NORTHEASTERN NEW JERSEY GRAPPLES WITH A DROUGHT,
New Jersey Dept. of Environmental Protection, Trenton.
For primary bibliographic entry see Field 8A.
W82-00289

THE WORLD CLIMATE PROGRAMME,
Bureau of Meteorology, Melbourne (Australia).
J. W. Zillman.
Search, Vol 11, No 4, p 108-111, April, 1980. 11 Ref.

Descriptors: Water resources, *Climatology, Planning, *Weather, *World Meteorological Organization, World Climate Program, Decision making, Water policy, International commissions.

The World Meteorological Organization established the World Climate Program in May 1979 as an international effort to foresee climatic changes and to use this knowledge in planning and management of man's activities. The Climate Study Program, one of the four components of the overall program, will concern formulation of rational policy alternatives in agriculture, water resources, ocean resources, fisheries, land use, etc. The Program will be operating on time scales from several weeks to several decades and on space scales from regional (1000 km) to global. (Cassar-FRC)
W82-00317

A NEW ERA FOR CHINA'S HYDROPOWER,
Manitoba Univ., Winnipeg. Dept. of Geography.
For primary bibliographic entry see Field 8A.
W82-00335

CHINA'S POTENTIAL FOR HYDRO DEVELOPMENT,
For primary bibliographic entry see Field 8A.
W82-00336

ANALYSIS OF CAPACITY REQUIREMENTS FOR STORAGE RESERVOIRS: A CASE STUDY,
Calgary Univ. (Alberta). Dept. of Civil Engineering.
I. Musik.
Canadian Journal of Civil Engineering, Vol 7, No 2, p 388-392, 1980. 3 Fig, 2 Tab, 8 Ref.

Descriptors: *Reservoir storage, *Storage requirements, *Stochastic process, Red Deer River, *Alberta, Streamflow, Drought, Case studies.

Three procedures for estimating reservoir storage from 61 years of historic mean monthly flows on the Red Deer River, Alberta, were considered. The stochastic simulation approach proved best because it allowed full extraction of information from the historic data on properties of inflow and generated 99 series of 100-year mean monthly flows for storage requirements analysis. The method of computing required storage capacity from the historic sample produced the minimum storage capacity, 225 million cu meters, but could not assign any probability of failure to satisfy the required yield. Using synthetic mass curves produced unrealistically high storage values because the curves did not indicate a realistic sequence of natural flows. (Cassar-FRC)
W82-00341

AREAL PREDICTIONS OF WATER AND SOLUTE FLUX IN THE UNSATURATED ZONE,
Arizona Univ., Tucson. Dept. of Soils, Water, and Engineering.
A. W. Warrick, and A. Amoozegar-Fard.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-191124, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-058, June 1981. 4 p, 2 Fig, 1 Tab, 4 Ref.

Descriptors: *Soil water, *Surface water, *Flow discharge, *Salts, *Flow pattern, Soil physical properties, Simulation analysis, Drainage, Irrigation practices, Diffusion coefficient, Flow velocity, Unsaturated zone, Prediction.

This investigation was undertaken to develop procedures for evaluating distribution of water and salt fluxes over land areas. Relevant applications include numerical simulations and sampling in fields of large extent. The primary focus is on irrigated lands including effects of salinization and crops on the ground and surface waters. The study was in three parts: observations of distributions for a variety of soil physical parameters and inference on sampling; simulations of water and salt fluxes for nondeterministic systems; and a sensitivity analysis for drainage. Simulations of water and salt fluxes were made using the 'crude' Monte Carlo technique. For infiltration, 'Philip's' equation was utilized in a scaled form by solving one time. Individual simulations were made algebraically without repeating the laborious steps of resolving the unsaturated moisture flow equation each time. Similarly, results for the nonlinear drainage case were solved based on only one finite difference determination. The Monte Carlo simulation was carried out by simple interpolation from the one nonlinear solution. Unfortunately, no great shortcut was found for cyclic or seasonal irrigation regimes, although some interesting results based on linearized solutions were found for high frequency water applications. Salt distributions were calculated for cases of equal irrigation amounts over time but with intake rate varying over space. Deterministic calculations based on the mean velocity and apparent diffusion coefficient gave erroneous results compared to the 'average' values over the field for both salt profiles or fluxes. The true 'average' by depth for a given time is much more dispersed, with more salts reaching very deep depths and also with more salts remaining close to the surface when pulses of salt are added. Similarly, the mass emission of salts averaged over a field for a given depth appear earlier in time and taper off more gradually for a pulse input than deterministic calculations based on mean velocities would indicate. (Author's abstract)
W82-00381

BEFORE THE WELL RUNS DRY: A HANDBOOK FOR DESIGNING A LOCAL WATER CONSERVATION PLAN.
New England River Basins Commission, Boston, MA.
For primary bibliographic entry see Field 3D.
W82-00396

DIGITAL MODEL OF THE UNCONSOLIDATED AQUIFER SYSTEM IN THE MODESTO AREA, STANISLAUS AND SAN JOAQUIN COUNTIES, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 4B.
W82-00415

6B. Evaluation Process

ALTERNATIVES WORKING GROUP REPORT.
Available from the National Technical Information Service, Springfield, VA 22161 as CONF-800137, Price codes: A10 in paper copy, A01 in microfiche. In: Ground Water and Energy, Proceedings of the U.S. Dept. of Energy's National Workshop, Jan 29-31, 1980, Albuquerque, NM. Dept. of Energy Report CONF-800137, Nov 1980. p 167-183, 3 Fig, 1 Ref.

Descriptors: *Groundwater potential, *Groundwater availability, *Water supply development, *Legislation, Federal jurisdiction, State jurisdiction, Water rights, Environmental effects, Economic aspects, Social aspects, Water conservation, Impaired water use.

The working group discussed various technical and institutional alternatives for ground water use in energy development. As energy activities compete with other users for water supplies, ground water will become an attractive option. A matrix was developed to identify the attributes of ground water problems. Surface and ground water supplies are considered in relation to their physical availability; reliability; the impact of state laws, purchase rights and Federal laws on the water rights; environmental effects on water, air, and land; cost; and social acceptance. Using the matrix a small number of possible sources can be identified. Further consideration in light of cost and social acceptance should reveal the best water source. This analysis should take into consideration process changes such as dry cooling, recycling, and reuse; use of process-derived water; and technological substitution; all of which reduce the water demand or make use of low quality water. (Brambley-SRC)
W82-00032

WATER QUALITY ISSUES AND ENERGY ASSESSMENTS,
Argonne National Lab., Argonne, IL.
M. J. Davis, and S. Chiu.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/EV/10154-01, Price codes: A04 in paper copy, A01 in microfiche. Dept. of Energy Report DOE/EV/10154-01, Nov, 1980. 64 p, 7 Tab, 67 Ref, 2 Append.

Descriptors: *Water quality, *Environmental effects, *Water pollution effects, *Fuel, Waste disposal, Resources development, Groundwater, Regional analysis, Energy sources.

A number of water quality issues will arise during assessments of the environmental impacts associated with various energy futures. Realistic assessment of the water quality impacts associated with future energy development requires that the most significant of these issues be properly addressed. The purpose of this report is twofold: first, to identify and to evaluate significant water quality issues related to regional and national assessments of energy developments; and second, to recommend for study related topics that bear on the capability to carry out such regional and national assessments. Issues concerning impacts on water quality include: impact of secondary effects of energy development; spills and accidental releases of pollutants; noncompliance with discharge requirements; solid waste disposal; coal mining; consumptive use and the maintenance of instream flow requirements; impacts on groundwater quality due to leaching, aquifer disruption, saltwater intrusion, waste disposal, and depletion; importance of hydroelectric load following for downstream conditions; inputs of pollutants to the Great lakes; atmospheric deposition and acid rain; salinity and energy-related residuals in the Colorado River Basin; biomass residue harvesting; synfuel development; and water quality impacts of energy developments in the coastal zone. Methodology issues in surface water quality assessments include: load estimation techniques; proper description of river basins; and water quality modeling procedures. (Moore-SRC)
W82-00036

REPORT OF SURVEY OF CORPS OF ENGINEERS CONSTRUCTION WORKFORCE,
Institute for Water Resources (Army), Fort Belvoir, VA.
C. M. Dunning.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A103324, Price codes: A07 in paper copy, A01 in microfiche. Research Report 81-R05, June 1981. 135 p, 3 Fig, 41 Tab, 31 Ref, 3 Append.

Descriptors: *Employment, *Social aspects, *Construction, *Economic impact, Benefits, Cost-benefit analysis, Dam construction, Unemployment, Reservoir construction, Flood control, *Engineering personnel, *Corps of Engineers.

A survey of the Corps of Engineers construction workforce was conducted in order to develop an

empirical basis for determining employment benefits due to construction of Corps projects, and to develop an empirical basis for determining the socioeconomic impacts of the workforce utilized for Corps project construction on local communities. The study is based on a 51-project sample selected from 136 projects constructed during 1979. The data base represents 4,089 complete responses from workers at a cross-section of Corps projects. Project types include: flood control, reservoirs, power projects, channels and harbors, locks and dam projects, beach erosion projects, and replacement projects. Some unemployment immediately prior to beginning work on Corps projects was reported by 39.6% of the workers. Clear differences in previous unemployment status were found among the workforce according to occupational group, locality, and the project area EDA status. The survey revealed that a large majority of the Corps' construction workforce is composed of local workers (69.4%). Approximately 60% of the non-local workforce is accompanied by dependents. A ratio of 1.24 dependents to each non-local worker was computed. For non-local workers, nearness to project site seems to be the most important housing choice location criterion. (Moore-SRC)
W82-00102

REVIEW OF REPORTS FOR FLOOD CONTROL; WESTCHESTER COUNTY STREAMS, NEW YORK.
Army Engineer District, New York.
For primary bibliographic entry see Field 4A.
W82-00103

ENVIRONMENTAL IMPACT ASSESSMENT OF CHINA'S WATER TRANSFER PROJECT,
Research Inst. on Environmental Science, Beijing (China).
For primary bibliographic entry see Field 6D.
W82-00129

OPTIMAL DESIGN OF WATER CONVEYANCE SYSTEMS,
Texas Dept. of Water Resources, Austin.
Q. W. Martin.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 106, No HY9, p 1415-1433, September, 1980. 5 Fig, 2 Tab, 15 Ref.

Descriptors: *Water conveyance, *Design criteria, Conveyance structures, Water distribution, Aqueducts, Computers, *Cost analysis, Water supply systems, *Texas.

A procedure is described for establishing the minimum cost design and location of a water conveyance system. The design problem considered is limited to the evaluation of the construction of conveyance facilities to their ultimate flow capacity without consideration of capacity expansion. The application of the method is described for a potential water conveyance canal from Lake Texoma on the Texas-Oklahoma border to the upper Trinity River Basin watershed. The various corridors for a potential water conveyance facility from Lake Texoma to the Basin were evaluated using the largest scale US Geological Survey topographic map available. The use of the demographic and topographic information led to the immediate elimination of certain portions of the potential route. Some of the territory was occupied by cities or wildlife refuge locations, or was of high elevation. The remaining area was then examined using topographic maps based on a smaller scale. Using a composite map of four, 15 minute quadrant sheets, a set of 110 possible conveyance route sections and 90 junction points between the sections was delineated. The CANAL-I program is able to analyze up to 174 junctions and 250 route sections, with additional junction points and route sections being added to provide further detail. Several computer runs using CANAL-I were required. The use of this program significantly reduced the time required to determine reconnaissance level design for the water conveyance system. It is expected that in the future, use of this program will significantly cut costs in the construction and operation of water conveyance facilities. (Baker-FRC)
W82-00160

WORTHLESS, VALUABLE, OR WHAT. AN APPRAISAL OF WETLANDS,
Vermont Univ., Burlington.
J. Brande.
Journal of Soil and Water Conservation, Vol 35, No 1, p 12-16, January/February, 1980. 23 Ref.

Descriptors: *Wetlands, *Economic aspects, *Attitudes, Marshes, Swamps, Value, Drainage effects, Ecological effects, Hydrologic cycle, Hydrological regime, Reviews.

Wetlands have been recognized as having a positive value only in the past 30 years. This paper traces history of the negative attitude toward wetlands, swamps, and marshes from Hippocrates in the fourth century B.C., through Roman times, Shakespeare's writings, early American colonial leaders, and surveyors of the Dismal Swamp in Virginia to the recent literature. It is now realized that wetlands can improve water quality, store floodwaters, recharge groundwater supplies, provide habitat for wildlife and an environmental margin of safety, produce useful materials (peat, fish, game), protect shorelines from erosion, provide recreational and educational opportunities, purify the air, act as sound barriers, and provide a genetic reservoir. The vast amount of data on wetlands now being acquired must be translated and interpreted so that society can understand and use it, especially the economic aspects. If monetary values for the variety of wetland functions are assigned, the true value of these formerly 'dangerous' and 'worthless' areas may be realized. (Cassar-FRC)
W82-00177

POWER PLANT WATER INTAKE ASSESSMENT,
Consumers Power Co., Jackson, MI.
For primary bibliographic entry see Field 6G.
W82-00216

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING: LEWIS RIVER BASIN, WASHINGTON.
Federal Energy Regulatory Commission, San Francisco, CA. Office of Electric Power Regulation.
Report FERC-0067, January 1981. 59 p, 13 Fig, 6 Tab.

Descriptors: *Water resources development, *Hydroelectric plants, *Electric power production, *Flood control, Economic feasibility, Irrigation, Water supply, Navigation, Recreation, Water quality, Groundwater availability, Appraisals, *Lewis River basin, Washington.

The Lewis River basin has an area of 1,046 sq miles and there are four hydroelectric projects on the river. All but one are storage projects, which provide significant seasonal flow regulation of the river. The water resources of the basin have also been developed for irrigation, flood control, water supply, navigation, and water-based recreation. The license for the Merwin project has expired and it is being considered for relicensing. The plant is in good condition and the project appears to be economically favorable for continued operation. The major water resource management problems in the basin are related to water quality, groundwater availability, and municipal water supply, with flooding, preservation of instream flow values, and undeveloped water-related recreational potentials as lesser considerations. Seventeen conventional hydropower sites have been identified, but the economic feasibility of each project has not been determined. (Brambley-SRC)
W82-00370

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING: ELWHA RIVER BASIN, WASHINGTON.
Federal Energy Regulatory Commission, San Francisco. Office of Electric Power Regulation. Report FERC-0072, March 1981. 46 p, 11 Fig, 7 Tab, 6 Ref.

Descriptors: *Water resources development, *Hydroelectric plants, *Electric power production, *National parks, Water supply, Flood control, Recreation, Economic feasibility, Project planning, Fish management, Appraisals, *Elwha River basin, Washington.

The Elwha River basin has an area of about 321 sq miles, most of which is within national park or national forest boundaries. The water resources of the basin have been developed to provide for water supply, flood control, recreation, and hydropower. There are two hydroelectric plants on the river, and, given the restrictions on development within national parks, it is unlikely that further development will be allowed. The Glines Canyon Dam is within Olympic National Park, and functions essentially as a run-of-river powerplant. It is well maintained and seems to be an economical source of power and recreational activities for many years. Five potential conventional and hydroelectric and one potential pumped storage site have been considered, but will not now be developed. At both projects regulation for minor flood control should be undertaken. It is recommended that a fish passage facility be constructed at the Elwha Dam, and that Lake Aldwell be regulated in the future to provide water supply and streamflow regulation for fish. (Brambley-SRC)
W82-00371

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING: LITTLE TENNESSEE RIVER BASIN, TENNESSEE, NORTH CAROLINA, AND GEORGIA.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation. Available from Supt. of Documents, GPO, Washington, DC 20402. Report FERC-0066, January 1981. 83 p, 17 Fig, 19 Tab.

Descriptors: *Water resources development, *Hydroelectric plants, *Electric power production, *Economic feasibility, Project planning, Water level fluctuations, Minimum flow, Environmental effects, Fish management, *Little Tennessee River basin, Tennessee, North Carolina, Georgia.

The Little Tennessee River basin has an area of 2,627 sq miles; the river is 602 miles long, and there are 17 licensed hydroelectric developments in the basin. Six other projects have license applications pending. Together they have an installed capacity of 93,975 kilowatts. All the projects are in good physical condition and appear to be capable of providing an economic source of power for the foreseeable future, and it may be economic to expand them. Minimum flow regulations and reservoir water level fluctuations for the benefit of fish are considerations in the possible licensing of these projects. The projects are economically justified, and are not environmentally harmful. There is potential for further hydroelectric development in the basin, up to 4,000 megawatts, 98% of which would be from pumped storage. (Brambley-SRC)
W82-00372

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING: PIT RIVER BASIN, CALIFORNIA.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation. Available from Supt. of Documents, GPO, Washington, DC 20402. Report FERC-0045-2, September 1980, 85 p, 39 Fig, 22 Tab, 8 Ref, Append.

Descriptors: *Water resources development, *Hydroelectric plants, *Electric power production, *Economic feasibility, *Flood control, Environmental effects, Fish management, Dam construction, Irrigation, Recreation, Land use, Appraisals, *Pit River basin, California.

The Pit River basin has an area of 6,100 sq miles, and there are nine hydroelectric developments on the Pit River with a generating capacity of 725,150 kilowatts. The license for Project 233, comprising three developments, has expired, and the project is

being considered for a new license. The plants are in good operating condition and can continue to be an economic source of power. Continuation of the existing reservoirs would not have significant adverse effects on the environmental aspects of the basin, but some alterations in operation may be necessary to improve fish management. Flood control is needed in the basin to alleviate flooding downstream on the Sacramento River. Since it would not be economic to use or modify the existing hydroelectric projects for this purpose, new projects have been suggested. The Allen Camp project would provide benefits from irrigation, recreation, flood control, power, fish and wildlife enhancement, and area development, and would possibly provide headwater improvement to hydroelectric power at the downstream plants, but since the original study this project has become unfavorable economically. One of the three potential hydroelectric projects is considered economically favorable. (Brambley-SRC)
W82-00373

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING: CLARK FORK-PEND OREILLE RIVER BASIN, MONTANA, IDAHO, WASHINGTON.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Available from Supt. of Documents, GPO, Washington, DC 20402. Report FERC-0062, September 1980. 108 p, 37 Fig, 32 Tab, 8 Ref.

Descriptors: *Water resources development, *Hydroelectric plants, *Electric power production, *Economic feasibility, Project planning, Water conservation, Irrigation, Municipal water, Flood control, Water quality control, Recreation, Wildlife management, Colorado River basin, *Clark Fork-Pend Oreille River basin.

The Clark Fork-Pend Oreille River basin is a major component of the Columbia River basin, having a drainage area of 25,800 sq miles, of which 1,203 sq miles are in Canada. There are 13 hydroelectric generating plants in the United States portion. The license for the Thompson Falls plant expired in December 1975 and was renewed in December 1979, and the license for the Kerr plant expired in May 1980 and is currently operating under an annual license. This plant is in good physical condition and is capable of providing an economical source of power for an extended period. Preliminary studies indicate that an additional generating unit would be economic. Thirteen potential conventional power projects and five additions to existing hydroelectric projects are discussed. The principal purposes of these developments would be to provide hydroelectric power, water conservation for irrigation and municipal supply, and flood control, with consideration being given to fish and wildlife management, water quality control, and water-oriented recreation. A preliminary economic analysis of the new projects indicates that five projects have favorable energy economics, while four of the five additions are economically favorable. (Brambley-SRC)
W82-00374

ASSESSMENT OF SOLVENT EXTRACTION FOR TREATMENT OF COAL GASIFIER WASTEWATER,
Missouri Univ.-Columbia.
For primary bibliographic entry see Field 5D.
W82-00439

SUMMARY OF THE NEW ENGLAND CONFERENCE ON LEGAL AND INSTITUTIONAL INCENTIVES TO SMALL-SCALE HYDROELECTRIC DEVELOPMENT, JANUARY 30-31, 1979, BOSTON, MASSACHUSETTS.
Franklin Pierce Law Center, Concord, NH. Energy Law Inst.
For primary bibliographic entry see Field 6E.
W82-00447

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

WESTERN WATER RESOURCES: COMING PROBLEMS AND POLICY ALTERNATIVES,
Federal Reserve Bank of Kansas City, MO.
For primary bibliographic entry see Field 6D.
W82-00107

THE VALUATION OF RECREATIONAL FISHERIES,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
D. Cauvin.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 8, p 1321-1327, August, 1980. 17 Ref.

Descriptors: *Recreation demand, *Fisheries, *Resources allocation, Value, Pricing, Economic aspects, Resources allocation, *Canada.

The present concept of recreational fisheries in Canada as a nonpriced resource should be changed. These techniques do not allow a realistic value to be assigned for allocation and management decision making. Two valuation techniques, favorable in Western Canada, are discussed--the willingness to pay method and the expenditure method. When the government provides free or nominal-cost fishing, overallocation of resources for fisheries or distorted demand statistics result. The argument is made that recreational fishing should be priced in spite of the difficulties and of the opposition posed by fishermen and by governmental agencies charged with administration of this work. (Cassar-FRC)
W82-00348

6D. Water Demand

GROUND WATER AVAILABILITY,
Geological Survey, Denver, CO. Water Resources Div.
H. H. Hudson.
Available from the National Technical Information Service, Springfield, VA 22161 as CONF-800137. Price codes: A10 in paper copy, A01 in microfiche. In: Ground Water and Energy, Proceedings of the U. S. Department of Energy's National Workshop, January 29-31, 1980, Albuquerque, New Mexico. Department of Energy Report CONF-800137, November 1980. p 37-47, 13 Ref.

Descriptors: *Groundwater availability, Groundwater potential, *Resources development, *Water supply, Surface water availability, *Water demand, Oil shale, Coal, Energy sources, Regional development.

When water requirements for energy resource development are considered, it is generally only surface water that is considered. In both the Upper Missouri and Upper Colorado River basins there are extensive coal and oil shale reserves, but the surface water reserves which are not already allocated are inadequate. In studies in which scenarios were developed, water sources were generally not indicated. The more recent studies indicate that less water would be needed than the earlier studies indicated. While surface water resources are well known, ground water resources tend to be estimates, with quantity and quality unknown. It is suggested that this ground water resource may provide the water necessary for energy development, once the supply is sufficiently studied. Water of low quality, which is unsuitable for domestic or agricultural purposes, may be suitable for energy development processes, particularly in coal-slurry pipelines. Use of ground water may overcome some of the legal, economic, political, institutional and environmental conflicts which accompany the use of surface water. (Brambley-SRC)
W82-00027

GROUND WATER ALTERNATIVES AND SOLUTIONS,
Los Alamos Scientific Lab., NM.
F. Roach.
Available from the National Technical Information Service, Springfield, VA 22161 as CONF-800137, Price codes: A10 in paper copy, A01 in microfiche. In: Ground Water and Energy, Proceedings of the U.S. Department of Energy's National Workshop, January 29-31, 1980, Albuquerque, New Mexico. Department of Energy Report CONF-800137, November 1980. p 65-94, 13 Fig.

Descriptors: *Water supply, *Water demand, *Economics, *Groundwater potential, Groundwater availability, Groundwater depletion, Resources development, Aquifers, Saline water, Surface water availability, Energy sources, *Impaired water use.

It is generally acknowledged that surface water supplies will not be able to meet the demands of a developed energy industry in many areas of the U.S. Increasing claims on this resource may put the price out of an economic range for energy or other users. Using maps of energy resources, surface water, ground water use, and saline and deep aquifers, it can be shown that while the energy resources generally occur in areas with surface water problems, they occur outside areas with high ground water use. They coincide well with areas of saline and deep aquifers. Saline and low quality water has applications in the energy industry such as: in cooling water systems; air pollution control systems; waste disposal; conversion process modifications; mining; and coal slurry pipelines. Use of saline water has the economic advantages of lower development costs, adding little to the product price, and lessening the political and transaction costs. The use of ground water, and ground water in conjuction with surface water, is a solution to the water needs of the energy industry, and there are opportunities for the industry to cooperate with other users in developing water sources for all. (Brambley-SRC)
W82-00029

SUPPLY WORKING GROUP REPORT.
Available from the National Technical Information Service, Springfield, VA as CONF-800137, Price codes: A10 in paper copy, A01 in microfiche. In: Ground Water and Energy, Proceedings of the U.S. Department of Energy's National Workshop, January 29-31, 1980, Albuquerque, New Mexico. Department of Energy Report CONF-800137, November 1980. p 131-144, 2 Ref.

Descriptors: Groundwater availability, *Groundwater potential, *Geohydrology, *Hydrologic cycle, Water supply, *Water demand, Surface water, Energy sources.

The primary objective of the Supply Working Group was to discuss the Office of Technology Impacts' (OTI) procedures for assessing the potential impacts of using ground water for energy production. Four levels or categories of OTI assessments were thought to be necessary: national, State/regional, basin, and site-specific. The needs of the national assessment could be met by collecting and summarizing information on ground water across the nation, but the other three levels of assessment would require more than an aggregation of available information. Ground water is part of the hydrologic cycle and cannot be considered separately from surface water when water supplies are being assessed. At the basin or aquifer level, an interpretation of the hydrologic unit requires the following information: geologic configuration, aquifer and basin boundaries, recharge and discharge, capture potential, storage capabilities, transmissive qualities, quality characteristics, transport or dispersive qualities, water dating, and water demand. Development of ground water is possible only when it is hydrologically and economically feasible and will always be accompanied by declining water levels and stream flow depletion. The group identified data base issues, fundamental issues, saline aquifer issues, impacts of ground water development, permit and legislation issues, modeling, relocation and reallocation, and general issues. (Brambley-SRC)
W82-00030

CONFLICTS AND BARRIERS WORKING GROUP REPORT.
For primary bibliographic entry see Field 6E.
W82-00031

WATER-RELATED ENVIRONMENTAL CONTROL REQUIREMENTS AT MUNICIPAL SOLID WASTE-TO-ENERGY CONVERSION FACILITIES,
Iowa State Univ., Ames.
For primary bibliographic entry see Field 5D.
W82-00037

WATER RELATED PLANNING AND DESIGN AT ENERGY FIRMS,
Los Alamos Scientific Lab., NM.
D. Abbey, and F. Lucero.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/EV/10180-1, Price codes: A03 in paper copy, A01 in microfiche. Department of Energy Report DOE/EV/10180-1, November 1980. 44 p, 8 Fig, 6 Tab, 23 Ref.

Descriptors: *Water demand, *Water allocation, *Planning, *Powerplants, Cost analysis, Water use, Cooling water, Water scarcity, Wastewater treatment, Waste disposal, Water treatment, Water reuse, Energy sources.

Energy production and conversion activities have historically been water intensive, so accelerated domestic energy production is expected to make increased demands on water resources. By identifying production alternatives and specifying their costs under a variety of conditions, future patterns of water use in the energy industry and its response to water-related regulation may be projected. The three principal decisions of industry that affect water allocation are where to build plants, where to get water, and how much water to use. Site selection is currently based on water supplies for evaporative cooling; this may change in response to increasing water scarcity. Water may be acquired from a number of sources; the source will be selected on the basis of uncertainty, risk, transaction and engineering costs. Water system design entails the evaluation of tradeoffs among water intake, water treatment, and wastewater disposal costs. A survey of recently constructed and planned plants shows that water supply costs are site-specific, and the following conclusions may be drawn. If water intake or disposal costs are nonzero, recirculating systems are cheaper than once-through systems. Treatment costs for low quality water may be less than transport costs for high quality water. Discharge standards and disposal costs promote the maximum degree of recirculation, reuse, and treatment. Dry cooling has great potential for application at synthetic fuel plants and very limited potential at electric plants. (Brambley-SRC)
W82-00042

WATER SUPPLY AND DEMAND IN AN ENERGY SUPPLY MODEL,
Los Alamos Scientific Lab., NM.
D. Abbey, and V. Loose.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/EV/10180-2, Price codes: A04 in paper copy, A01 in microfiche. Department of Energy Report DOE/EV/10180-2, December 1980. 63 p, 1 Fig, 17 Tab, 79 Ref.

Descriptors: *Resource development, *Water supply, *Water demand, Water conservation, *Industrial water, *Model studies, Cooling water, Groundwater, Water scarcity, Irrigation water, Energy sources.

Environmental factors are frequently omitted from energy supply models. This report describes a tool for water and energy related policy analysis, the development of a water supply and demand sector in a linear programming model of energy supply in the United States. The model allows adjustments in the input mix and plant siting in response to water scarcity. On the demand side, energy conversion facilities can substitute more costly dry cooling systems for conventional evaporative systems. On the supply side, groundwater and water purchased from irrigators are available as more costly alternatives to unappropriated surface water. The availability of water was determined from water basin information for 30 regions in 10 Western states. Preliminary results for a 1990 energy demand scenario suggest that, at this level of spatial analysis, water availability plays a minor role in plant siting. Certainly, there are legal and institutional impediments to the procurement of large industrial water supplies. But, as represented by the structure and data inputs of the model, there are a variety of water use alternatives available to energy firms when any one option is foreclosed. (Moore-SRC)
W82-00050

A 10-YEAR PLAN TO STUDY THE AQUIFER SYSTEM OF INDIAN WELLS VALLEY, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
P. Lipinski, and D. D. Knochenmus.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225, Price codes: $5.75 in paper copy, $5.00 in microfiche. Geological Survey Open-File Report 81-404, June 1981. 16 p, 4 Fig, 12 Ref.

Descriptors: *Planning, *Aquifer systems, *Groundwater, *Water resources development, Pumpage, Over-draft, Groundwater recharge, Observation wells, Water level, Water quality, Model studies, Prediction, Evaluation, Water management, *California, Indian Wells Valley, China Lake.

Water needs of the population of Indian Wells Valley, Calif., must be met through further development of ground-water resources. Studies show that annual ground-water pumpage there has increased since 1945 and has exceeded mean annual recharge since 1966. Continued and increased stress on the aquifer system of the valley is expected because population in the valley is predicted to double by 1998 and triple by 2020, based on 1977 population figures. The U.S. Geological Survey proposes a 10-year program to develop a data base to aid in evaluation of future water-management alternatives. A study plan has been developed that describes present and potential problems and objectives of the program, and outlines work items to be undertaken in the study area. (USGS)
W82-00086

WESTERN WATER RESOURCES: COMING PROBLEMS AND POLICY ALTERNATIVES,
Federal Reserve Bank of Kansas City, MO.
M. Duncan, and A. Laing.
Journal of Soil and Water Conservation, Vol 35, No 3, p 192-195, July/August, 1980. 2 Fig.

Descriptors: *Water policy, *Water law, *Water allocation, *Water management, Water resources development, Water demand, Water supply, Water shortage, Water conservation, Western states, Legislation, Decision making, Financing, Legal aspects, Political aspects, Economic aspects.

Water resources in the western United States are becoming increasingly scarce and expensive. A symposium in Denver, Colorado, examined the coming problems and some policies for coping with them. The two fundamental difficulties in formulating a natural resource policy are finding the right balance between private and public resource development, and the harmonization between individual and group decision making. An area of great potential conflict may be Indian water claims; no definitive judicial decisions have been handed down to supplement the 1908 Winters Doctrine. Methods of meeting water shortages can include interbasin transfers, additional impoundments, better knowledge of aquifer recharge systems, and forecasting and management of precipitation as well as the more exotic proposals--snowfield management, iceberg towing, and undersea aqueducts. The most practical means of saving water was judged to be demand reduction by full-cost pricing and more reuse and recycling. The water allocation process must be improved to reflect the actual conditions in the west and must not be used to manipulate land use and economic development. Benefit-cost analysis should be used in the decision making process, although this method is not without difficulties. (Cassar-FRC)
W82-00107

ENVIRONMENTAL IMPACT ASSESSMENT OF CHINA'S WATER TRANSFER PROJECT,
Research Inst. on Environmental Science, Beijing (China).
C. Yiqiu.
Water Supply and Management, Vol 5, No 3, p 253-260, 1981. 1 Fig, 2 Tab.

Descriptors: *Water supply development, *Decision making, *Water transfer, Planning, Water resources development, *Water transport, Water demand, Water shortage, Pipelines, Water delivery, *China.

China's South-to-North Water project is a broad concept employing numerous pipelines for diverting water of the Yangtze river in the south to the north of the Yellow River. In 1975 the North China Plain suffered an acute water shortage, and the Eastern Line was proposed by the relevant agencies in 1976 as the first phase of the plan to be established. Since the water supply is interrelated with the regional economy and agricultural production, these factors should be considered conjunctively. An environmental impact assessment must be performed as well; it has two major purposes. The first is to assess the impacts of the proposed projects on the environment, and the second is to select alternatives which might achieve the same goal as the proposed project, while minimizing any harmful effects. The material and technical data presently available for such assessments is quite limited. Thus the alternative to the Eastern Line, the Middle Eastern Line, is being left in its preliminary form. However, the general trend is clear: by taking the Middle Eastern Line as the first phase projct for diverting water of the Yangtze River to the north of the Yellow River, both capital cost and annual operating cost can be economized, as compared with the Eastern Line alone. The cost/benefit ratio will be much lower than that of the Middle Line alone. Most of the environmental problems inherent in the Eastern Line can be avoided. The Middle Eastern Line will be able to accommodate changes in the future. (Baker-FRC)
W82-00129

SMALL-SCALE HYDRO IN NEW ENGLAND: 1960-1976,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
P. H. Kirshen.
Journal of the Energy Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EY1, p 31-39, May, 1981. 2 Fig, 2 Tab, 10 Ref.

Descriptors: *Hydroelectric power, *Time series analysis, *Reviews, Hydroelectric plants, Electric power production, Water resources development, *New England, Dams, Dam effects, Powerplants, Electric powerplants.

A review of the small-scale hydropower (SSH) plants in New England from 1960-1976 is presented by a time series analysis as part of a project to study the obstacles and incentives to the development of such facilities. Since 1960, the installed conventional hydroelectric capacity of the United States has increased steadily, while the total number of plants has decreased. SSH in New England has steadily decreased from 828 megawatts in 1960 to 750 megawatts in 1976. However, the average plant size in New England in 1976 was decreased over average sizes for 1960. Large-scale hydroelectric power (LSH) in New England is used primarily for peak production, while SSH is used for smaller projects. As the price of fossil fuels continues to increase, so does the demand for hydroelectric power. Industrial use of SSH has declined, while the interest of municipalities and rural electric cooperatives in SSH has expanded. A potential 1,000 megawatts of unharnessed SSH exists at nongenerating dams in New England. To

expedite licensing processes to take advantage of these sites, several federal and private institutions are studying developmental strategies to be considered by environmental policymakers. (Geiger-FRC)
W82-00169

DOMESTIC WATER SUPPLIES FOR POWER PLANT COOLING,
Technion-Israel Inst. of Tech., Haifa.
G. Sinai, W. A. Jury, and L. H. Stolzy.
Journal of the Energy Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EY1, p 149-165, May, 1981. 7 Fig, 4 Tab, 23 Ref.

Descriptors: *Environmental effects, *Cooling water, *Thermal pollution, Water cooling, *Powerplants, Electric powerplants, Waste heat, Heated water, Thermal capacity, Water pollution effects, Conveyance structures, Aqueducts.

The once-through conveyor (OTC) method for powerplant cooling which utilizes water from large domestic networks close to the site of the powerplant is described. The OTC system siphons water from the domestic system and passes it once through the power plant condenser and returns the slightly warmed water to a point downstream from the intake area. The OTC system is proposed as a feasible source of cooling water which could meet the anticipated expasion rates of electrical power plants in the western United States. No adverse environmental effects are expected from this inland cooling system, and the OTC method is very inexpensive to construct and operate. Estimations of thermal capacity of major water supply systems in the Southwest show that such states as Arizona and California are already in excess of the anticipated demand for additional electricity generation in the near future. It was suggested that new powerplants be located along large aqueducts of these states to utilize their thermal cooling capacity in OTC systems. (Geiger-FRC)
W82-00180

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING: SKAGIT RIVER BASIN, WASHINGTON.
Federal Energy Regulatory Commission, San Francisco, CA. Office of Electric Power Regulation.
Available from Supt. of Documents, GPO, Washington, DC 20402. Report FERC-0057, August 1980. 83 p, 22 Fig, 14 Tab, 5 Ref.

Descriptors: *Water resources development, *Hydroelectric plants, *Electric power production, *Economic feasibility, *Flood control, Project planning, Flood damage, Dam construction, Water supply, Water demand, *Skagit River basin, Washington.

The Skagit River is about 163 miles long, and the basin has an area of 3,105 sq miles, of which 381 sq miles are in Canada. There are six hydroelectric generating projects on the river, with an average annual generation of 3,061 gigawatt-hours. The Ross Reservoir and Upper Baker project are used for flood control, regulating 41% of the drainage basin. Significant flood damage continues to occur annually. An addition of 121 ft to the height of the Ross Dam has been authorized. Surface water supplies are capable of exceeding municipal and industrial needs through the year 2020, and surface and groundwater sources are capable of meeting anticipated demands for irrigation water. All the projects are in good physical condition. Their continued use is economically useful, and some expansion seems feasible, if reregulation of flows from the dams is provided, and if a demand for capacity develops. (Brambley-SRC)
W82-00368

6E. Water Law and Institutions

REPORT OF THE ANNUAL YIELD OF THE ARKANSAS RIVER BASIN FOR THE ARKANSAS RIVER BASIN COMPACT, ARKANSAS--OKLAHOMA, 1980 WATER YEAR,
Geological Survey, Little Rock, AR. Water Resources Div.
G. L. Ducret, Jr.
Geological Survey Open-File Report 81-208, 1981. 25 p, 1 Fig, 3 Tab, 3 Ref.

Descriptors: *Interstate compacts, *Interstate rivers, *Arkansas, *Oklahoma, *Streamflow, Flow rates, Gaging stations, Water yield, Runoff, Reservoir storage, *Arkansas River basin.

The computed annual yield and deficiency of the subbasins as defined in the Arkansas River Compact, Arkansas-Oklahoma, are given in tables. Actual runoff from the subbasins and depletion caused by major reservoirs in the compact area are also given in tabular form. Monthly, maximum, minimum, and mean discharge is shown for the 15 streamflow stations used in computing annual yield. (USGS)
W82-00012

GROUND WATER CONFLICTS AND BARRIERS,
Arizona Univ., Tucson. Law School.
R. E. Clark.
Available from the National Technical Information Service, Springfield, VA 22161 as CONF-800137, Price codes: A10 in paper copy, A01 in microfiche. In: Ground Water and Energy, Proceedings of the U.S. Department of Energy's National Workshop, January 29-31, 1980, Albuquerque, New Mexico. Department of Energy Report CONF-800137, November 1980. p 49-63, 43 Ref.

Descriptors: *Groundwater potential, *Water law, *Legislation, Groundwater management, State jurisdiction, Federal jurisdiction, Public rights, Water rights.

Three main areas of tension involving old ground water claims, emerging rights, and statutory provisions for transfers to different uses and places of use are outlined, with primary emphasis on the western U.S. The three areas are state law, U.S. claims and reserved rights, and intrastate and interstate opportunities. Water law is mainly property law and almost entirely state law, with ground water law being even more local than surface water law, and being developed much later. Weaknesses in ground water law include conflict over public versus private rights, water uses, quality, and water management. It is very difficult to enact legislation that will integrate surface and ground water management and encourage conservation, easy transfers, local management, and better water quality. The Federal Government, as owner of public lands, appropriates the water rights of these lands. These lands are under pressure for their water resources. Two complementary approaches to improving ground water law are suggested: legislation can be prepared that will confront and minimize many old conflicts, settle claims and determine rights; and procedures can be proposed for anticipating conflicts which have not reached the courts, including interstate conflicts. (Brambley-SRC)
W82-00028

CONFLICTS AND BARRIERS WORKING GROUP REPORT.
Available from the National Technical Information Service, Springfield, VA 22161 as CONF-800137, Price codes: A10 in paper copy, A01 in microfiche. In: Ground Water and Energy, Proceedings of the U.S. Dept. of Energy's National Workshop, Jauary 29-31, 1980, Albuquerque, New Mexico. Dept. of Energy Rept. CONF-800137, November, 1980. p 145-165.

Descriptors: *Environmental effects, *Groundwater potential, Groundwater availability, Energy sources, *Economic aspects, *Legal aspects, Political aspects, Jurisdiction, Legislation, Public opinion, Social impact, Water supply, Water demand, Water pollution, Land use, Water rights.

This group focused on identifying the nature, prevalence, and importance of conflicts that might arise, and the barriers likely to be encountered in using ground water for energy production purposes. Conflicts were categorized as institutional/political, Indian, physical, environmental, economic, and legal. The institutional/political issues arise because of competing jurisdiction over water issues, inadequate or non-existent laws, dispersion of urisdiction amony Federal and state agencies, and local public objection to development. Indian issues include problems of ownership rights, social impacts of development, division of opinion within the Indian population, and resistance to development of resources for the benefit of non-Indians. Physical issues produce conflicts over interference with shallow wells and streamflow, excessive withdrawals, demand versus supply, subsidence and salt water intrusion, and the poor quality of aquifers and their poential pollution. The environmental issues identified relate to the physical problems in terms of flow disruption, pollution, and changes in land use, and a general lack of data. Economic conflicts arise due to values assigned to water uses, costs of pollution, delays in projects, and third-party effects. Legal conflicts arise when there are competing demands on water supplies, competing values, uncertainties over water rights, and deficiencies in reallocation mechanisms, and when water quality and quantity are considered separately, and the interstate nature of many aquifers is not considered. (Brambley-SRF)
W82-00031

ALTERNATIVES WORKING GROUP REPORT.
For primary bibliographic entry see Field 6B.
W82-00032

LEGAL ASPECTS OF SUBSIDENCE DUE TO WELL PUMPING,
California Dept. of Water Resources, Sacramento.
W. Kopper, and D. Finlayson.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR2, p 137-149, June, 1981. 55 Ref.

Descriptors: *Subsidence, *Pumpage, *Legal aspects, *Judicial decisions, *Statutes, Wells, Institutional constraints, Law enforcement, Compaction, Flooding, Withdrawal, Drawdown, Groundwater storage, Available water, Aquifers, Economic aspects, Land subsidence.

The legal roots of the United States' 'laissez faire' attitude toward groundwater pumpage and subsidence are discussed. Some of the legal precedents which indicate a shift in policy toward holding pumpers liable for subsidence are identified, and innovative programs for the management of groundwater are reviewed. Most early cases endorsed the English common law rule and the principle of 'damnum absque injuria', or no remedy under the law for injury. A restatement of Torts II in 1969 provided a foundation for interpreting liability to include subsidence. The largest damage suit for subsidence related to pumpage was the United States Versus Anchor Oil. It provided numerous technical reports and briefs which are useful. However, the case did not go to trial. A landmark decision in Texas, Coastal Industrial Water Authority Versus W. B. York, held that a property owner did not lose title to property that became submerged. Subsequent cases in Texas contained language indicating that the court would recognize and apply the law of negligence along with willful waste and malicious injury as limitation on the existing rulings. Model legislation based upon local control of groundwater has been developed in California to address a need for basin management. The proposed legislation gives the management authority broad powers to implement various activities. (Titus-FRC)
W82-00170

POLLUTANT TREATABILITY: A MOLECULAR ENGINEERING APPROACH,
Environmental Protection Agency, Washington, DC.
M. P. Strier.
Environmental Science and Technology, Vol 14, No 1, p 28-31, January, 1980. 6 Tab.

Descriptors: *Water pollution control, *Molecular structure, Chemical properties, Physical proper-

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ties, Organic compounds, Filtration, Oxidation, Biodegradation, Activated carbon, Carbon, Adsorption, *Wastewater treatment, Effluents.

At present, in order to comply with restrictions laid down by the Clean Water Act Amendments of 1977, the idea prevails of developing a separate treatment model for each nonpesticidal toxic organic compound, based on fundamental physical and chemical data. Based on experience with evaluating treatment processes, the following five unit treatment processes were used in this investigation: steam- or air-stripping, oil/water separation, filtration on diatomaceous earth or dual media, biochemical oxidation, and activated-carbon adsorption. These suggested potential treatment processes were separately applied to treatment models for each pollutant considered. Steam stripping possibilities are determined by the boiling point of the organic contaminant. Oil-water separation is a good procedure for compounds having relatively low solubilities in water. Separation is achieved by means of API separation or dissolved air flotation. Filtration is used for compounds having low water solubilities and tending to be highly adsorptive on particulate matter, organic or inorganic. Biochemical oxidation can reduce an influent concentration of about 100 mg/liter for phenols to an effluent concentration of 50 micrograms/liter, maximum. Carbon adsorption is particularly effective for compounds of higher molecular weight, lower polarity, increasing hydrocarbon unsaturation, and aromatic structure. Pollutant solubility in water may be associated with entropy, which opposes the driving force for removing the substance from water. This is particularly evident when phenolic and nitrogen-containing compounds are considered. (Baker-FRC)
W82-00252

GRAPHICAL EFFLUENT QUALITY CONTROL FOR COMPLIANCE MONITORING: WHAT IS A VIOLATION,
Illinois Environmental Protection Agency, Springfield.
For primary bibliographic entry see Field 5G.
W82-00261

A 201 POLLUTION CONTROL PLANNING TRAGEDY,
R. E. Wallace.
Public Works, Vol 111, No 1, p 54-60, January, 1980. 2 Fig.

Descriptors: *Political aspects, *Governmental interrelations, *Financing, Wastewater treatment facilities, *Northwest Hillsborough County, *Florida, Water pollution control, Water policy, Planning, Grants, Federal Water Pollution Control Act, Economic aspects, Government supports.

The sequence of events in the Section 201 (Federal Water Pollution Control Act) funding of the Northwest Hillsborough County, Florida, wastewater treatment facilities is detailed, starting in 1970 when the Board of County Commissioners decided to acquire private franchises and move toward a regional wastewater treatment system. The original 1973 plans called for $22 million in capital expenditures and engineering fees. As a result of delays and intergovernmental confusion, actual costs escalated to $49 million. Construction finally started in March 1979, with completion scheduled for March 1980. The author places the blame for the County's problems on overworked grant administrators, poorly written regulations and guidelines, constantly changing decisions, involvement of too many agencies and political bodies, lack of attention to nonpoint sources, too much reliance on computer models, and lack of agreement on what constitutes pollution. (Cassar-FRC)
W82-00285

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING: LITTLE TENNESSEE RIVER BASIN, TENNESSEE, NORTH CAROLINA, AND GEORGIA.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
For primary bibliographic entry see Field 6B.
W82-00372

THE U.S. GEOLOGICAL SURVEY COAL HYDROLOGY PROGRAM AND THE POTENTIAL OF HYDROLOGIC MODELS FOR IMPACT ASSESSMENTS,
Geological Survey, NSTL Station, MS. Water Resources Div.
W. H. Doyle, Jr.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $7.75 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-542, 1981. 56 p, 4 Fig, 5 Tab, 29 Ref.

Descriptors: *Coal, *Hydrologic models, *Strip mines, *Surface water, Mathematical models, Simulation, Coal mining, Soil erosion, Evaluation, Small watersheds, *Tennessee, *Indiana, Public Law 95-87, Geological Survey Coal Hydrology Program.

A requirement of Public Law 95-87, the Surface Mining Control and Reclamation Act of 1977, is the understanding of the hydrology in actual and proposed surface-mined areas. Surface-water data for small specific-sites and for larger areas such as adjacent and general areas are needed also to satisfy the hydrologic requirements of the Act. The Act specifies that surface-water modeling techniques may be used to generate the data and information. The purpose of this report is to describe how this can be achieved for smaller watersheds. This report also characterizes 12 'state-of-the-art' strip-mining assessment models that are to be tested with data from two data-intensive studies involving small watersheds in Tennessee and Indiana. Watershed models are best applied to small watersheds with specific-site data. Extending the use of modeling techniques to larger watersheds remains relatively untested, and to date the upper limits for application have not been established. The U.S. Geological Survey is currently collecting regional hydrologic data in the major coal provinces of the United States and this data will be used to help satisfy the 'general-area' data requirements of the Act. This program is reviewed and described in this report. (USGS)
W82-00429

SUMMARY OF THE NEW ENGLAND CONFERENCE ON LEGAL AND INSTITUTIONAL INCENTIVES TO SMALL-SCALE HYDROELECTRIC DEVELOPMENT, JANUARY 30-31, 1979, BOSTON, MASSACHUSETTS.
Franklin Pierce Law Center, Concord, NH. Energy Law Inst.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/RA/04934-03, Price codes: A04 in paper copy, A01 in microfiche. Department of Energy Report DOE/RA/04934-03, May 1980. 74 p, 47 Ref, 5 Append.

Descriptors: *Hydroelectric power, *Institutional constraints, *Federal jurisdiction, *State jurisdiction, *Regulations, Water use, Economic aspects, Model studies, Policy making, Financing, Subsidies, *New England.

Workshops were held addressing the topics: Federal regulatory systems; state regulatory systems; the economics of small-scale hydroelectric development; and systems dynamics and the systems dynamics model. Problems discussed at the Federal workshops included definitions with the Public Utilities Regulatory Policies Act (PURPA), streamlining the regulatory systems, and conflicts over competing uses of water. The states workshops discussed these topics and concern for markets, the problems of incentives for hydro development, and local processes. The economics workshops discussed the importance of determining a supply curve for small-scale hydro, and the establishment of an energy futures market in small-scale hydro. The systems workshop demonstrated how the model HYDRO I can be used in policy analysis and to predict the amount of small-scale hydro in New England over the next 20 yrs. It was suggested that the Federal Energy Regulatory Commission be able to approve a state hydro licensing plan, and then defer licensing of small-scale hydro projects to the state. Credits and allowances should be permitted for the financing of fish passage ways. State licensing reform may take the form of lead agency licensing, the removal of small-scale hydro from state utility regulations and tax laws, and provision of direct subsidies and other incentives. (Brambley-SRC)
W82-00447

EXECUTIVE SUMMARY, LEGAL OBSTACLES AND INCENTIVES TO SMALL-SCALE HYDROELECTRIC DEVELOPMENT IN THE SIX MIDDLE ATLANTIC STATES.
Franklin Pierce Law Center, Concord, NY. Energy Law Inst.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/RA/04934-06, Price codes: A04 in paper copy, A01 in microfiche. Department of Energy Report DOE/RA/04934-06, May 1980. 68 p, 6 Fig.

Descriptors: *Hydroelectric power, *Legal aspects, *Legislation, *State jurisdiction, *Regulations, *Economic aspects, Dams, Water rights, Taxes, Competing use, Economic development, Delaware, Maryland, New Jersey, New York, Pennsylvania, Virginia.

Executive summaries of the regulation of small dams are presented for Delaware, Maryland, New Jersey, New York, Pennsylvania, and Virginia. The water laws of each state are reviewed briefly as they pertain to riparian rights, navigable waters, natural flow doctrine, reasonable use, and the presence or absence of a Mill Dam Act. Direct regulation of small-scale hydroelectric projects is the responsibility of a number of state agencies and commissions, and of municipalities through zoning regulations. The projects may be affected by indirect regulations such as energy policy, protection of historic sites, wild and senic river designation, water quantity or quality requirements, wetlands protection, soil and water conservation, recreational facilities and fish and game projects, and endangered species protection. Finanical considerations include both taxation and rate setting powers vested in the states and their agencies, and the provision of various forms of financial assistance to promote economic growth and employment. A flow diagram for regulation is given for each state. All of state regulations interrelate with Federal regulations and may be in conflict with them. Laws such as the Clean Water Act and the Public Utilities Regulatory Policies Act have particular impact. (Brambley-SRC)
W82-00448

SUMMARY OF THE MIDWEST CONFERENCE ON SMALL-SCALE HYDROPOWER IN THE MIDWEST: AN OLD TECHNOLOGY WHOSE TIME HAS COME.
Franklin Pierce Law Center, Concord, NH. Energy Law Inst.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/RA/04934-05, Price codes: A07 in paper copy, A01 in microfiche. Department of Energy Report DOE/RA/04934-05, May 1980. 147 p, 4 Fig, 3 Tab, 3 Ref.

Descriptors: *Legal aspects, *Hydroelectric plants, *Economic aspects, *Institutional constraints, Computer models, Financing, Permits, Licensing, Dams, Midwest.

The conference focused on the legal and institutional barriers to small scale hydroelectric dam development in the Mid-west. Two of the workshop sessions discussed problems and policy responses raised by state and federal regulation, while the remaining two dealt with economic issues confronting small scale hydroelectric development and the operation and usefulness of the systems dynamics model developed by the Thayer School of Engineering. The main problems with state regulation concern the time spent on obtaining a permit and the unnecessary duplication of effort because of overlapping or parallel federal requirements. There is a need for a simplified and expeditions licensing process coordinated by a

single licensing agency. Central to the issues surrounding federal regualtion was the need to coordinate state and federal activities. It was suggested that the following features be added to the systems dynamics model: inflationary effects of licensing delays; individuals developing small scale hydroelectric sites; impacts of state laws and administration; cost of complying with federal regulations; national costs of policies as well as small scale hydroelectric development benefits; competition among various types of developers to develop a site; and impact of coordinated use of a series of dams. A major economic issue is the price to be paid to the small developer for power. Financing small scale hydroelectric projects is another major issue. Although hydroelectric generation has proven to be reliable, the overall risk of any small scale hydroelectric development is high, due to the leverage ratio, payback period and overall return, institutional uncertainties and form of power sales. (Moore-SRC)
W82-00449

LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POWER IN KENTUCKY.
Franklin Pierce Law Center, Concord, NH. Energy Law Inst.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/RA/04934-10, Price codes: A06 in paper copy, A01 in microfiche. Department of Energy Report DOE/RA/04934-10, May 1980. 106 p, 118 Ref.

Descriptors: *Hydroelectric plants, *Legal aspects, *Water rights, *Dams, Institutional constraints, Water rights, Riparian rights, Water quality, Construction, Taxes, Financing, Utilities, *Kentucky.

Development of small scale hydroelectric sites in Kentucky involves interaction with all levels of government; Federal, State and local. The developer must not only obtain the rights to the dam structure itself and the land it is on, but must also obtain the rights to receive and impound the water, to raise and lower the water level in the reservoir, and the right to run transmission lines across neighboring land. In Kentucky, a riparian owner may not unreasonably change the natural flow of water so as to cause substantial damage to a lower riparian owner. Riparian rights on a navigable watercourse are subordinate to the public rights to navigate such waters and to make improvements in aid of such navigation. A stream is navigable by law in Kentucky if it can float logs downstream during spring high waters. The most significant department concerned with dam construction, maintenance and operation is the Department for Natural Resources and Environmental Protection (NREP). NREP has the power to prevent, abate and control water pollution. The Secretary of the department is authorized to examine and approve or disapprove all applications for dam construction permits not otherwise excepted, and establishes standards for dam safety. All energy utilities are subject to the various requirements of the Energy Commission, but developers of hydroelectric power for wholesale use or for their own are not subject to the Energy Commission. Loans or grants may be available from the Kentucky Development Finance Authority, and Business Development Corporations. The hydroelectric developer will have to pay property taxes, income taxes, and sales taxes, as well as special taxes for dealing in electricity. (Moore-SRC)
W82-00450

WATER REGULATIONS,
J. Josephson.
Environmental Science and Technology, Vol 15, No 6, p 620, 1981.

Descriptors: *Federal jurisdiction, *Water quality standards, *Water pollution control, Economic aspects, Cost analysis, Legal aspects, Regulations, Pollutants.

Many proposed revisions to the Clean Water Act will be reviewed by the Congress when the Act is considered for reauthorization in 1981. These proposed revisions are designed to increase the flexibility and enhance the cost-effectiveness of water pollution criteria and standards. This would be accomplished primarily by ending the application of uniform criteria and standards to all water bodies and substituting regulations which consider the nature and uses of the receiving water, including the ability of the waterway to handle pollutants. Other suggestions include greater input by scientists into the development and documentation of standards and increased responsibility on the part of the states for water quality control, with a reduced Federal role. Increased consideration of cost-benefit relationships is also encouraged. (Carroll-FRC)
W82-00482

6F. Nonstructural Alternatives

FLOOD FORECAST AND WARNING SYSTEM EVALUATION, SUSQUEHANNA RIVER BASIN, NEW YORK, PENNSYLVANIA AND MARYLAND.
Susquehanna River Basin Commission, Harrisburg, PA.
Report prepared for Army Corps of Engineers, Baltimore District, January, 1979. 137 p, 11 Fig, 8 Tab, 49 Ref, 5 Append.

Descriptors: *Flood forecasting, *Flood protection, *Warning systems, Flood damage, Reservoir operation, Flood control, Communication, Nonstructural alternatives, Data collections, Flash floods, *Susquehanna River basin, New York, Pennsylvania, Maryland.

Following the devastation resulting from Tropical Storm Agnes in June, 1972, the Corps of Engineers was directed to conduct a Flood Control Review Study of the Susquehanna basin to determine if any improvements or additions to the existing flood control system would be feasible. Flood forecasting and warning is evaluated as a flood damage reduction alternative for this basin. The river flood forecasting and warning system is operated to provide advance warning of flooding conditions which threaten human life and can cause property damage. The components of the system, some of which are operated by different levels of government, are: data collection; data assembly; forecast preparation; forecast dissemination; reservoir regulation; and local action. Problems or areas of concern identified in the Susquehanna River basin flood warning system include; speeding up the river forecasting process; increasing the reliability of the river forecasting system; improving flash flood warning; improving local response; and providing ongoing review of the forecasting system. The existing river forecasting system is too slow to provide timely flood forecasts for upstream areas on main rivers. It sometimes takes over 6 hours to assemble data, transfer it to the forecast center, prepare a forecast and disseminate it. A serious deficiency is the failure of the telephone communications system and its disruptive effect on the forecast system. (Moore-SRC)
W82-00351

6G. Ecologic Impact Of Water Development

WATER QUALITY MANAGEMENT STUDIES, LAKE SEMINOLE, APRIL-NOVEMBER 1978.
Corps of Engineers, Mobile, AL. Mobile District.
Technical Publication ACF80-10 (Final Report), September 1981. 519 p, 4 Fig, 16 Tab, 70 Ref, 13 Append.

Descriptors: *Water quality management, *Reservoirs, *Hydrologic data, *Sediments, *Biological samples, Limnology, Eutrophication, Turbidity, Iron, Mixing, Nutrients, Productivity, Zooplankton, Algal growth, Climatology, Biomass, Reservoir operation, Macrophytes, *Lake Seminole, Tributaries, Georgia, Florida, Alabama.

The purpose of Phase I was the establishment of a comprehensive water quality, sediment, and biological data base at various sites within the impoundment, in the backwater stretches of the major tributaries, and immediately downstream of the outfall on the Apalachicola River. This data base is to be utilized for the combined purposes of future reference, guidance in the improvement of reservoir operations, facilitation of coordination with state agencies in the implementation of watershed pollution control measures, and identification of significant water quality problems. Meteorological, hydrological, water quality, sediment, and biological data were obtained at a total of 19 main sampling stations in Lake Seminole, the Chattahoochee River, the Flint River, Spring Creek, Fish Pond Drain, and the Apalachicola River during 6 sampling cycles from April 17, 1978 through November 30, 1978. The Chattahoochee River accounted for 60-80% of the flow into the impoundment. As a result of operational procedures at the Walter F. George Lock and Dam on the Chattahoochee River upstream of Lake Seminole, flows through the Chattahoochee River impoundment arm exhibited considerable short term variation. Each of the major impoundment arms of Lake Seminole tended to be well-mixed both laterally and vertically. Average turbidity levels in the Chattahoochee River were approximately three times those in the Flint River. Concentrations of total iron at most stations during the spring and early summer months exceeded the EPA criterion of 1.0 mg/l. Based on nutrient content, the waters of Lake Seminole tended to be moderately high to highly productive with respect to the production of algal biomass. Zooplankton assemblages exhibited little variation in the number of taxa found at each station during the year. Aquatic macrophytes constituted the most conspicuous feature of Lake Seminole. Emergent and floating macrophytes covered over 40% of the total surface and nearly 100% of the surface with a depth less than 2 m. (Moore-SRC)
W82-00051

EFFECT OF MICROCRUSTACEANS ON BLUE-GREEN ALGAE IN FLOODED SOIL,
Cornell Univ., Ithaca, NY. Lab. of Soil Microbiology.
J. T. Wilson, S. Greene, and M. Alexander.
Soil Biology and Biochemistry, Vol 12, No 3, p 237-240, 1980. 2 Tab, 7 Ref.

Descriptors: Eutrophication, *Floodwater, *Crustaceans, Cyanophyta, Water pollution effects, *Rice, Algae, Ostracods, Waterfleas, Nitrogen, Insecticides, Grazing, *Nitrogen fixation, Soil types, Soil water, *Algal control, Grazing.

In lowlands rice paddies, nitrogen-fixing algae can be an important source of nitrogen. Grazing by microcrustaceans and other fauna of flooded soil may limit the extent of algal development and affect the amount of nitrogen fixed by the algae. Previous studies have shown that the use of lindane or parathion kills the microcrustaceans and allows algal growth to flourish. Laboratory experiments were conducted to assess the effects of controlled numbers of ostracods and waterfleas (Daphnia magna) on the growth rate and nitrogen-fixing activity of Tolypothrix tenuis and Anabaena sp. When present in large numbers, grazing ostracods suppressed growth of Anabaena sp. on flooded soil and prevented the development of T. tenuis. Large numbers of D. magna had only a slight effect on the growth rate and development of these nitrogen-fixing algae. T. tenuis was more susceptible than Anabaena sp. to the grazing of these microcrustaceans. It was suggested that microcrustaceans may play a significant role in the nitrogen fixation by algae in lowland rice growing areas. (Geiger-FRC)
W82-00146

DOMESTIC WATER SUPPLIES FOR POWER PLANT COOLING,
Technion-Israel Inst. of Tech., Haifa.
For primary bibliographic entry see Field 6D.
W82-00180

POWER PLANT WATER INTAKE ASSESSMENT,
Consumers Power Co., Jackson, MI.
I. H. Zeitoun, J. A. Gulvas, and J. J. Rochow.

Environmental Science and Technology, Vol 14, No 4, p 398-402, April, 1980. 2 Fig, 2 Tab, 5 Ref.

Descriptors: *Power plants, *Environmental effects, Vegetation effects, Aquatic life, Fish, Entrainment, Impingment, Economic aspects, Decision making, Planning, Legal aspects, Regulations, *Intakes, Water intake, *Ecological effects, Ecosystems.

The total assessment of the impact of water intake by power plants should be related to its total effect on the ecological system, not solely on the numbers or weights of aquatic organisms impinged or entrained. The lack of emphasis on this aspect in the Federal Water Pollution Control Act (FWPCA) and the lack of an established set of criteria to explain or define acceptable limits of environmental impact creates perplexing situations. Alternative cooling schemes must be evaluated and compared as to their effects on all ecosystems. Acceptability of an intake should be based on prediction or detection of significant adverse changes or disruption at the ecosystem level. In many cases power plant effects are isolated and the stresses imposed on aquatic life are ignored. Attempts have been made to integrate the biotic and economic values in order to compare the environmental impact potential with the cost of an offshore intake. In examining 20 Lake Michigan power plants via this economic approach, the value of fishes lost was found to represent less than 1% of the established commercial value of fish landed during the time of the evaluation. It is concluded that the ability of the environment to resist perturbation and the existence of indigenous compensatory mechanisms must be taken into account as part of the decision making progress related to power plant operation. (Baker-FRC)
W82-00216

FINAL ENVIRONMENTAL IMPACT STATEMENT; DINKEY CREEK PROJECT NO. 2890 - CALIFORNIA.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Report FERC/EIS-0010, August 1980. 302 p, 21 Fig, 35 Tab, 56 Ref, 11 Append.

Descriptors: *Environmental impact statement, *Hydroelectric plants, *Dam effects, *Construction, Water quality, Turbidity, Wildlife habitats, Water pollution sources, Fish populations, Reservoirs, Benthic fauna, Spoil disposal, Planning, *Dinkey Creek project, *California.

The conventional hydroelectric project proposed for construction on Dinkey Creek, Fresno County, California would consist of: a dam and reservoir on Dinkey Creek; a power tunnel; two powerhouses; three diversion tunnels; access road; recreational facilities; and other appurtenant facilities. The total installed capacity would be 120 megawatts. Environmental impacts caused by construction and operation of the project would include: increased turbidity and loss of benthic invertebrates and fish in portions of Dinkey Creek and the diversion tributaries during construction; alteration of approximately 1,176 acres of upland valley topography; loss of productive timber land and wildlife habitat; disturbance to the existing recreational setting while construction is underway; and inundation of archeological resources. The introduction of large quantities of suspended sediments into Dinkey Creek and tributaries from excavating tunnels and from spoil deposition areas would have the greatest impact on the water quality of the project. During tunnel excavation, drilling operations would require cooling water that would be characterized by high concentrations of hydraulic oil, cement, and inorganic materials after use. In addition, ground water encountered during drilling would compound the water quality problem. (Moore-SRC)
W82-00352

FINAL ENVIRONMENTAL IMPACT STATEMENT; TERROR LAKE PROJECT NO. 2743 - ALASKA.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Report FERC/EIS-0026, August, 1981. 393 p, 43 Fig, 16 Tab, 59 Ref, 8 Append.

Descriptors: *Environmental impact statement, *Dam effects, *Construction, *Environmental effects, Reservoirs, Wildlife habitats, River flow, Water temperature, Diversion dams, Planning, *Terror Lake, Kodiak, *Alaska.

Kodiak Electric Association proposes to construct a 20-MW conventional hydroelectric project by using the hydroelectric potential of Terror Lake, a natural lake located in a glaciated valley, 25 miles southwest of the City of Kodiak, Alaska. The proposed development would require the construction of a 156-foot high rockfill dam, 2,100 feet in length. The 270-acre natural lake would be inundated and replaced by an 850-acre reservoir. During project operation, water would be diverted from Terror Lake Reservoir and Falls, Shotgun, and Rolling Rock Creeks, through the power tunnel and penstock, to turn generators in the powerhouse that would be located on the Kizhuyak River. Approximately 1,878 acres of land and 270 water surface acres within the Kodiak National Wildlife Refuge would be included in the project. Significant environmental impacts of the proposed project include: loss of approximately 1,080 acres of wildlife habitat; human intrusions and construction activities within the wildlife refuge; flow in the Terror River immediately below the dam would be reduced by up to 90%; reduced flows in the Kizhuyak River from the Shotgun and Falls Creeks Diversion Dams downstream to the powerhouse; alteration of the thermal regime of the Terror and Kizhuyak Rivers. The design of the proposal is considered to be environmentally superior to that of either of the proposed alternatives. (Moore-SRC)
W82-00353

FINAL ENVIRONMENTAL IMPACT STATEMENT; TYEE LAKE PROJECT FERC NO. 3015 - ALASKA.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Report FERC/EIS-0023, June, 1981. 224 p, 24 Fig, 17 Tab, 25 Ref, 6 Append.

Descriptors: *Environmental impact statement, *Hydroelectric plants, *Construction, Wildlife, Aquatic habitats, Water temperature, Wetlands, Environmental effects, Flow discharge, Water conveyance, Intakes, Transmission lines, Planning, Baseline studies, *Tyee Lake Project, Wrangell, *Alaska.

The proposed 20 MW hydroelectric project on Tyee Creek in Tongass National Forest near Wrangell, Alaska, would require: a lake tap intake structure in Tyee Lake at approximately 1,230 ft elevation; approximately 8,700 ft of shaft and tunnel for water conveyance; a powerhouse near the Bradfield Canal; approximately 1,100 ft of channel from the powerhouse tailrace to Airstrip Slough; 69 miles of overhead and 12 miles of submarine transmission line; approximately 1 mile of access road; and other appurtenant facilities. Development of the proposed Tyee Lake Project would result in the following unmitigated environmental impacts: removal of 490 acres of commercial forest land; some degradation of visual resources related to the proposed transmission line; up to a 92% reduction in the discharge to Tyee Creek, and associated reduction in aquatic habitat; changes in the thermal regime of Airstrip Slough; disturbance of wetlands near Airstrip Slough; and human intrusion on wildlife resources during construction. The Tyee Lake Project is recommended as proposed, with mitigative measures. (Moore-SRC)
W82-00354

FINAL ENVIRONMENTAL IMPACT STATEMENT FOR PROPOSED SEWERAGE FACILITIES IN THE MARION COUNTY LAKE IMPROVEMENT DISTRICT, MARION COUNTY, KANSAS.
Environmental Protection Agency, Kansas City, MO. Region VII.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-160145, Price codes: A11 in paper copy, A01 in microfiche.
Report EPA-907/9-80-004, December, 1980. 246 p, 12 Fig, 30 Tab, 80 Ref, 5 Append.

Descriptors: *Environmental impact statement, *Marion County Lake, Kansas, *Sewer systems, *Wastewater facilities, *Domestic wastes, Storage tanks, Septic tanks, Economic impact, Environmental effects, Social impact, Water quality, Population dynamics, Leachates, Flora, Fauna, Hydrology, Geology, Soils.

The Marion County Lake Improvement District is a small residential community, surrounding the 150 acre lake, in which the sewerage facilities consist entirely of on-site systems - septic tanks, holding tanks, and privies. This Environmental Impact Statement examined five alternatives for the improvement of sewerage facilities: no action; facility plan; down-sized facility plan; down-sized total retention lagoon; and limited public on-site systems. The environmental, social, and economic impacts of each of these alternatives were evaluated, along with appropriate mitigation measures. Extensive investigations were conducted into population projections; hydrology, geology, and soils; flora and fauna; septic leachate; and cost effectiveness. Based on these investigations the EPA has determined that sufficient water quality problems do not exist to merit funding under the Construction Grants program of the Clean Water Act of 1977, and therefore no further grant will be awarded for this project. (Brambley-SRC)
W82-00355

FINAL ENVIRONMENTAL IMPACT STATEMENT, CITY OF PORTAGE WASTEWATER SYSTEM, COLUMBIA COUNTY, WISCONSIN.
Environmental Protection Agency, Chicago, IL. Region V.
Report, July, 1980. 362 p, 23 Fig, 31 Tab, 142 Ref, 6 Append.

Descriptors: *Environmental impact statement, *Portage, Wisconsin, *Secondary wastewater treatment, *Wastewater facilities, *Wastewater disposal, Air pollution, Geology, Soils, Groundwater, Flora, Fauna, Surface water, Land use, Flood plains, Social impact.

A 201 Facilities Plan was prepared for Portage, Wisconsin, that concluded that a new secondary treatment facility adjacent to the Wisconsin River was necessary to replace the old and hydraulically overloaded facility now located on the Fox River. The Environmental Impact Statement addresses the impacts on the environment that would result from each of eight alternate sites, and the cost for each site. The environmental parameters considered are air quality and sound; geology, soils, and groundwater; surface waters; terrestrial and aquatic flora (including wetlands); terrestrial and aquatic fauna; cultural resources; socioeconomic characteristics; agricultural land and land use; flood plains; and energy and chemical requirements. It is concluded that secondary effluent should be discharged to the Wisconsin River from a new site which avoids destruction of wetlands and other environmental problems. Some mitigative measures are recommended to overcome problems resulting from heavy metals, residual PCB sources, and construction dust, noise, nuisance, erosion and sedimentation. An archaeological survey was used to identify historic places likely to be affected by waste facility construction. (Brambley-SRC)
W82-00356

FINAL ENVIRONMENTAL IMPACT STATEMENT FOR WASTEWATER TREATMENT FACILITIES; CITY OF OLATHE, JOHNSON COUNTY, KANSAS.
Environmental Protection Agency, Kansas City, MO. Region VII.
For primary bibliographic entry see Field 5D.
W82-00357

FINAL ENVIRONMENTAL IMPACT STATEMENT; BEMIDJI WASTEWATER TREATMENT SYSTEM, BELTRAMI COUNTY, MINNESOTA.

Environmental Protection Agency, Chicago, IL. Region V.
For primary bibliographic entry see Field 5D.
W82-00358

FINAL ENVIRONMENTAL IMPACT STATEMENT; WASTEWATER TREATMENT FACILITIES, SOUTH SHORE LAKE TAHOE BASIN.
Environmental Protection Agency, San Francisco, CA. Region IX.
For primary bibliographic entry see Field 5D.
W82-00359

FINAL ENVIRONMENTAL IMPACT STATEMENT; SLUDGE DISPOSAL AND LAND RECLAMATION IN FULTON COUNTY, ILLINOIS.
Environmental Protection Agency, Chicago, IL. Region V.
For primary bibliographic entry see Field 5E.
W82-00360

FINAL ENVIRONMENTAL IMPACT STATEMENT; REHABILITATION OF WASTEWATER FACILITIES, STREATOR, ILLINOIS.
Environmental Protection Agency, Chicago, IL. Region V.
For primary bibliographic entry see Field 5D.
W82-00361

FINAL ENVIRONMENTAL IMPACT STATEMENT; ALTERNATIVE WASTEWATER TREATMENT SYSTEMS FOR RURAL LAKE PROJECTS; CASE STUDY NO. 1: CRYSTAL LAKE AREA SEWAGE DISPOSAL AUTHORITY, BENZIE COUNTY, MICHIGAN.
Environmental Protection Agency, Chicago, IL. Region V.
For primary bibliographic entry see Field 5D.
W82-00362

FINAL ENVIRONMENTAL IMPACT STATEMENT; ALTERNATIVE WASTEWATER TREATMENT SYSTEMS FOR RURAL LAKE PROJECTS; CASE STUDY NO. 2: THE GREEN LAKE SANITARY SEWER AND WASTE DISTRICT, KANDIYOHI COUNTY, MINNESOTA.
Environmental Protection Agency, Chicago, IL. Region V.
For primary bibliographic entry see Field 5D.
W82-00363

FINAL ENVIRONMENTAL IMPACT STATEMENT; ALTERNATIVE WASTEWATER TREATMENT SYSTEMS FOR RURAL LAKE PROJECTS; CASE STUDY NO. 3: SPRINGVALE-BEAR CREEK SEWAGE DISPOSAL AUTHORITY, EMMET COUNTY, MICHIGAN.
Environmental Protection Agency, Chicago, IL. Region V.
For primary bibliographic entry see Field 5D.
W82-00364

FINAL ENVIRONMENTAL IMPACT STATEMENT; ALTERNATIVE WASTEWATER TREATMENT SYSTEMS FOR RURAL LAKE PROJECTS; CASE STUDY NO. 4: STEUBEN LAKES REGIONAL WASTE DISTRICT, STEUBEN COUNTY, INDIANA.
Environmental Protection Agency, Chicago, IL. Region V.
For primary bibliographic entry see Field 5D.
W82-00365

FINAL ENVIRONMENTAL IMPACT STATEMENT; ALTERNATIVE WASTEWATER TREATMENT SYSTEMS FOR RURAL LAKE PROJECTS; CASE STUDY NO. 5: OTTER TAIL COUNTY BOARD OF COMMISSIONERS, OTTER TAIL COUNTY, MINNESOTA.
Environmental Protection Agency, Chicago, IL. Region V.
For primary bibliographic entry see Field 5D.
W82-00366

FINAL ENVIRONMENTAL IMPACT STATEMENT; SOUTH FORK AMERICAN RIVER DEVELOPMENT, UPPER MOUNTAIN PROJECT NO. 2761 - CALIFORNIA.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Report FERC/EIS-0020, May 1981. 304 p, 37 Fig, 43 Tab, 141 Ref, 6 Append.

Descriptors: *Environmental impact statement, *Hydroelectric plants, *Dam effects, Construction, *Conveyance structures, Reservoirs, Fish populations, Social aspects, Economic aspects, Wildlife habitats, Dam construction, Environmental effects, Recreation facilities, Stream discharge, Sedimentation rates, Planning, *South Fork American River Project, *California.

El Dorado County Water Agency and El Dorado Irrigation District filed an application for a license for the proposed South Fork American River Development, Upper Mountain Project, a conventional hydroelectric and water supply project. The issuance of a license would authorize the construction of: two major diversion structures (dams), one each on the upper South Fork American River and the Silver Fork American River; seven minor diversion structures on tributaries of the South and Silver forks of the American River; a major diversion structure and storage reservoir on Alder Creek; approximately 34 miles of water conveyance structures; three powerhouses; approximately 29 miles of transmission lines; three new access roads; new and improved recreational facilities; and other appurtenant facilities. The total installed generating capacity would be 110.4 MW, with an annual average generation of approximately 470,000 MWh. Environmental impacts caused by construction and operation of the project would include: alteration of existing stream hydraulic parameters, flow rates, sedimentation rates, water temperatures, species composition, and growth and population sizes of fish; the withdrawal of approximately 2850 acres from timber production; the permanent loss of approximately 2000 acres of wildlife habitat; possible decrease in the population size of at least one deer herd; disturbance to existing recreational use of the area during construction; disturbance of normal highway traffic during construction; temporary impacts to air quality and ambient noise levels during construction; direct and indirect impacts to cultural resource sites, direct and indirect socioeconomic effects in El Dorado County; and changes in the characteristics of visual and recreational resources. (Moore-SRC)
W82-00367

FINAL ENVIRONMENTAL IMPACT STATEMENT; SOUTH TAHOE PUBLIC UTILITY DISTRICT AND DOUGLAS COUNTY SEWER IMPROVEMENT DISTRICT NO. 1, APPENDIX B: MITIGATION PROGRAM.
Sedway/Cooke, San Francisco, CA.
Environmental Protection Agency Report, May 1981. 439 p.

Descriptors: *Environmental impact statement, *Lake Tahoe, California, *Environmental protection, *Wastewater facilities, Erosion control, Runoff, Land use, Forest management, Water quality control, Monitoring, Environmental quality.

The Mitigation Task Force, which was created to coordinate the actions of the agencies with authority to reduce the environmental impacts of the proposed expansion of the South Tahoe Public Utility District, has identified 97 measures to be implemented by 28 agencies. The measures and the agency responsible for implementation of each measure are presented in a matrix. There are 13 areas of impact: water resources and water quality; geology and soils; biology; noise; meteorology and air quality; visual resources; land use and housing; transportation; recreation; public services/fiscal concerns; utilities; cultural, archeological and historical resources; and the Carson Valley. In the water resources and quality category there are sixteen required measures in the areas of erosion and drainage projects, on-site runoff controls, development restrictions, and forest practices; and one recommended measure, monitoring. For each measure, the statements of the responsible agencies are given, and implementation statements from all agencies are also presented. (Brambley-SRC)
W82-00369

7. RESOURCES DATA

7A. Network Design

EVALUATION OF GROUND-WATER MONITORING NETWORK, SANTA CRUZ COUNTY, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
G. G. Blankenbaker, and C. D. Farrar.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $7.50 in paper copy, $4.50 in microfiche. Geological Survey Open-File Report 81-139 (WRI), April 1981. 20 p, 1 Fig, 2 Plates, 6 Tab, 10 Ref.

Descriptors: *Groundwater, *Network design, *Monitoring, *Water quality, Observation wells, Water level, Groundwater storage, Saline water intrusion, Forecasting, Evaluation, *California, *Santa Cruz County.

The Santa Cruz County Flood Control and Water Conservation District seeks to improve the existing network of observation wells to monitor water levels and ground-water quality in the Pajaro Valley subarea and the Aptos-Soquel, San Lorenzo, and Santa Cruz Coastal subbasins in California. The proposed network, consisting of 92 wells, is designed to monitor changes in storage and quality of ground water resulting from climatic changes and management-induced stresses. In the proposed network, water levels in all wells would be measured semiannually, in April and September, and monthly in a few key wells. The water-level measurements would provide data that could be used to determine changes in ground-water storage. In addition to the currently monitored characteristics--temperature, specific conductance, pH, and chloride ion concentration--inclusion of annual sampling and analysis for major ions and nutrients is proposed. The network would also include sampling and analysis for trace elements once every 4 years. More frequent analyses are proposed in areas where water-quality problems are known to exist or where potential water-quality problems are recognized. Analyses for major ions, nutrients, and trace elements are included in the proposed network to provide baseline data for monitoring long-term changes in water quality and to detect any unexpected changes in quality. (USGS)
W82-00023

PROPOSED OBSERVATION-WELL NETWORKS AND GROUND-WATER LEVEL PROGRAM FOR NORTH CAROLINA,
Geological Survey, Raleigh, NC. Water Resources Div.
For primary bibliographic entry see Field 4B.
W82-00426

7B. Data Acquisition

A QUALITATIVE APPRAISAL OF THE HYDROLOGY OF THE YEMEN ARAB REPUBLIC FROM LANDSAT IMAGES,
Geological Survey, Reston, VA. Water Resources Div.
M. J. Grolier, G. C. Tibbitts, Jr, and M. M. Ibrahim.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price: $18.75 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 80-565, 1981. 103 p, 6 Fig, 1 Plate, 2 Tab, 34 Ref, 3 Append.

Descriptors: *Arid lands, *Remote sensing, *Foreign research, *Drainage systems, Land use, Irrigation effects, Vegetation, Ephemeral streams, Intermittant streams, Surface-groundwater relations, Groundwater potential, Water quality, Hydrologic cycle, Evaluation, Water resources development, Planning, *Yemen Arab Republic, Landsat, Arabi-

an Peninsula, Red Sea, Tihama, Satellite technology.

Six series of Landsat-1 and Landsat-2 images taken between 1972 and 1976 were analyzed to describe the flow regimens of streams and the regional distribution of vegetation in the Yemen Arab Republic. The findings provide a factual basis for planning a surface-water data collection program, and for preparing maps of plant distribution and agricultural land use. They lay the foundation for modernized water development, for effecting a program of country-wide water management. The work was undertaken as part of the program of the U.S. Agency for International Development with the cooperation of the Yemen Mineral and Petroleum Authority, Ministry of Economy. A false-color composite mosaic of the nine images which cover the country was prepared using Landsat 1 images taken at relatively low sun-angle in winter 1972-73. Catchment areas and the major drainage basins of the country were delineated on this mosaic. In order of increasing water availability, the four catchment areas of the YAR are: Ar Rub al Khali, Wadi Jawf (Arabian Sea), Red Sea, and Gulf of Aden. Most streams are ephemeral. No lakes were detected during the period under investigation, but sebkhas--salt flats or low salt-encrusted plains--are common along the Red Sea coast. In spite of resolution and scale constraints, streamflow was interpreted as perennial or intermittent, wherever it could be detected on several Landsat images covering the same scene at seasonal or yearly intervals. Much of the land under cultivation is restricted to valley floors, and to valley slopes and irrigated terraces adjacent to stream channels. Little or no vegetation could be detected over large regions of the Yemen Arab Republic. (USGS)
W82-00022

SEASAT SAR RESPONSE FROM WATER RESOURCES PARAMETERS,
Texas A and M Univ., College Station. Remote Sensing Center.
B. J. Blanchard, A. J. Blanchard, S. W. Theis, W. D. Rosenthal, and C. Jones.
Final Report 3891, June, 1981. 41 p, 11 Fig, 1 Tab, 7 Ref.

Descriptors: *Soil water, *Remote sensing, Flooding, *Satellite technology, Forests, Corn, Alfalfa, Milo, *Vegetation, Radar, Agriculture, Furrows.

An initial investigation of the SEASAT synthetic aperture radar (SAR) data was directed toward estimation of soil moisture; vegetation type, surface roughness due to tillage and flood extent under forest canopy. The SAR response was validated with a series of data sets from an L-band scatterometer flown in the NASA C-130 aircraft. Soil moisture in the surface 15 cm from fields of milo, alfalfa and bare soil produce similar differences (9 db range) in the scattering coefficient from both systems. Most agricultural vegetation was effectively transparent and was penetrated by this wave-length. Corn produces exceptionally high returns; however, there was evidence that tillage roughness could be detected through the corn canopy. Forest canopy, in contrast, produces moderate returns except when the forest floor is flooded. Flooded forest produced 3 to 6 db higher scattering coefficients than non-flooded forest for both the SAR and scatterometer. There was no detectable difference in response from conifer and deciduous forest canopy. Circular tillage patterns were used to illustrate the look angle dependence of row direction effects on the radar return. Roughness due to tillage can produce as much as 12 db increase in return. The SEASAT SAR produced valuable information and in some instances would enable estimates of parameters that are not feasible with any other known system.
W82-00101

SEDIMENT TRAP DYNAMICS AND CALIBRATION: A LABORATORY EVALUATION,
Lamont-Doherty Geological Observatory, Palisades, NY.
W. Gardner.
Journal of Marine Research, Vol 38, No 1, p 17-39, 1980. 5 Fig, 5 Tab, 41 Ref.

Descriptors: *Sediments, *Experimental design, Calibration, Turbulence, *Particle size, *Trap efficiency, Lakes, Estuaries, Laboratory equipment, Technology, Trapping, Flow, Currents, Fluvial sediments, Deposits.

The flow dynamics and particle trapping characteristics of several designs of sediment traps were investigated using dye, seawater, and deep sea lutite in a recirculating flume and fish tank at velocities of 0, 4, and 9 cm per second. Particles are collected through a process of fluid exchange rather than by falling into the trap. The efficiency of the trap is therefore a function of the residence time and circulation pattern of fluid, processes controlled by trap geometry and current velocity. Cylinders trap particles in the closest agreement with the sediment deposition rate in the flume. Funnels undertrap, but their efficiency may be improved with baffles at the top of the funnel. Containers with narrow mouths and wide bodies overtrap at an unpredictable rate. (Titus-FRC)
W82-00104

FIELD ASSESSMENT OF SEDIMENT TRAPS,
Lamont-Doherty Geological Observatory, Palisades, NY.
W. D. Gardner.
Journal of Marine Research, Vol 38, No 1, p 41-52, 1980. 7 Fig, 1 Tab, 13 Ref.

Descriptors: *Sediments, Trapping, *Trap efficiency, On-site tests, *Particle size, *Flumes, Field tests, Flow, Velocity, Calibration, Funnels, Coastal waters, Tidal effects, Currents, Water sampling, Harbors.

Sediment traps whose particle collection abilities had been calibrated in a laboratory flume at velocities of 0, 4, and 9 cm per second were deployed in natural bodies of water to intercalibrate larger traps under current conditions ranging from tranquil to over 20 cm per second. For cylinders, the height to width ratio is the controlling factor for the mass of sediment collected. Traps can be scaled up in size and maintain a similar collection rate. Increasing current velocity will alter the collection rate of a trap in a manner which depends on the trap geometry. The size distribution of particles collected in traps is biased by trap geometry, with overefficient traps collecting more fine particles. (Titus-FRC)
W82-00105

AN AQUATIC RESPIROMETER FOR USE IN SUBLETHAL STUDIES,
Environmental Sciences Ltd., Vancouver (British Columbia).
For primary bibliographic entry see Field 5C.
W82-00122

MEASURING FLUMES OF SIMPLIFIED CONSTRUCTION,
Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
J. A. Replogle, and A. J. Clemmens.
Transactions of the ASAE, Vol 24, No 2, p 362-366, 374, March-April, 1981. 4 Fig, 2 Tab, 16 Ref.

Descriptors: *Flumes, Flow measurement, Water measurement, Irrigation canals, Mathematical models, Channel flow, Water flow.

Mathematical modeling has provided information for design and construction of a simplified measuring flume for irrigation channels. The flumes are designed for the canal, rather than vice versa. The flumes have high submergence limits and can be used on canals that cannot tolerate much head loss. Portable aluminum or precast flumes have been constructed and installed. Three standard-sized flumes were developed for each of three canal shapes for a normal flow range, 20 to 500 liters per sec. These flumes cost about one-tenth as much as previously used measuring structures. (Cassar-FRC)
W82-00140

A MORE VERSATILE SOIL WATER SAMPLER,
North Central Forest Experimental Station, Grand Rapids, MN.
M. D. Knighton, and D. E. Streblow.
Soil Science Society of America Journal, Vol 45, No 1, p 158-159, 1981. 1 Fig, 3 Ref.

Descriptors: *Soil water, *Sampling, *Measuring instruments, Nutrients, Leachates.

The development of a versatile ceramic-cup soil water sampler which overcomes some of the limitations of previous models is reported. Having no rigid parts extending above the soil surface, this new model may be installed at shallow depths prior to such disruptive plot activities as logging which would normally destroy earlier models. The ceramic cup of the new sampler may be positioned within a few centimeters of the soil surface without the problems of instability or flow of surface water down the side of the sampler which occurred with previously existing models. Location of the ceramic cup above the sampler reservoir prevents the reverse flow of soil water through the cup which occurs if the soil dries during the sampling interval. Disadvantages of the new sampler include the need for a larger and deeper hole for installation than was necessary with the earlier sampler, resulting in more soil profile disruption; the possibility that the ceramic cup will dry out more readily because it is not in contact with the collected water; and slightly increased materials, labor, and equipment needs for construction of the sampler. Comparison of the chemistry of soil water samples collected using new samplers and the previously existing samplers indicated no significant differences in the concentrations of nitrogen, phosphorus, potassium, calcium, or magnesium nor in specific conductance. (Carroll-FRC)
W82-00191

BIONESS, A NEW DESIGN IN MULTIPLE NET ZOOPLANKTON SAMPLERS,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Marine Ecology Lab.
D. D. Sameoto, L. O. Jaroszynski, and W. B. Fraser.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 4, p 722-724, April, 1980. 2 Fig, 3 Ref.

Descriptors: *Biological samples, *Plankton nets, *Measuring instruments, Sampling, Water sampling, *Zooplankton, Nets, Data collections, Marine biology, Temperature, Conductivity, Entrainment.

A new multiple-net zooplankton and micronekton sampler (BIONESS) designed by the Bedford Institute of Oceanography is designed with a horizontal arrangement of nets to reduce the size of the mouth opening and make the structure more streamlined. Ten 1.0 sq m nets open sequentially and are towed at three knots on a conductor cable. The conductor cable is equipped with transmitters and receivers to relay information from the sampler to the ship. Sensors for temperature, conductivity, depth, illumination, pitch, roll, and yaw are featured on the BIONESS sampler along with a camera and internal and external electronic flowmeters. These features enable environmental data to be collected simultaneously with biological samples. The sampler is easier to handle than older models, and its chance for contamination by larger organisms is minimal. (Geiger-FRC)
W82-00210

REPORT ON THE SUMMER MONEX FIELD PHASE,
National Science Foundation, Washington, DC.
For primary bibliographic entry see Field 2B.
W82-00265

POSSIBILITIES OF USING HELIUM AND TRITIUM SURVEYS FOR STUDYING RECHARGE CONDITIONS OF SUBSURFACE WATERS,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
V. L. Zlobina, V. S. Kovalevskii, I. K. Morkovkina, L. K. Ovchinnikova, and V. V. Romanov.

Water Resources (English Translation), Vol 7, No 1, p 73-76, January/February, 1980. 3 Fig, 4 Ref. Translated from Vodnye Resursy, No 1, p 166-170, January/February, 1980.

Descriptors: *Recharge, *Subsurface water, Water, Natural recharge, Groundwater, Helium, *Geohydrology, Tritium, Chemical composition, Chemical analysis, Water analysis, Groundwater movement, *Groundwater recharge, Tracking techniques.

A helium survey was used for detecting areas of water-bearing deposits of sedimentary rocks with maximum permeability in the Moscow territory. The principle of such a survey consists in recording the distribution of concentrations of free, mobile helium, whose main form of migration is seepage with subsurface waters in a dissolved state. Helium concentrations in subsurface waters increase with depth; thus an increase in helium concentration indicates discharge of deeper water-bearing horizons via lithologic windows and tectonic crush zones and by through-flow. A marked decrease proves the existence of inflow of infiltration, river, or ground waters, diluting the background concentrations of this element in the aquifer. Thus on the basis of helium anomalies one can detect recharge areas of the aquifer from above and below and make a quantitative evaluation of the components of the balance of the given aquifer and its change in time under the effect of exploitation of subsurface waters. Water samples were taken in 1978 from water-bearing horizons of Middle and Lower Carboniferous and partially Devonian deposits. Samples for tritium analysis were also taken. It was concluded that the use of helium and tritium surveys in complex hydrodynamic and hydrochemical settings permits the detection of possible recharge areas of subsurface waters and also areas of qualitative change in the chemical composition of these waters as well as the mapping of the contours of areas of possible activation of karst processes. (Baker-FRC)
W82-00302

AN APPRAISAL OF POND-NET SAMPLES FOR BIOLOGICAL MONITORING OF LOTIC MACROINVERTEBRATES,
Freshwater Biological Association, Wareham (England).
M. T. Furse, J. F. Wright, P. D. Armitage, and D. Moss.
Water Research, Vol 15, No 6, p 679-689, 1981. 4 Fig, 4 Tab, 22 Ref.

Descriptors: *Sampling, *Macroinvertebrates, *Classification, Monitoring, Invertebrates, Aquatic animals, Benthic fauna, Rivers, Lotic environment, Precision, Pond-net test.

The pond-net technique for sampling benthic macroinvertebrates proved suitable and reliable to use in a British national classification scheme for running water sites. In a field trial, 6 pond-net samples (3 operators, 2 samples each) of 3 min duration were taken at each of 4 sites on the River Axe, England. There were significant differences with respect to sites, operators, and site x operator interactions. There were significant interoperator differences in the number of taxa removed from samples at the family level in the sample processing stage. Nevertheless, at the species level there was strong site faithfulness for each series of 6 samples. A 3 min sample netted 62% of the families and 50% of the species caught in an 18 min sample. The results of this trial confirmed the suitability of the pond-net test for use in the classification exercise, which involves 40-60 biologists, 267 sites, and 41 rivers in Great Britain. (Cassar-FRC)
W82-00308

7C. Evaluation, Processing and Publication

WATER RESOURCES INVESTIGATIONS IN NEW YORK--1980.
Geological Survey, Albany, NY. Water Resources Div.
Geological Survey Open-File Report 80-1219, 1980. 68 p, 5 Fig, (Compiled by Finch, A.).

Descriptors: Reviews, *Surface water, *Groundwater, *Water quality, Bibliographics, *Projects, Publications, *New York, U.S. Geological Survey, Water Resources Division.

This report describes the water-resources investigations conducted by the U.S. Geological Survey in New York in 1980; many of these studies will continue into 1981 or longer. The Geological Survey began its water-resources studies in New York State in 1895 with a stream-gaging program in the Catskill Mountain region and entered its first cooperative program, with the Office of the State Engineer, in 1900. Since 1910, the Survey has maintained a District office in Albany to direct its water investigations within the State. A Long Island subdistrict office was established in 1932 to monitor and study the ground-water situation in this area of increasing urbanization. Subdistrict offices are also maintained in Ithaca and Albany to collect and interpret data from western and eastern New York, respectively. A field station is maintained in Potsdam to collect records in the northernmost part of the State. A bibliography of reports published or released in 1980 by the New York District is included. (USGS)
W82-00011

SELECTED HYDROLOGIC DATA, ARKANSAS RIVER BASIN, PUEBLO AND SOUTHEASTERN FREMONT COUNTIES, COLORADO, 1975-80,
Geological Survey, Lakewood, CO. Water Resources Div.
D. Cain, and P. Edelmann.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225, Price codes: $33.50 in paper copy, $4.00 in microfiche. Geological Survey Open-File Report 80-1185, 1980. 233 p, 1 Plate, 20 Tab, 2 Ref.

Descriptors: *Data collections, *Water quality, *Surface water, Discharge measurement, Gaging stations, Traveltime, Nutrients, Pesticides, Trace metals, Chemical analysis, *Colorado, Pueblo County, Fremont County, *Arkansas River basin.

Selcted hydrologic data collected in 1975-80 as part of water-quality investigations by the U.S. Geological Survey in Pueblo and southeastern Fremont Counties, Colo., are presented in this report. The data, in tabular form, consist of streamflow-discharge measurements for 33 sites, channel-geometry measurements for 97 sites, traveltime data for 12 sites, and field and laboratory water-quality analyses for 194 sites. Federal, state, and local officials may find these data useful in making decisions relating to the management of water resources of the area. (USGS)
W82-00020

WATER RESOURCES OF THE SANTA YSABEL AND MESA GRANDE INDIAN RESERVATIONS, SAN DIEGO COUNTY, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
J. R. Freckleton.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $6.25 in paper copy, $4.00 in microfiche. Geological Survey Open-File Report 81-342 (WRI), 1981. 27 p, 1 Fig, 1 Plate, 8 Tab, 8 Ref.

Descriptors: *Hydrology, *Geology, *Water resources development, *Water supply, Groundwater, Drillers logs, Wells, Water yield, Springs, Surface water, Streamflow, Precipitation, Water quality, Chemical analysis, Potential water supply, Evaluation, *California, Santa Ysabel Indian Reservation, Mesa Grande Indian Reservation, *Indian reservations, San Diego County.

The Santa Ysabel (consisting of three tracts) and Mesa Grande Indian Reservations are in north-central San Diego County, Calif. On both reservations fractured and weathered igneous and metamorphic rocks and alluvium are water bearing; however, no wells are known to derive their water entirely from alluvium. Well yields range from 2.5 to 250 gallons per minute. Springs occur where saturated fractured or weathered material intersects the land surface. Spring discharge ranged from 0 gallon per minute (November 1979) to 9.4 gallons per minute (November 1979). Few data are available for the surface water characteristics of the study area. One-time measurements of discharge at selected stream sites were made in late November 1979 and late May 1980; discharges ranged from less than 0.01 cubic foot per second to an estimated 3 cubic feet per second. Further study of the surface-water systems would provide a basis for estimating their development potential. The existing water-supply development on the Santa Ysabel Indian Reservation is adequate for the present residents. The Mesa Grande reservation was unoccupied in 1952, was reportedly unoccupied in November 1979, and has no developed water supply. Additional water can be developed for both reservations from the igneous and metamorphic rock, from presently undeveloped springs, and from perennial reaches of the larger streams. Except for excessive iron and sodium at some ground-water sites and excessive sodium at a few surface-water sites, the water is of suitable quality for domestic and agricultural use. (USGS)
W82-00021

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER IN THE SUWANNEE RIVER WATER MANAGEMENT DISTRICT, FLORIDA, MAY 1980,
Geological Survey, Tallahassee, FL. Water Resources Div.
J. C. Rosenau, and R. S. Milner.
Geological Survey Open-File Report 81-211 (WRI), 1981. 1 Sheet.

Descriptors: *Maps, *Aquifers, *Water level, *Potentiometric level, *Wells, Contours, Water level fluctuations, *Florida, Floridan aquifer, Suwannee River Water Management District.

A May 1980 potentiometric surface map of the Suwannee River Water Management District area, Florida, depicts water levels in wells tapping the Floridan aquifer. Compared to the May 1976 potentiometric map of the area, there are no significant differences in the general appearance of the contours. Water levels, however, are generally about 10 feet higher than in 1976 along the Suwannee River and for some 20 miles west of the river and in Gilchrist and Levy Counties to the east. (USGS)
W82-00024

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER IN THE NORTHWEST FLORIDA WATER MANAGEMENT DISTRICT, MAY 1980,
Geological Survey, Tallahassee, FL. Water Resources Div.
J. C. Rosenau, and R. S. Milner.
Geological Survey Open-File Report 81-205 (WRI), 1981. 1 Sheet.

Descriptors: *Maps, *Aquifers, *Water level, *Potentiometric level, *Wells, Contours, Water level fluctuations, *Florida, Floridan aquifer, Northwest Florida Water Management District.

A May 1980 potentiometric surface map of the Northwest Florida Water Management District depicts water levels in wells tapping the Floridan aquifer prior to summer pumpage. Compared to earlier potentiometric maps of the area, there are no significant differences in the 1980 map that are the result of hydrologic conditions. The addition of numerous new monitor wells in Jackson, Calhoun, Gadsden, and Liberty Counties, however, permitted refinement or better delineation of contours and a separation of water-bearing zones of the Floridan aquifer in the latter two counties. (USGS)
W82-00025

WATER RESOURCES OF PRINCE WILLIAM FOREST PARK, VIRGINIA,

Geological Survey, Albany, NY. Water Resources Div.
G. A. Brown.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price: $2.50 in paper copy, $0.50 in microfiche. Geological Survey Open-File Report 80-964 (WRI), 1981. 2 Sheets, 13 Fig, 13 Ref.

Descriptors: *Maps, *Water supply, *Water quality, *National parks, Geohydrology, Data collections, Groundwater availability, Water level, Groundwater movement, Well yields, Surface water, Flow characteristics, Water use, Recreation facilities, *Virginia, *Prince William Forest Park.

Prince William Forest Park is in the southern part of Prince William County, Va. Its natural beauty and nearness to Washington, D.C. have made it one of the most popular recreation areas in northern Virginia. To help the National Park Service plan the development of new facilities and effectively manage its total resources, the U.S. Geological Survey made a hydrologic study of the park from October 1972 to November 1975. The overall objective of the Survey's study was to evalute the quantity and quality of the park's water resources. Available information was compiled and analyzed, and new data on streamflow, ground-water levels, and the chemical quality of water were collected. Test wells were drilled and aquifer tests made at the sites of wells to evaluate the occurrence and availability of ground water. (USGS)
W82-00026

WATER RESOURCES DATA FOR NEW HAMPSHIRE AND VERMONT, WATER YEAR 1980.
Geological Survey, Boston, MA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-110156, Price codes: A09 in paper copy, A01 in microfiche. Geological Survey Water-Data Report NH-VT-80-1, 1981. 177 p, 3 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *New Hampshire, *Vermont.

Water-resources data for the 1980 water year for New Hampshire and Vermont consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels and water quality of wells. This report contains discharge records for 77 gaging stations, stage records for 3 lakes, monthend contents for 25 lakes and reservoirs, water-quality data for 4 gaging stations, and water levels for 40 observation wells. Also included are data for 4 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. A few pertinent stations (not included above) in bordering States and Province of Quebec are also included in this report. These data represent that portion of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in New Hampshire and Vermont. (USGS)
W82-00076

WATER RESOURCES DATA FOR WEST VIRGINIA, WATER YEAR 1980.
Geological Survey, Charleston, WV. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-111637, Price codes: A21 in paper copy, A01 in microfiche. Geological Survey Water-Data Report WV-80-1, 1981. 475 p, 5 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *West Virginia.

Water resources data for the 1980 water year for West Virginia consist of records of stage, discharge, and water quality of streams and springs; stage and contents of lakes and reservoirs; and water levels in wells. This report contains discharge records for 117 gaging stations, stage only records for 8 gaging stations, stage and contents for 8 lakes and reservoirs, contents for 1 reservoir, change in contents for 1 reservoir, water quality for 101 gaging stations, and water levels for 37 observation wells. Also included are 5 crest-stage partial-record stations, and 1 low-flow partial record station. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements and analyses. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in West Virginia. (USGS)
W82-00077

WATER RESOURCES DATA FOR KANSAS, WATER YEAR 1980--VOLUME 1. MISSOURI RIVER BASIN.
Geological Survey, Lawrence, KS. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-106139, Price codes: A19 in paper copy, A01 in microfiche. Geological Survey Water-Data Report KS-80-1, 1981. 422 p, 8 Fig, 4 Tab.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Kansas, *Missouri River basin.

Water resources data for the 1980 water year for Kansas, presented in two volumes, consist of records of stage, discharge, and water quality streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality in wells. This volume contains discharge records for 89 gaging stations; stage and contents for 14 lakes and reservoirs; water quality for 49 gaging stations and 2 lakes; and water levels for about 176 observation wells and water quality for about 266 wells. Also included are data for 56 crest-stage partial-record stations. All data in this report represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Kansas. (USGS)
W82-00078

WATER RESOURCES DATA FOR KANSAS, WATER YEAR 1980--VOLUME 2. ARKANSAS RIVER BASIN.
Geological Survey, Lawrence, KS. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-106147, Price codes: A16 in paper copy, A01 in microfiche. Geological Survey Water-Data Report KS-80-2, 1981. 340 p, 8 Fig, 4 Tab.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Kansas, *Arkansas River basin.

Water resources data for the 1980 water year for Kansas, presented in two volumes, consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality in wells. This volume contains discharge records for 67 gaging stations; stage and contents for 7 lakes and reservoirs; water quality for 78 gaging stations; and water levels for about 306 observation wells and water quality for about 262 wells. Also included are data for 32 crest-stage partial-record stations and 22 low-flow partial-record stations. All data in this report represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Kansas. (USGS)
W82-00079

WATER RESOURCES DATA FOR TEXAS, WATER YEAR 1979--VOLUME 1. ARKANSAS RIVER BASIN, RED RIVER BASIN, SABINE RIVER BASIN, NECHES RIVER BASIN, TRINITY RIVER BASIN, AND INTERVENING COASTAL BASINS.
Geological Survey, Austin, TX. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-110479, Price codes: $44.00 in paper copy, A01 in microfiche. Geological Survey Water-Data Report TX-79-1, 1980. 619 p, 1 Fig.

Descriptors: *Hydrologic data, *Surface water, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Data collections, Sites, *Texas, Arkansas River basin, Red River basin, Sabine River basin, Neches River basin, Trinity River basin.

Surface-water data for the 1979 water year for Texas are presented in three volumes, appropriately identified as to content by river basins. Data in each volume consist of records of stage, discharge, and water quality of streams and canals; and stage, contents, and water quality of lakes and reservoirs. Also included are crest-stage and flood-hydrograph partial-record stations, reconnaissance partial-record stations, and low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data collection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering States are also included. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Texas. (USGS)
W82-00080

WATER RESOURCES DATA FOR TEXAS, WATER YEAR 1979--VOLUME 2. SAN JACINTO RIVER BASIN, BRAZOS RIVER BASIN, SAN BERNARD RIVER BASIN AND INTERVENING COASTAL BASINS.
Geological Survey, Austin, TX. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-110487, Price codes: A23 in paper copy, A01 in microfiche. Geological Survey Water-Data Report TX-79-2, 1980. 511 p, 1 Fig.

Descriptors: *Hydrologic data, *Surface water, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Data collections, Sites, *Texas, San Jacinto River basin, Brazos River basin, San Bernard River basin.

Surface-water data for the 1979 water year for Texas are presented in three volumes, appropriately identified as to content by river basins. Data in each volume consist of records of stage, discharge, and water quality of streams and canals; and stage, contents, and water quality of lakes and reservoirs. Also included are crest-stage and flood-hydrograph partial-record stations, reconnaissance partial-record stations, and low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering States are also included. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Texas. (USGS)
W82-00081

WATER RESOURCES DATA FOR TEXAS, WATER YEAR 1979--VOLUME 3. COLORADO RIVER BASIN, LAVACA RIVER BASIN, GUA-

DALUPE RIVER BASIN, NUECES RIVER BASIN, RIO GRANDE BASIN, AND INTERVENING COASTAL BASIN.
Geological Survey, Austin, TX. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-110495, Price codes: $42.50 in paper copy, A01 in microfiche. Geological Survey Water-Data Report TX-79-3, 1980. 619 p, 1 Fig.

Descriptors: *Hydrologic data, *Surface water, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Data collections, Sites, *Texas, Colorado River basin, Lavaca River basin, Guadalupe River basin, Nueces River basin, Rio Grande basin.

Surface-water data for the 1979 water year for Texas are presented in three volumes, appropriately identified as to content by river basins. Data in each volume consist of records of stage, discharge, and water quality of streams and canals; and stage, contents, and water quality of lakes and reservoirs. Also included are crest-stage and flood-hydrograph partial-record stations, reconnaissance partial-record stations, and low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering States are also included. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Texas. (USGS)
W82-00082

HYDROLOGIC DATA FOR URBAN STUDIES IN THE AUSTIN, TEXAS METROPOLITAN AREA, 1979,
Geological Survey, Austin, TX. Water Resources Div.
R. M. Slade, Jr., M. E. Dorsey, J. D. Gordon, R. N. Mitchell, and J. L. Gaylord.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225, Price codes: $36.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-628, May 1981. 281 p, 18 Fig, 17 Tab, 5 Ref.

Descriptors: *Hydrologic data, *Urban hydrology, *Urban runoff, *Rainfall-runoff relationships, *Storm runoff, Streamflow, Flow rates, Watersheds, Groundwater, Water quality, Flood profiles, Flood peak, Watershed management, Data collections, *Texas, Austin, Colorado River.

This report contains rainfall and runoff data collected during the 1979 water year for the Austin, Texas, metropolitan area. In 1975, the program was expanded to include the collection of water-quality data. In 1978, the program was expanded to include a groundwater resources study of the south Austin metropolitan area in the Balcones fault zone. The information will be useful in determining the extent to which progressive urbanization will affect the yeild and mode of occurrence of storm runoff. The major streams in the study area are the Colorado River, Onion Creek, Barton Creek, Walnut Creek, Bull Creek, Boggy Creek, Shoal Creek, Williamson Creek, Slaughter Creek, Bear Creek, and Waller Creek. Detailed rainfall-runoff computations are presented for eight storm periods during the 1979 water year. Water-quality data for sites in the Austin metropolitan area are also given in this report. (USGS)
W82-00083

PRELIMINARY DATA FROM A SERIES OF ARTIFICIAL RECHARGE EXPERIMENTS AT STANTON, TEXAS,
Geological Survey, Denver, CO. Water Resources Div.
R. L. Bassett, E. P. Weeks, M. L. Ceazan, S. G. Perkins, and D. C. Signor.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225, Price codes: $31.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-149, 1981. 235 p, 38 Fig, 84 Tab, 18 Ref.

Descriptors: *Artificial recharge, *Data collections, *Aquifers, *Hydraulic properties, Sampling, Monitoring, Tracers, Distribution, Organic compounds, Inorganic compounds, Geology, Porosity, Hydraulic conductivity, *Texas, Stanton, Ogallala Formation.

A series of artificial recharge experiments was conducted by the U.S. Geological Survey at an experimental site located in Stanton, Texas. Five tests were performed from March 1977 through December 1978 to: (1) Evaluate the hydraulic properties of the aquifer; (2) test sampling and monitoring equipment; (3) compare tracers for future use in hydrologic investigations; and (4) determine the radial and vertical distribution of hydraulic properties at the site. Suites of inorganic, and both volatile and nonvolatile organic tracers were used in the tests, and comparative data were obtained from sampling points at several radial distances and depths from the injection well. Hydraulic data from aquifer tests and geologic data from core material also were obtained during the investigation. (USGS)
W82-00085

WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN WYOMING, FISCAL YEAR 1980,
Geological Survey, Cheyenne, WY. Water Resources Div.
S. L. Green.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price codes: $15.75 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-201, 1981. 118 p, 11 Fig, 5 Tab.

Descriptors: *Surface water, *Groundwater, *Water quality, *Hydrologic data, Water supply, Streamflow, Sediment transport, Reservoirs, Observation wells, Oil shale, Environmental effects, Publications, Reviews, *Wyoming, Coal regions.

This report contains lists and location maps of streamflow and reservoir stations, ground-water stations, water-quality stations, sediment stations, and peak-flow partial-record stations that are currently being operated in Wyoming. Water-resources appraisal projects are also described, including many that are related to development of energy resources. The general locations of the projects are shown on maps. The U.S. Geological Survey is striving to coordinate its water-resources investigations with those of other agencies. This report is one phase of that coordination effort and serves as an annual progress report to cooperators and the public. (USGS)
W82-00087

WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN COLORADO--FISCAL YEAR 1981.
Geological Survey, Lakewood, CO. Water Resources Div.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price codes: $19.25 in paper copy, $4.00 in microfiche. Geological Survey Open-File Report 81-150, March 1981. 131 p, 45 Fig, 1 Plate, 1 Tab. (Compiled by William E. Price, Jr.).

Descriptors: *Surface water, *Groundwater, *Water quality, Data collections, Maps, *Colorado, Colorado River basin, Missouri River basin, Arkansas River basin, Rio Grande basin.

The report provides an overview of water-resources data collection and hydrologic investigations in Colorado from October 1, 1980, to September 30, 1981. Most of the work is carried out in cooperation with 51 Federal, State, and local agencies. Data are being collected at 503 surface-water gaging stations, 161 surface-water quality stations, and 1,151 observation wells. Sixty-seven hydrologic investigations are underway and are described in the report by a map showing the location of the study area and a statement of the purpose, objective, approach, progress, and plans. Twelve of the investigations are statewide, 6 are regional, 9 are in the Missouri River basin, 8 in the Arkansas River basin, 6 in the Rio Grande basin, and 5 are multistate. Listed in the report are references to 9 data reports and 27 interpretive reports released or published in fiscal year 1980 as a result of water-resources investigations in Colorado. (USGS)
W82-00088

GEOLOGIC, HYDROLOGIC AND CHEMICAL DATA FROM TEST WELLS IN THE DICKSON AREA, TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
M. W. Bradley, and J. Jonas.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price codes: $1.00 in paper copy, $0.50 in microfiche. Geological Survey Open-File Report 81-202, 1981. 1 Sheet, 3 Tab.

Descriptors: *Hydrologic data, *Groundwater, *Water quality, *Test wells, Sites, Water sampling, Well data, Well yield, Physical properties, Chemical properties, Specific capacity, Pumping tests, *Tennessee, Dickson County, Maps.

Seventeen test wells were drilled at 12 sites in south central Dickson County, Tenn. Most of the sites were selected on the basis of carefully developed concepts of groundwater occurrence. These wells range from 20 to 400 feet deep and average 276 feet deep. The yields range from 0 to 300 gal/min and average 69 gal/min, with 6 wells yielding more than 100 gal/min. The water-bearing zones in rock that yield more than 50 gal/min are all between 100 and 200 feet below land surface. Sulfur gas was detected in two of the wells and large concentrations of iron were present in other wells. Capacity tests were conducted on those wells which yield more than 100 gal/min. The specific capacities of these wells range from 1.36 to 8.11 and average 3.46 gal/min for each foot of drawdown. (USGS)
W82-00090

GEOGRAPHIC INFORMATION SYSTEMS AND ENVIRONMENTAL IMPACT ASSESSMENT,
Queen's Univ., Kingston (Ontario). Dept. of Geography.
C. Griffith.
Environmental Management, Vol 4, No 1, p 21-25, January, 1980. 4 Fig, 2 Tab, 5 Ref.

Descriptors: *Land use, *Environmental impact statement, *Regional analysis, Recreation, Agriculture, Canada Geographic Information System, Glengowan Dam, Thames River, Ontario, Dams, Reservoirs, Rivers, Planning, Data processing, *Canada.

The Canadian Geographic Information System categorizes land use capabilities into six groups: agriculture, forestry, recreation, wildlife, watershed boundaries, and land use. A set of seven classes in each group describes the suitability within each category for a use, Class 1 being most desirable. The data base was used to retrieve, analyze, and produce land capability statistics and land use maps for the proposed Glengowan Dam and reservoir on the Thames River, Ontario. The method, as illustrated in this paper, analyzed impacts at different levels, facilitated data profiling and assessment in areas where little information was available, and offered a spatial perspective for evaluation and communication. (Cassar-FRC)
W82-00338

GARRETT COUNTY WATER-WELL RECORDS, CHEMICAL-QUALITY DATA GROUND-WATER USE, COAL TEST-HOLE DATA AND SURFACE-WATER DATA.
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 2F.
W82-00395

ALTITUDE OF WATER TABLE, BISCAYNE AQUIFER, DADE COUNTY, FLORIDA, MAY 1980,

Geological Survey, Miami, FL. Water Resources Div.
K. W. Ratzlaff.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $3.50 in paper copy, $0.50 in microfiche. Geological Survey Open-File Report 81-808, 1981. 1 Sheet.

Descriptors: *Water table, *Maps, *Contours, Low flow, Water level, Water management, *Florida, Dade County, Biscayne aquifer.

Average May water levels for the Biscayne aquifer in Dade County, Florida, were contoured (contour interval 1 and 2 feet) on a 1:96,000-scale map. Maps are prepared for periods of low and high water levels to provide water managers with information about water levels in Dade County and how they are affected by water-management practices. (USGS)
W82-00409

ALTITUDE OF WATER TABLE, BISCAYNE AQUIFER, DADE COUNTY, FLORIDA, OCTOBER 1979,
Geological Survey, Miami, FL. Water Resources Div.
K. W. Ratzlaff.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $3.50 in paper copy, $0.50 in microfiche. Geological Survey Open-File Report 81-807, 1981. 1 Sheet.

Descriptors: *Water table, *Maps, *Contours, Low flow, Water level, Water management, *Florida, Dade County, Biscayne aquifer.

Average October water levels for the Biscayne aquifer in Dade County, Florida, were contoured (contour interval 1 and 2 feet) on a 1:96,000-scale map. Maps are prepared for periods of low and high water levels to provide water managers with information about water levels in Dade County and how they are affected by water-management practices. (USGS)
W82-00410

ALTITUDE OF WATER TABLE, BISCAYNE AQUIFER, DADE COUNTY, FLORIDA, MARCH 1979,
Geological Survey, Miami, FL. Water Resources Div.
K. W. Ratzlaff.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $3.50 in paper copy, $0.50 in microfiche. Geological Survey Open-File Report 81-647, 1981. 1 Sheet.

Descriptors: *Water table, *Maps, *Contours, Low flow, Water level, Water management, *Florida, Dade County, Biscayne aquifer.

Average March water levels for the Biscayne aquifer in Dade County, Florida, were contoured (contour interval 1 and 2 feet) on a 1:96,000-scale map. Maps are prepared for periods of low and high water levels to provide water managers with information about water levels in Dade County and how they are affected by water-management practices. (USGS)
W82-00411

AN OBSERVATION-WELL NETWORK CONCEPT AS APPLIED TO NORTH CAROLINA,
Geological Survey, Raleigh, NC. Water Resources Div.
For primary bibliographic entry see Field 4B.
W82-00414

SUMMARY OF U.S. GEOLOGICAL SURVEY INVESTIGATIONS AND HYDROLOGIC CONDITIONS IN SOUTHWEST FLORIDA FOR 1979,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 10C.
W82-00419

WATER-LEVEL RECORDS FOR THE NORTHERN HIGH PLAINS OF COLORADO, 1977-81,
Geological Survey, Lakewood, CO. Water Resources Div.
R. G. Borman, and T. S. Meredith.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $4.25 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-637, 1981. 29 p, 2 Fig, 1 Tab.

Descriptors: *Water level, Water level fluctuations, *Wells, Aquifers, *Colorado, Northern High Plains, *Ogallala Formation.

Water-level measurements were made in 661 wells in the winter of 1980-81 in the northern High Plains of Colorado. Measurements for the winter of 1980-81 and the four preceding winters are given in a table. (USGS)
W82-00422

WATER LEVEL DATA FOR WELLS IN AND NEAR BURIAL GROUND 3, OAK RIDGE NATIONAL LABORATORY, TENNESSEE, 1975-1979,
Geological Survey, Knoxville, TN. Water Resources Div.
D. A. Webster, J. S. Beatty, P. M. Benjamin, and W. M. Tranum.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $6.25 in paper copy, $4.00 in microfiche. Geological Survey Open-File Report 81-489, 1981. 35 p, 2 Fig, 2 Tab, 1 Ref.

Descriptors: *Water level, *Data collections, *Observation wells, *Radioactive waste disposal, Solid wastes, Well data, Water measurement, Water level fluctuations, Hydrographs, *Tennessee, *Oak Ridge National Laboratory.

Data pertaining to wells in and near Burial Ground 3 (radioactive wastes) at Oak Ridge National Laboratory, Tennessee are presented for the period 1975 to 1979. It includes an inventory of wells, measurements of water levels, well hydrographs, and a map showing the location of the wells. (USGS)
W82-00423

HYDROGEOLOGIC DATA FROM TEST DRILLING NEAR VERNA BEACH, FLORIDA, 1978,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W82-00424

INDEX TO ACTIVE HYDROLOGIC DATA COLLECTION SITES IN FLORIDA, 1980-81,
Geological Survey, Tallahassee, FL. Water Resources Div.
D. W. Foose, and M. E. Thagard.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $40.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-813, 1981. 308 p, 2 Fig, 4 Ref.

Descriptors: *Indexing, *Hydrologic data, *Groundwater, *Surface water, *Sites, Gaging stations, Data collections, Water quality, Wells, Networks, *Florida.

There are about 5,000 active data collection sites in Florida operated by the U.S. Geological Survey in cooperation with State, local, and Federal agencies. This index shows the location of each site, the cooperators supporting the data-collection activities, the type and frequency of the data collected, and the U.S. Geological Survey Office responsible for collecting and processing the data. (USGS)
W82-00425

8. ENGINEERING WORKS

8A. Structures

MODEL STUDY OF A BOX-INLET CHUTE SPILLWAY AND SAF STILLING BASIN,
Science and Education Administration, Stillwater, OK. Conservation Structures Lab.
W. R. Gwinn.
Agricultural Reviews and Manuals ARM-S-17, July 1981. 16 p, 16 Fig, 4 Tab, 4 Ref.

Descriptors: *Spillways, *Stilling basin, *Riprap, *Model studies, Flood control, *Hydraulic design, Maximum probable floods, Scour, Design flood, Stillwater Creek, Boomer Lake, Oklahoma.

Boomer Lake at Stillwater, Oklahoma, is being considered for incorporation into the flood control plan as site 23 for Stillwater Creek, to which Boomer Creek is tributary. The present concrete spillway will pass only 46% of the probable maximum flood (PMF) without overtopping the earthen embankment. A structure is being developed to contain the specified design flood. A scale model of a proposed box-inlet chute spillway and Saint Anthony Falls (SAF) stilling basin for Boomer Lake was tested to determine the head-discharge rating and required riprap. Test results indicate that the riprap should have a mean diameter of 1 foot or more and that the trapezoidal channel at the stilling basin exit should have 3:1 side slopes, with the bottom as wide as the distance between the basin sidewalls and level with the top of the end sill. The channel should be excavated to a depth equal to the maximum scour depth plus normal riprap thickness (2ft). By providing extra thickness in the area of scour, the basin will form its own natural shape if and when the extreme flows occur. (Moore-SRC)
W82-00046

FLOATING BREAKWATER,
Industrie Pirelli, S.p.A., Milan (Italy). (Assignee).
A. Angioletti.
U.S. Patent No. 4,234,266, 6 p, 2 Fig, 9 Ref; Official Gazette of the United States Patent Office, Vol 1000, No 3, p 1054, November 18, 1980.

Descriptors: *Patents, *Breakwaters, *Engineering structures, Barriers, Floating, Waves, Shore protection.

A floating breakwater has two closed buoyant cylindrical members spaced laterally from each other and joined together in their spaced position by longitudinally spaced flexible and inextensible strips such as rubberized fabric. Closed elongated tubular members are mounted on the cylindrical members where they will be above water. The breakwater is anchored to the bottom of the waterway by chains or the like and conventional anchors. An object of the invention is to provide a flexible floating breakwater that insures excellent protection from wave motion for an enclosed area of water and any structures on or in the water lying behind the breakwater structure. (Sinha-OEIS)
W82-00067

OPTIMAL DESIGN OF WATER CONVEYANCE SYSTEMS,
Texas Dept. of Water Resources, Austin.
For primary bibliographic entry see Field 6B.
W82-00160

THE LIMITATIONS AND USEFULNESS OF STREAMFLOW GENERATION METHODS: A CASE STUDY,
Saskatchewan Univ., Saskatoon. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W82-00229

ICE PROBLEMS AT A COOLING WATER INTAKE IN A TIDAL ESTUARY AT LINGAN, N.S.,

Albery, Pullerits, Dickenson and Associates Ltd., Don Mills (Ontario).
S. Skarborn, and T. Korol.
Canadian Journal of Civil Engineering, Vol 7, No 2, p 225-232, 1980. 6 Fig, 1 Tab, 11 Ref.

Descriptors: *Cooling water, *Intakes, *Ice, Powerplants, Electric powerplants, Seawater, Estuaries, *Nova Scotia, Anchor ice, Frazil ice, Ice cover, Sea ice, Recirculated water, Canals.

Design considerations for a salt water cooling water system in a coal-fired generating station in northern Nova Scotia are described. Engineers had to study regional ice conditions; alternative sites for intakes and outfalls (near shore, medium water depth, or deep water); the bathymetry, current tides, and waves of the Bridgeport Basin channel; water temperature and salinity; local ice conditions (shorefast ice, pack ice, and frazil); channel intake design (a rubble structure extending to steel sheet pile cells which support ice booms); and the canal flow characteristics with and without ice cover. In the canal connecting the sea to the plant, water would reach the pumphouse in 15 min with no ice cover and in 13 min with ice cover at a flow rate of 25.5 cu meters per sec. Provision for recirculation of cooling water was made in case of an ice buildup at the intake. The discharged water would be let out 50 meters upstream of the pumphouse to melt some of the ice and mix thoroughly with canal water. (Cassar-FRC)
W82-00230

NORTHEASTERN NEW JERSEY GRAPPLES WITH A DROUGHT,
New Jersey Dept. of Environmental Protection, Trenton.
J. O'Dowd.
Public Works, Vol 112, No 6, p 74-77, June, 1981.

Descriptors: *Drought, *Reservoir operation, *Pipelines, *Pumpage, *Project planning, Water deficit, Water shortage, Water yield, Reservoirs, Water transport, Conveyance structures, Flow rates, Flow discharge, Low flow, Emergency water supply, *New Jersey.

Arrangements for temporary facilities for emergency water supply during the 1980 drought in New Jersey are described. Numerous federal and state agencies cooperated in funding and planning short and long term solutions to the water supply problem. A pipeline diverting lake water to a nearby reservoir was constructed. Water was pumped from a 100 foot deep well in New York and transported through high pressure pipes along the George Washington bridge to New Jersey. Pumping water from abandoned mines has also been explored. Additional connections to existing reservoirs are being constructed for the transfer of water. (Titus-FRC)
W82-00289

ENGINEERING RESEARCH AND THE WATER INDUSTRY,
Water Research Centre, Marlow (England).
M. Rouse.
Water, No 31, p 7-9, March, 1980.

Descriptors: *Water mains, *Sewers, *Research priorities, *Great Britain, Sewer systems, Water conveyance, Maintenance, Needs assessment, Engineering, Technology, Design criteria.

The Water Research Centre in Great Britain has created an Engineering Group which will concentrate its efforts on underground technology, materials, and instrumentation. Initial work by the Group will consist of developing information on sewers and water mains and conducting full scale field investigations of survey methods and pipe renovation systems. Research and development will center on increased understanding of the mechanisms leading to problems and failures and development of effective data collection systems and survey methods. The Standing Technical Committee on Sewers and Water Mains provides a forum in which Water Research Centre staff can work with the users of the research and development results. The Standing Technical Committee has conducted such activities as a study designed to measure leakage and the effectiveness of leakage control measures. Research and development efforts will attempt to focus on total problems, establishing the approach and technology needed to effectively solve existing problems. Problems which are likely to arise in the future will also be addressed. Advances in technology which may benefit water conveyance will be examined. Operational innovations will be initiated and encouraged by the Centre, but much of the innovation will be accomplished by suppliers and/or within the water industry itself. (Carroll-FRC)
W82-00313

DAM CONSTRUCTION IN CHINA.
International Water Power and Dam Construction, Vol 33, No 4, p 17-18, April, 1981.

Descriptors: *Peoples Republic of China, *Dam construction, *Dam design, Asia, *China, Irrigation, Earth dams, Gravity dams, Hollow dams, Arch dams.

Dam construction has been an essential tool in China's development over the past 2000 years. China has about 86,000 dams, with earthfill dams being the most common type. The use of a concrete base and a thin wall of clay inside the earthfill to provide some stiffening has proved a useful technique on river beds with thick layers of gravel subject to serious seepage. The sluicing-siltation method involves depositing loess in ponds lying higher than the crest of the dam to create a high-concentration slurry and then releasing the slurry through ditches to the construction surface of the dam embankment, where it forms a solid layer as the water drains. This method has provided an efficient, labor-saving, and relatively inexpensive means of dam construction. About 5200 irrigation networks throughout the country provide water to a total of over 46,000,000 hectares. Most of the dams are small projects, financed by rural people's communes and built between two flood seasons. Hundreds of masonry dams have been built in the country; one of these is still operating normally after 2000 years of service. While most of the masonry dams built before 1960 are of the gravity type, recent constructions have used light-type dams which incorporate a single-arch retaining wall for narrow gorges or multiple arches or hollow gravity dams on wide rivers. The giant Gezhouba dams currently being constructed on the Yangtze river in Hubei province will include two powerplants with a combined capacity of 2.7 GW, three locks (one of which will be among the largest in the world), a flood gate, and two silt gates. Many dams are now being built on China's largest rivers. (Carroll-FRC)
W82-00334

A NEW ERA FOR CHINA'S HYDROPOWER,
Manitoba Univ., Winnipeg. Dept. of Geography.
V. Smil.
International Water Power and Dam Construction, Vol 33, No 4, p 23-25, April, 1981. 1 Fig, 2 Tab.

Descriptors: *People's Republic of China, *Hydroelectric power, *Dam construction, Asia, *China, Planning, Dams, Electric power production, Powerplants.

Political changes in the People's Republic of China in the 1970's have ushered in an era of industrial modernization and economic development. A central focus of this effort has been the assignment of top priority to the development of hydroelectric power in the country. Bold development plans have included the proposed construction of several giant hydroelectric projects. China is also, for the first time in over 20 years, seeking foreign technical and financial assistance in designing and constructing several large planned projects. Twelve major hydroelectric plants, with total capacities of about 11 GW, are currently in various stages of construction. The largest of these is the Gezhouba on the Yangtze River, which will be 2561 meters long and 70 meters high. This dam will include two generating stations with a total capacity of 2715 MW and an annual production capacity of 13.8 TWh. The project will include three ship locks, a central sluice gate for flood control, and a dozen discharge tunnels to remove silt. Both Japan and the United States have agreed to provide loans and technical assistance for hydroelectric power development in China. (Carroll-FRC)
W82-00335

CHINA'S POTENTIAL FOR HYDRO DEVELOPMENT,
C. Weigong.
International Water Power and Dam Construction, Vol 33, No 4, p 18-21, April, 1981. 3 Fig, 1 Tab.

Descriptors: *People's Republic of China, *Hydroelectric power, Electric power, Planning, *China, Dam construction.

Surveys of the most important rivers in China have indicated that the total theoretical hydroelectric power potential in the People's Republic of China is 680,000 megawatts, corresponding to an annual generation of 6000 TWh of electrical energy. Although China has more water power resources than any other country, it has developed only 2.4% of the exploitable potential, with combined generating capacity of hydroelectric power installations totaling 16.02 GW. Southwest China, which includes the provinces of Sichuan, Yunnan, and Guizhou and the Tiber autonomous region, accounts for 69% of the total water power potential in the country and for about 40% of the total developed hydroelectric power. Five additional major hydropower systems currently planned for this region will serve both Southwest China and the industrial areas in East China, which are short of energy. Northwest China possesses about 12.3% of China's total hydropower resources, while Central and South China account for 9.4% of the national total. East, Northeast, and North China account for relatively negligible percentages of the total hydropower potential, and most of this has already been developed. Major planned projects in Southwest China, Northwest China, Central and South China, and East China are briefly described. (Carroll-FRC)
W82-00336

A LABORATORY MODEL FOR UNDERWATER CONSTRUCTION OF A DAM,
University of the Witwatersrand, Johannesburg (South Africa).
For primary bibliographic entry see Field 8D.
W82-00347

HYDRAULIC SEDIMENT MODEL STUDY FOR PROPOSED BLANCO DIVERSION DAM MODIFICATION,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
R. A. Dodge.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-122920, Price codes: A03 in paper copy, A01 in microfiche. Report REC-ERC-81-3, June 1981. 48 p, 42 Fig.

Descriptors: *Diversion dams, *Sediment control, *Hydraulic models, Headworks, Model studies, Trash racks, Trap efficiency, Tunnels, Suspended sediments, Hydraulic design, *Blanco Diversion Dam, *San Juan-Chama Project, Colorado, New Mexico.

Blanco Diversion Dam is the uppermost and largest of three dams on the San Juan-Chama Project. During a heavy runoff of water in 1973, operators reported large quantities of sediment passing through the headworks and tunnel. Sediment passing through the Blanco Tunnel headworks travels through about 40 km of tunnel. A 1/16-scale sediment model was used to study proposed modifications of Blanco Diversion Dam. Pit-run sand was used to simulate bed sediment sizes ranging from cobbles to fine sand, including sizes in the coarsest 7% part of suspended sediment samples. The model was verified with hydrologic estimates and field data. Tests were directed toward keeping coarse sediment out of the headworks, making sluicing of sediment less troublesome to downriver water users, reducing trash problems on the headworks rack, and keeping sediment from inter-

fering with downstream water measurement. A three-part sequential trap system in front of the headworks was developed. This system uses sluicing over successive trap walls and reduces the amount of sediment entering the tunnel to about 19% of that entering the existing system during 1971 to 1975. At lower river flows, the traps reduced the grain size of the sediment entering the tunnel to 1/20 that of the riverbed material, and at higher riverflows the reduction was to 1/5 that of the riverbed material. (Moore-SRC)
W82-00446

8B. Hydraulics

SECONDARY FLOW, SHEAR STRESS AND SEDIMENT TRANSPORT,
Pittsburgh Univ., PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W82-00117

RESONATOR STUDIES FOR KINCARDINE HARBOUR, LAKE HURON,
McMaster Univ., Hamilton (Ontario). Dept. of Civil Engineering and Engineering Mechanics.
W. James, and D. R. Cuthbert.
Canadian Journal of Civil Engineering, Vol 7, No 1, p 133-143, 1980. 10 Fig, 2 Tab, 8 Ref.

Descriptors: *Resonance, *Harbors, *Waves, *Kincardine Harbor, *Lake Huron, Boating, Recreation, Surveys, Acoustics, Model studies, Lakes, Breakwaters.

A series of acoustical models was used to study wave action in Kincardine Harbor, Lake Huron. Installation of sheet steel piling on the original concrete quays had produced excessive waves in the harbor, used primarily for pleasure boating. Subsequently, a resonator and rubble breakwater were constructed to exclude wave energy from the harbor. A public opinion survey of users indicated that the resonator was effective in decreasing inner harbor oscillations, but posed a navigational hazard. Conclusions were: (1) the acoustic model effectively simulated harbor resonance, (2) the existing breakwater should be extended and marked with a light, and (3) no more than two resonators of unequal lengths (60 and 80 ft) should be constructed. A utility function was proposed; it indicates an average condition of the harbor in relation to outside wave conditions. (Cassar-FRC)
W82-00228

8C. Hydraulic Machinery

OPTIMIZATION OF PUMP TURBINES,
Technische Univ., Munich (Germany, F.R.).
J. Raabe.
Journal of the Energy Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EY1, p 41-63, May, 1981. 15 Fig, 29 Ref.

Descriptors: *Cost analysis, *Electric power production, *Pump turbines, *Mathematical studies, Costs, Economic aspects, Powerplants, Electric power, Turbines, Design criteria, Computer models, Model studies, Impellers.

Some costs involved with excavation work and mechanical losses which occur during the operation of pump turbines of electrical powerplants are presented. The pump turbine design should be based on an impeller outside diameter which minimizes losses from disc friction and the diffuser during pumping. This diameter may be derived mathematically as a function of the given head, flow rate, and type number. A new technique applied to calculating the type number also aids in reducing internal losses and keeps the costs of excavation to a minimum. The optimum type number is functionally related to geometrical data, cavitation coefficients, and loss. Computed results were in close agreement with values encountered in actual practice on a modern pump turbine. The pump turbine design must also take into account specific properties associated with the operation of the set. (Geiger-FRC)
W82-00181

THE CASE FOR SPECIFYING AWWA BUTTERFLY VALVES.
Water and Sewage Works, Vol 127, No 3, p 46, 51, March, 1980.

Descriptors: *Valves, *Design considerations, Equipment, Mechanical equipment, Wastewater treatment, Water treatment, Water treatment facilities, Wastewater treatment facilities, Standards, AWWA, Valves, Butterfly valves.

Basic criteria which a butterfly valve must meet to satisfy the minimum requirements of the AWWA standard are that the materials have a basic safety factor of 5:1 on the ultimate tensile strength or 3:1 on the yield strength, whichever is lower. The standard also covers the operator structure. Manual-type operators must satisfy the minimum requirements of two times the rated torque without damage to internal components. Other requirements are listed. Stringent test procedures are also contained in the AWWA standard C504; these impose significant requirements on quality and long-term cycle life for butterfly-valve applications. The clear interpretation of federal specification guidelines offers the consulting engineer the necessary freedom to specify AWWA-quality valves for EPA projects, notably municipal water and wastewater systems. (Baker-FRC)
W82-00213

CAVITATION AND WEAR ON HYDRAULIC MACHINES,
Chengdu Agricultural Machinery Coll. (China).
DuTong.
International Water Power and Dam Construction, Vol 33, No 4, p 26-28, 33-35, April, 1981. 6 Fig.

Descriptors: *Hydraulic machinery, *Cavitation, *Abrasion, Fluid mechanics, Hydraulic equipment, Flow friction, Sand, Maintenance, *Design criteria.

It has been widely assumed that the scaly pitting of hydraulic machinery is a typical characteristic of wear caused by the abrasion of sand contained in flowing water. Several experiments and analyses were conducted to determine whether such damage is caused by sandy water or by cavitation, including comparison of sand-washing attacks under normal atmospheric conditions and in a compressed air environment; tests with a straight tube and a cavitation generator; tests with a bent tube; tests with pumps connected in series; and tests with water passages connected in series. These tests demonstrated that when no cavitation existed, the wearing effect from the sand alone resulted in all surfaces becoming smooth, with some becoming deep brown in color while others showed a metallic lustre, regardless of the size of the sand grain. Thus elimination of cavitation will eliminate scaly pitting and other surface damage to hydraulic machinery. When sand is present in flowing water it promotes the development of bubbles, and the onset of cavitation occurs sooner than it would have in the absence of the sand. In addition, the sand will continuously wash away the protective film formed on the damaged surface by cavitation so that the sound material of the machinery is successively exposed to the action of cavitation. Sand has a direct influence on cavitation effects, intensifying deterioration and contributing to the development of long scaly pits which join to form channels along the direction of the flow stream. When hydraulic machinery will be operating in water containing a considerable amount of sand, the prevention of cavitation is one of the most important design criteria. The presence of cavitation is the essential condition for corrosion, rather than the amount of sand the water contains. (Carroll-FRC)
W82-00331

HYDRAULIC GATES: THE STATE-OF-THE-ART,
Internacional de Engenharia, Rio de Janeiro (Brazil).
P. C. Erbiste.
International Water Power and Dam Construction, Vol 33, No 4, p 43-48, April, 1981. 5 Fig, 5 Tab, 5 Ref.

Descriptors: *Hydraulic gates, *Design criteria, *Surveys, Hydraulic equipment, Gates, Hydroelectric power, Flood control, Statistical data, Design standards.

The selection of a suitable gate is one of the most important tasks of design engineers for hydraulic installations. Gate selection should be based on a complete analysis of factors which could influence performance, cost, quality, and reliability of the equipment. Past experience with successful types and local manufacturing capability should also be considered. The increasing sizes of hydroelectric power installations and flood control schemes have led to requirements for larger hydraulic gates and extensions of operating limits. Gates are also often built to the maximum allowable dimensions and heads for the gate type. The author of this article conducted a review of the state-of-the-art of hydraulic gates in 1978-1979. Summary data from this study are presented. Data are presented on the project, manufacturer, quantity, span, height, area, head, and hydrostatic load of each of the 15 largest of each type of high pressure gate, under underflow spillway gate, overflow spillway gate, and overflow and underflow spillway gate. Data are also presented on the current limits of the size and head for various types of gates. These data are intended to outline the present fields of application of gates and to assist engineers in the preliminary selection of a gate type. (Carroll-FRC)
W82-00332

8D. Soil Mechanics

PERFORMANCE OF GRANULAR SOIL COVERS ON CANALS,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
C. W. Jones.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-104696, Price codes: A04 in paper copy, A01 in microfiche. Report REC-ERC-81-7, August 1981. 70 p, 49 Fig, 1 Tab, 9 Ref, Append.

Descriptors: *Canal linings, *Erosion control, *Soil stabilization, Soil physical properties, Soil moisture, Sand, Freezing, *Seepage control, Channel erosion.

For canals that do not have concrete or other hard-surfaced, exposed-type lining, selected granular soils are often used as erosion resistant covers at the canal-water interface. Such covers are also needed on most membrane type linings provided for seepage control to hold them in place, protect them from exposure to the elements, and prevent damage to the membrane. The characteristics and observed stability of fine and coarse soil cover layers placed on 19 selected earth-lined and unlined canal reaches to resist water erosion and to protect asphalt and plastic membrane linings are reported. Soils which have generally performed well in coarse cover layers on canals with tractive forces less than 5 N/sq m have contained: maximum particle sizes between 75 and 150 mm; less than 50% passing a No. 4 sieve, and less than 10% passing a No. 200 sieve. Predominantly medium to coarse sand in the fine layer may cause the coarser layer to be unstable during canal filling and drawdown. Some cover soils placed loosely without moisture or density control will settle when water is introduced into a canal and cause cracks to form. In cold climates, freezing of soil moisture drawn to the underside of a membrane lining may cause sliding of the membrane on the subgrade during periods of thawing. (Moore-SRC)
W82-00047

SHEAR STRENGTH OF ROCKFILL,
Terra Tek, Salt Lake City, UT.
N. Barton, and B. Kjaernsli.
Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No GT7, p 873-891, July, 1981. 12 Fig, 2 Tab, 27 Ref.

Descriptors: *Rock fill, *Rockfill dams, *Strength, Rocks, Dam stability, Dam design, Leakage, Porosity.

A method was developed to estimate the peak drained friction angle of rockfill consisting of angular quarried rock, moraine, or well-rounded fluvial gravels. The peak drained friction angles of rock joints and rockfill are quantified by an equivalent roughness, an equivalent asperity or particle strength, and by the residual or friction angle. Each of these parameters can be estimated by simple index tests or by classification. The peak drained friction angle for rockfill and rock joints is inversely proportional to the log of effective normal stress. This is a positive factor in the toe region of a rockfill dam, as high values in this region can explain the high resistance to raveling during extreme leakage. Checking full-scale strength and porosity in different lifts of a dam or in a trail fill prior to dam construction may be accomplished using large-scale tilt testing of in-place compacted rockfill. (Small-FRC)
W82-00116

ESTIMATING END-OF-CONSTRUCTION PORE-PRESSURES IN UNSATURATED EARTH EMBANKMENTS,
Pretoria Univ. (South Africa).
G. W. Annandale.
Civil Engineer in South Africa, Vol 22, No 2, p 31-313, February, 1980. 5 Fig, 6 Ref.

Descriptors: *Pore pressure, *Embankments, Earthworks, Water pressure, Mathematical studies.

A method is presented with which the end-of-construction pore-air pressure in an embankment can be estimated. This method takes into account the degree of saturation of the soil as well as dissipation of excess pore-air pressure during construction and allows reasonable settlement and stability estimates. The distribution of end-of-construction pore-air pressure can also be studied. (Baker-FRC)
W82-00194

A LABORATORY MODEL FOR UNDERWATER CONSTRUCTION OF A DAM,
University of the Witwatersrand, Johannesburg (South Africa).
Z. Ofer.
Civil Engineer in South Africa, Vol 23, No 1, p 17-21, January, 1981. 8 Fig, 10 Ref.

Descriptors: *Dam construction, *Earth dams, *Rockfill dams, Dam stability, Cofferdams, Permeability, Structural models, Design criteria, Model studies.

A small-scale (270 mm high) model dam was built in the laboratory by dumping soil-stone mixtures into water. Two concepts were tested: (1) dumping of pre-mixed soil-stone mixture and (2) placement of a stone core covered with a soil layer on the upstream side. A total of 18 tests were conducted, using different combinations and types of stone and sand. A stone-dolerite soil mixture dumped in water provided a feasible solution for constructing a cofferdam in a lake. The high permeability of the mixture was reduced by placing a layer of fine impermeable material on the upstream slope. Larger proportions of stone improved stability, and larger proportions of soil decreased permeability. Use of non-plastic or very low plasticity materials was not as effective. Over a period of 15 days the permeability of the stone-dolerite dam decreased to 20% of the initial rate. This was caused by the finer particles entrapped in the spaces between the rocks. These small-scale studies may not reproduce on a full scale because of scale effects. (Cassar-FRC)
W82-00347

8G. Materials

LINING OF WASTE IMPOUNDMENT AND DISPOSAL FACILITIES.
Matrecon, Inc., Oakland, CA.
For primary bibliographic entry see Field 5E.
W82-00099

10. SCIENTIFIC AND TECHNICAL INFORMATION

10B. Reference and Retrieval

GROUND-WATER INFORMATION: NWWA PROVIDES THE RESOURCES,
National Water Well Association, Worthington, OH.
For primary bibliographic entry see Field 2F.
W82-00301

NATIONAL WATER DATA EXCHANGE (NAWDEX) SYSTEM 2000 DATA RETRIEVAL MANUAL,
Geological Survey, Reston, VA. Water Resources Div.
O. O. Williams, and W. A. Knecht.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $26.25 in paper copy, $6.50 in microfiche. Geological Survey Open-File Report 81-419, 1981. 196 p, 18 Fig, 8 Append.

Descriptors: *Data storage and retrieval, *Hydrologic data, *Training, *Information retrieval, Computer programs, *NAWDEX(National Water Data Exchange), Water Data Sources Directory, Master Water Data Index.

The manual offers general instructions on the use of SYSTEM 2000 to retrieve any type of data, and specific instructions on how to retrieve data from the U.S. Geological Survey's Water Data Sources Directory and Master Water Data Index Data Bases. The manual is divided into five major sections plus six appendixes for reference. Section I contains introductory material, including the purpose and scope of the manual, instructions on how to use the manual, basic computer concepts, and basic SYSTEM 2000 concepts. Section II contains basic instructions on retrieving and displaying data, and section III goes into more complex retrievals. Section IV explains how to make efficient use of techniques developed in sections II and III. Section V summarizes and discusses practical applications, and section IV contains all the appendixes required for reference. (USGS)
W82-00420

10C. Secondary Publication And Distribution

SUMMARY OF U.S. GEOLOGICAL SURVEY INVESTIGATIONS AND HYDROLOGIC CONDITIONS IN SOUTHWEST FLORIDA FOR 1979,
Geological Survey, Tallahassee, FL. Water Resources Div.
H. C. Rollins.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $12.75 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-78, 1981. 93 p, 48 Fig, 3 Tab, 7 Ref.

Descriptors: *Water management, *Publications, *Bibliographies, Groundwater, Surface water, Water quality, Streamflow, Water supply, Water use, Water resources development, Reviews, Hydrologic data, *Florida, Southwest Florida, *Geological survey projects.

This report summarizes water-resources investigations in the Southwest Florida Water Management District performed by the U.S. Geological Survey, Water Resources Division, for fiscal year 1979. The investigations are part of the Federal program of appraising the nation's water resources. The cooperative program for fiscal year 1979 included 37 interpretive investigations. Abstracts of 15 reports released during 1979 are included. The hydrologic setting of southwest Florida and discussions of surface-water, groundwater, and quality-of-water conditions are given. Hydrologic conditions in southwest Florida are described and illustrated by hydrographs of selected surface-water, groundwater, and lake-stage data-collection sites. In addition, summaries of water-use data and data on the regional observation monitor-well program are provided. (USGS)
W82-00419

10D. Specialized Information Center Services

DIRECTORY OF MEMBER ORGANIZATIONS OF THE NATIONAL WATER DATA EXCHANGE (NAWDEX),
Geological Survey, Reston, VA. Water Resources Div.
J. M. Nokes, and C. D. Blackwell.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price codes: $8.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-497, 1981. 59 p. (Supersedes Open-File Report 80-556).

Descriptors: *Data storage and retrieval, *Hydrologic data, *NAWDEX(National Water Data Exchange), Directories, Member organizations.

The National Water Data Exchange (NAWDEX) is a national confederation of water-oriented organizations working together to improve access to water data. It consists of member organizations from all sectors of the water-data community. This Directory provides the names, addresses, and telephone numbers of all NAWDEX member organizations and their designated NAWDEX representatives. (USGS)
W82-00089

UNIV. OF ILL. URBANA-CHAMPAIGN

SUBJECT INDEX

ABRASION
Cavitation and Wear on Hydraulic Machines,
W82-00331 8C

ABSORPTION
Absorption of Radium and Thorium From New Mexico Uranium Mill Tailing Solutions,
W82-00040 5D

ACID MINE DRAINAGE
Limestone-Lime Treatment of Acid Mine Drainage - Full Scale,
W82-00377 5D

Effects of Surface Mining on Water Quality in a Small Watershed, Sullivan County, Indiana,
W82-00427 5C

ACID RAIN
Chemistry of Precipitation at Gainesville, Florida,
W82-00185 2K

Are Sierra Lakes Becoming Acid,
W82-00231 5C

Understanding Acid Rain,
W82-00479 5B

ACID STREAMS
Control Technology Strategies for Coal Preparation Waste Drainages,
W82-00440 5D

ACIDIC WATER
Are Sierra Lakes Becoming Acid,
W82-00231 5C

ACTIVATED CARBON
Evaluation of the Effectiveness of Granular Activated Carbon Adsorption and Aquaculture for Removing Toxic Compounds From Treated Petroleum Refinery Effluents,
W82-00098 5D

Textile Effluents Lose Their Color.
W82-00342 5D

Effectiveness of Activated Carbon for Removal of Toxic and/or Carcinogenic Compounds From Water Supplies,
W82-00383 5F

Continuous Bioregeneration of Granular Activated Carbon During the Anaerobic Degradation of Catechol,
W82-00408 5D

ACTIVATED SLUDGE
Technique for Determining Total Bacterial Virus Counts in Complex Aqueous Systems,
W82-00222 5A

The Alpha-Beta-Gamma's of Wastewater Treatment,
W82-00275 5D

ACTIVATED SLUDGE PROCESS
Low Temperature Removal of Nitrate by Bacterial Denitrification,
W82-00461 5D

ADSORPTION
Evaluation of the Effectiveness of Granular Activated Carbon Adsorption and Aquaculture for Removing Toxic Compounds From Treated Petroleum Refinery Effluents,
W82-00098 5D

Effect of Kaolin Concentration on Distribution Coefficient of Copper,
W82-00153 5B

Effect of Cations on Copper Adsorption by Kaolin,
W82-00172 2K

Influence of Estuarine Sediment on Virus Survival Under Field Conditions,
W82-00199 5A

Viral Transport Through Soil Columns Under Conditions of Saturated Flow,
W82-00295 5B

Assessment of Environmental Control Technology for Coal Conversion Processes,
W82-00432 5D

Potential Uses of Spent Shale in the Treatment of Oil Shale Retort Waters,
W82-00445 5D

AERATED LAGOONS
Design Guidelines for Incompletely Mixed or Aerobic-Anaerobic Aerated Lagoons,
W82-00250 5D

Avoiding an Environmental Hangover.
W82-00344 5D

AERATION
Underwater Aerator,
W82-00065 5D

Foam Control in Aeration Tanks,
W82-00171 5D

Effects of Alpha, Beta and Theta Factor Upon the Design, Specification and Operation of Aeration Systems,
W82-00291 5D

Role of Hydrodynamic Factors in Ammonia Desorption by Diffused Aeration,
W82-00293 5D

AEROBIC-ANAEROBIC LAGOONS
Design Guidelines for Incompletely Mixed or Aerobic-Anaerobic Aerated Lagoons,
W82-00250 5D

AEROMONAS
Isolation, Enumeration, and Characterization of Aeromonas from Polluted Waters Encountered in Diving Operations,
W82-00224 5C

AEROSOLS
Predictions for Particle Deposition on Natural Waters,
W82-00264 5B

AGRICULTURAL CHEMICALS
Element Mass Balances for South Carolina Coastal Plain Watersheds,
W82-00175 5B

Deposition of Heavy Elements on Belgian Agricultural Soils,
W82-00306 5B

AGRICULTURAL HYDROLOGY
Effect of Agricultural Land Development on Drainage Waters in the North Carolina Tidewater Region,
W82-00094 5B

AGRICULTURAL RUNOFF
Effect of Agricultural Land Development on Drainage Waters in the North Carolina Tidewater Region,
W82-00094 5B

An Empirical Equation for Predicting Soluble Phosphorus Loads from Agricultural Watersheds,
W82-00134 5B

AGRICULTURAL WATERSHEDS
An Empirical Equation for Predicting Soluble Phosphorus Loads from Agricultural Watersheds,
W82-00134 5B

Amounts and Relative Significance of Runoff Types in the Transport of Nitrogen into a Stream Draining an Agricultural Watershed,
W82-00173 5B

AGRICULTURE
Protecting Agriculture's Natural Resource Base,
W82-00176 4D

Economics of Snow Management for Agriculture in the Great Plains,
W82-00178 3F

AIR POLLUTION
Are Sierra Lakes Becoming Acid,
W82-00231 5C

AIR-WATER INTERFACES
Modeling the Flux of Atmospheric Polychlorinated Biphenyls Across the Air/Water Interface,
W82-00193 5B

Predictions for Particle Deposition on Natural Waters,
W82-00264 5B

ALASKA
Erosion and Sedimentation in the Kenai River, Alaska,
W82-00015 2J

Sediment Transport in Norton Sound, Alaska,
W82-00151 2J

Final Environmental Impact Statement; Terror Lake Project No. 2743 - Alaska.
W82-00353 6G

Final Environmental Impact Statement; Tyee Lake Project FERC No. 3015 - Alaska.
W82-00354 6G

ALBERTA
Predicting Lake Levels by Exponential Smoothing,
W82-00118 2A

The Limitations and Usefulness of Streamflow Generation Methods: A Case Study,
W82-00229 6A

Projected Tile Effluent Effects on the Oldman River,
W82-00333 5C

Analysis of Capacity Requirements for Storage Reservoirs: A Case Study,
W82-00341 6A

ALGAE
Luxury Uptake of Nitrogen in Flocculating Algal-Bacterial System,
W82-00307 5D

Microplate Technique for Determining Accumulation of Metals by Algae,
W82-00492 5A

ALGAL CONTROL
Effect of Microcrustaceans on Blue-Green Algae in Flooded Soil,
W82-00146 6G

ALGAL GROWTH
Assessment of 1978 Water Quality Conditions in the Upper Potomac Estuary,
W82-00052 5C

ALKALINITY
Process for Removing Alkalinity and Hardness From Waters,
W82-00063 5F

ALKYLPYRIDINES
Alkylpyridines in Surface Waters, Groundwaters, and Subsoils of a Drainage Located Adjacent to an Oil Shale Facility,
W82-00481 5B

LIBRARY U. OF I. URBANA-CHAMPAIGN

ALLEGHENY COUNTY
Comparative Analysis of Sludge and Refuse Leachate: A Preliminary Report,
W82-00287 5E

ALUM
History of a Water Chemical,
W82-00074 5F

ALUMINUM SULFATE
History of a Water Chemical,
W82-00074 5F

AMINOCARB
Determination of Aminocarb in Water by High Performance Liquid Chromatography,
W82-00232 5A

AMMONIA
An Alternative Solution to the THM Problem,
W82-00072 5F

A Salicylate-Hypochlorite Method for Determining Ammonia in Seawater,
W82-00238 5A

Role of Hydrodynamic Factors in Ammonia Desorption by Diffused Aeration,
W82-00293 5D

AMMONIUM
Modeling Ammonium Exchange and Regeneration on Clinoptilolite,
W82-00125 5D

ANACOSTIA RIVER
Isolation, Enumeration, and Characterization of Aeromonas from Polluted Waters Encountered in Diving Operations,
W82-00224 5C

ANAEROBIC CONDITIONS
Anaerobic Methane Oxidation: Occurrence and Ecology,
W82-00218 2H

Chemistry of Septicity,
W82-00325 5D

ANAEROBIC DIGESTION
Apparatuses for the Anaerobic Digestion of Natural Organic Waste,
W82-00069 5D

Anaerobic Treatment of Human Waste in Northern Communities,
W82-00249 5E

ANAEROBIC LAGOONS
Treatment of Potato-Processing Waste Water by an Anaerobic Lagoon-Filter System,
W82-00226 5D

ANIMAL WASTES
Predicting Runoff Pollutant Reduction in Buffer Zones Adjacent to Land Treatment Sites,
W82-00141 5B

ANTARCTIC OCEAN
On the Estimation of Antarctic Iceberg Melt Rate,
W82-00166 2C

AQUACULTURE
Evaluation of the Effectiveness of Granular Activated Carbon Adsorption and Aquaculture for Removing Toxic Compounds From Treated Petroleum Refinery Effluents,
W82-00098 5D

AQUATIC BACTERIA
Comparison of Two Direct-Count Methods for Determining Metabolizing Bacteria in Freshwater,
W82-00495 5A

AQUATIC ENVIRONMENT
An Analysis of Factors Affecting Oxygen Depletion in the New York Bight,
W82-00106 5C

Distribution of Clostridium Botulinum,
W82-00349 5A

AQUATIC FUNGI
Occurrence of Aphanomyces Ovidestruens, a Fungus Parasitic on Copepods, in Two Eutrophic Lakes,
W82-00304 2H

AQUATIC LIFE
An Aquatic Respirometer for Use in Sublethal Studies,
W82-00122 5C

Development of Bioassay Procedures for Defining Pollution of Harbor Sediments,
W82-00387 5C

Clinical Tests in Aquatic Toxicology: State of the Art,
W82-00464 5A

AQUATIC MICROORGANISMS
Distribution of Obligately Oligotrophic Bacteria in Lake Biwa,
W82-00346 5A

AQUATIC PLANTS
Wastewater Treatment by Rooted Aquatic Plants in Sand and Gravel Trenches,
W82-00093 5D

AQUIFER CHARACTERISTICS
Groundwater Availability in Acadia National Park and Vicinity, Hancock and Knox Counties, Maine,
W82-00017 2F

Aquifer Parameter Identification with Optimum Dimension in Parameterization,
W82-00131 2F

Ground-Water Resources of the White River Basin, Madison County, Indiana,
W82-00412 2A

AQUIFER SYSTEMS
A 10-Year Plan to Study the Aquifer System of Indian Wells Valley, California,
W82-00086 6D

AQUIFERS
Ground-Water Data for Michigan, 1979,
W82-00014 2F

Potentiometric Surface of the Floridan Aquifer in the Suwannee River Water Management District, Florida, May 1980,
W82-00024 7C

Potentiometric Surface of the Floridan Aquifer in the Northwest Florida Water Management District, May 1980,
W82-00025 7C

Preliminary Data From a Series of Artificial Recharge Experiments at Stanton, Texas,
W82-00085 7C

Isolation of Methanobacterium Bryantii from a Deep Aquifer by Using a Novel Broth-Antibiotic Disk Method,
W82-00240 5A

Digital Model of the Unconsolidated Aquifer System in the Modesto Area, Stanislaus and San Joaquin Counties, California,
W82-00415 4B

ARCTIC ZONE
Lignocellulose Mineralization by Arctic Lake Sediments in Response to Nutrient Manipulation,
W82-00270 2H

ARID LANDS
A Qualitative Appraisal of the Hydrology of the Yemen Arab Republic from Landsat Images,
W82-00022 7B

ARID-ZONE HYDROLOGY
Physical Effects of Vehicular Disturbances on Arid Landscapes,
W82-00111 4C

ARKANSAS
Report of the Annual Yield of the Arkansas River Basin for the Arkansas River Basin Compact, Arkansas--Oklahoma, 1980 Water Year,
W82-00012 6E

ARKANSAS RIVER BASIN
Report of the Annual Yield of the Arkansas River Basin for the Arkansas River Basin Compact, Arkansas--Oklahoma, 1980 Water Year,
W82-00012 6E

Selected Hydrologic Data, Arkansas River Basin, Pueblo and Southeastern Fremont Counties, Colorado, 1975-80,
W82-00020 7C

Water Resources Data for Kansas, Water Year 1980--Volume 2. Arkansas River Basin.
W82-00079 7C

ARSENIC
Redox Stability of Inorganic Arsenic(III) and Arsenic(V) in Aqueous Solution,
W82-00206 5A

Experimental Studies on the Effect of Arsenic on Microbial Degradation of Organic Matter and Algal Growth,
W82-00237 2H

ARSENIC COMPOUNDS
Reduction, Methylation, and Incorporation of Arsenic into Lipids by the Marine Phytoplankton Dunaliella Tertiolecta,
W82-00239 5B

ARTIFICIAL RECHARGE
Preliminary Data From a Series of Artificial Recharge Experiments at Stanton, Texas,
W82-00085 7C

ASBESTOS
A/C Pipe - Assessment or Advocacy,
W82-00070 5F

Concentration and Size of Asbestos in Water Supplies,
W82-00262 5B

ASBESTOS CEMENT
A/C Pipe - Assessment or Advocacy,
W82-00070 5F

ASSESSMENTS
Water Treatment Model for Pollutant Exposure Assessment,
W82-00500 5F

ATHABASCA GLACIER
Shallow Core Snow Chemistry of Athabasca Glacier, Alberta,
W82-00320 2C

ATTITUDES
Worthless, Valuable, or What. An Appraisal of Wetlands,
W82-00177 6B

AUSTRALIA
The Significance of the Submarine Geology of Upper Spencer Gulf, South Australia, to Environmental Decision-Making,
W82-00314 2L

Recent Variations in Winter Extratropical Cyclone Activity for the Australian Region,
W82-00315 2B

The Conservative Effect of Rainfall Variation on Fertiliser Response in a Humid Environment,
W82-00316 2A

Field Evaluation of a Swirl Degritter at Tamworth, New South Wales, Australia,
W82-00376 5F

AVAILABLE WATER
Water in the Elizabethtown Area - A Study of Limestone Terrane in North-Central Kentucky,
W82-00413 5B

BACKWASH
Management and Design Implications of a Mathematical Model of a Rapid Gravity Sand Filter Backwash,
W82-00460 5D

BACTERIA
Bacterial Contamination of Drinking Water Supplies in a Modern Rural Neighborhood,
W82-00198 5A

Enrichment and Association of Bacteria and Particulates in Salt Marsh Surface Water,
W82-00201 2L

Enumeration of Potentially Pathogenic Bacteria from Sewage Sludges,
W82-00221 5A

Isolation of Methanobacterium Bryantii from a Deep Aquifer by Using a Novel Broth-Antibiotic Disk Method,
W82-00240 5A

Concentration of Coliphages from Large Volumes of Water and Wastewater,
W82-00247 5A

Enumeration and Relative Importance of Acetylene-Reducing (Nitrogen-Fixing) Bacteria in a Delaware Salt Marsh,
W82-00248 2L

The Effect of Bentonite Clay on Ozone Disinfection of Bacteria and Viruses in Water,
W82-00292 5F

Luxury Uptake of Nitrogen in Flocculating Algal-Bacterial System,
W82-00307 5D

Distribution of Obligately Oligotrophic Bacteria in Lake Biwa,
W82-00346 5A

Distribution of Clostridium Botulinum,
W82-00349 5A

A Bacterial Bioassay for Assessment of Wastewater Toxicity,
W82-00398 5A

High pH Treatment of Combined Water Softening and Wastewater Sludges,
W82-00403 5D

A Resonance Raman Method for the Rapid Detection and Identification of Bacteria in Water,
W82-00404 5A

Low Temperature Removal of Nitrate by Bacterial Denitrification,
W82-00461 5D

Response of Bacteria in Wastewater Sludge to Moisture Loss by Evaporation and Effect of Moisture Content on Bacterial Inactivation by Ionizing Radiation,
W82-00489 5D

BACTERIAL ANALYSIS
Automation of Water Bacteriological Analysis: Running Test of an Experimental Prototype,
W82-00225 5A

Membrane Filter Method for Enumerating Escherichia Coli,
W82-00487 5A

Impact of Verification Media and Resuscitation on Accuracy of the Membrane Filter Total Coliform Enumeration Technique,
W82-00494 5A

Comparison of Two Direct-Count Methods for Determining Metabolizing Bacteria in Freshwater,
W82-00495 5A

BANK EROSION
Erosion and Sedimentation in the Kenai River, Alaska,
W82-00015 2J

BAYS
Perpetual Shoals at the Entrance to Chesapeake Bay: Flow-Substrate Interactions and Mutually Evasive Net Currents,
W82-00149 2L

BEACH EROSION
Solar Cycles and Erosional Events on the New South Wales Central and South Coasts,
W82-00318 2J

BELGIUM
Deposition of Heavy Elements on Belgian Agricultural Soils,
W82-00306 5B

BEMIDJI
Final Environmental Impact Statement; Bemidji Wastewater Treatment System, Beltrami County, Minnesota.
W82-00358 5D

BENTHIC FAUNA
Effects of the Mount St. Helens Eruption on the Benthic Fauna of the Toutle River, Muddy River, and Pine Creek Drainage Basins, Washington,
W82-00005 5C

BENTHOS
Field Experiments on Responses of a Freshwater, Benthic Macroinvertebrate Community to Vertebrate Predators,
W82-00477 5C

BENTONITE
The Effect of Bentonite Clay on Ozone Disinfection of Bacteria and Viruses in Water,
W82-00292 5F

BERING SEA
Incidence of Vibrio Alginolyticus and Bacteria of Sanitary Significance in the Bering Sea,
W82-00490 5A

BERMUDAGRASS
Coastal Bermudagrass Yield and Soil Properties as Affected by Surface-Applied Dairy Manure and Its Residue,
W82-00195 3C

BIBLIOGRAPHIES
Summary of U.S. Geological Survey Investigations and Hydrologic Conditions in Southwest Florida for 1979,
W82-00419 10C

BIOACCUMULATION
Toxicity and Ecological Significance of Trace Elements in Aquatic Environments,
W82-00498 5B

BIOASSAY
Evaluation of Methodologies for the Determination of Acute Toxicity in Pulp and Paper Effluents,
W82-00297 5A

Development of Bioassay Procedures for Defining Pollution of Harbor Sediments,
W82-00387 5C

A Bacterial Bioassay for Assessment of Wastewater Toxicity,
W82-00398 5A

BIOCHEMICAL OXYGEN DEMAND
Sludge Settling Hampered by Industrial Discharge,
W82-00290 5D

BIOCHEMISTRY
Chemical Indicators of Organic River Sources in Rivers and Estuaries,
W82-00035 5B

BIODEGRADATION
Use of the Electrolytic Respirometer to Measure Biodegradation in Natural Waters,
W82-00126 5A

Assessment of Environmental Control Technology for Coal Conversion Processes,
W82-00432 5D

BIODEGRATION
Engineering Assessment of Vermicomposting Municipal Wastewater Sludges,
W82-00385 5E

BIOINDICATORS
Tadpoles as Indicators of Harmful Levels of Pollution in the Field,
W82-00478 5A

BIOLOGICAL OXIDATION
Biological Oxidation of Aqueous Thiocyanate,
W82-00442 5D

BIOLOGICAL SAMPLES
Water Quality Management Studies, Lake Seminole, April-November 1978.
W82-00051 6G

BIONESS, A New Design in Multiple Net Zooplankton Samplers,
W82-00210 7B

BIOLOGICAL TREATMENT
Engineering Assessment of Vermicomposting Municipal Wastewater Sludges,
W82-00385 5E

BIOLOGICAL WASTEWATER TREATMENT
Wastewater Treatment by Rooted Aquatic Plants in Sand and Gravel Trenches,
W82-00093 5D

Small is Environmentally Acceptable . . .,
W82-00311 5D

Treatment of Coal Gasification Process Wastewaters,
W82-00434 5D

BIOMASS
Aerial Biomass Distribution in an Undisturbed and Disturbed Subarctic Bog,
W82-00211 2C

The Prediction of Lacustrine Phytoplankton Diversity,
W82-00319 2H

Processing Needs and Methodology for Wastewaters from the Conversion of Coal, Oil Shale and Biomass to Synfuels.
W82-00431 5D

BIOTRANSFORMATION
Relationship Between Biotransformation and the Toxicity and Fate of Xenobiotic Chemicals in Fish,
W82-00186 5C

LIBRARY U. OF I. URBANA-CHAMPAIGN

BLANCO DIVERSION DAM
Hydraulic Sediment Model Study for Proposed Blanco Diversion Dam Modification,
W82-00446 8A

BLEACHING WASTES
Pulp Companies Face Billion Dollar Cleanup.
W82-00343 5D

BLOSSOM-END ROT
Effects of Soil Water Regime and Nitrogen Form on Blossom-End Rot, Yield, Water Relations, and Elemental Composition of Tomato,
W82-00162 2I

BOGS
Aerial Biomass Distribution in an Undisturbed and Disturbed Subarctic Bog,
W82-00211 2C

Vegetation and Nutrient Status of Northern Michigan Bogs and Conifer Swamps with a Comparison to Fens,
W82-00484 2I

BREAKWATERS
Floating Breakwater,
W82-00067 8A

BREWERY INDUSTRY
Avoiding an Environmental Hangover.
W82-00344 5D

BRINES
Evaluation of the Malaga Bend Salinity Alleviation Project, Eddy County, New Mexico,
W82-00018 5B

BULKING SLUDGE
Sludge Settling Hampered by Industrial Discharge,
W82-00290 5D

BULL RUN WATERSHED
Mount St. Helens Volcanic-Ash Fall in the Bull Run Watershed, Oregon, March-June 1980,
W82-00002 5B

BUMPING LAKE
An Analysis of Reservoir Storage Contents for the Proposed Enlargement of Bumping Lake in Washington,
W82-00421 4A

BUTTE BASIN
Flood Data for the Sacramento River and Butte Basin 1875 to 1978, Sacramento Valley, California,
W82-00019 2E

CADMIUM
Sorption of Trace Cadmium on Clay Minerals and River Sediments: Effects of pH AND CD(II) Concentrations in a Synthetic River Water Medium,
W82-00174 2K

CALCIUM
Leaching of Calcium and Magnesium from Soil Columns as Affected by Form of Nitrogen in Applied Sewage,
W82-00192 5E

Consecutive Amperometric Titrations for Calcium and Magnesium,
W82-00208 5A

CALIBRATIONS
Ground-Water Modeling: Recent Developments,
W82-00281 2F

CALIFORNIA
Flood Data for the Sacramento River and Butte Basin 1875 to 1978, Sacramento Valley, California,
W82-00019 2E

Water Resources of the Santa Ysabel and Mesa Grande Indian Reservations, San Diego County, California,
W82-00021 7C

Evaluation of Ground-Water Monitoring Network, Santa Cruz County, California,
W82-00023 7A

A 10-Year Plan to Study the Aquifer System of Indian Wells Valley, California,
W82-00086 6D

Wastewater Treatment by Rooted Aquatic Plants in Sand and Gravel Trenches,
W82-00093 5D

Final Environmental Impact Statement; Dinkey Creek Project No. 2890 - California.
W82-00352 6G

Final Environmental Impact Statement; South Fork American River Development, Upper Mountain Project No. 2761 - California.
W82-00367 6G

Digital Model of the Unconsolidated Aquifer System in the Modesto Area, Stanislaus and San Joaquin Counties, California,
W82-00415 4B

CAMPING
Human Use in a Dispersed Recreation Area and its Effect on Water Quality,
W82-00393 5B

CANADA
A 13-Month Survey of Nematodes at Three Water Treatment Plants in Southern Ontario, Canada,
W82-00294 5F

Geographic Information Systems and Environmental Impact Assessment,
W82-00338 7C

Recent Developments in Water Pollution Control,
W82-00340 5D

The Valuation of Recreational Fisheries,
W82-00348 6C

CANAL CONSTRUCTION
Predicted Effects on Ground Water of Construction of Divide Cut Section, Tennessee-Tombigbee Waterway, Northeastern Mississippi Using a Digital Model,
W82-00428 2F

CANAL LININGS
Performance of Granular Soil Covers on Canals,
W82-00047 8D

CARBON
Carbon Transformations in the Land Areas Receiving Organic Wastes in Relation to Nonpoint Source Pollution: A Conceptual Model,
W82-00179 5B

CARBON CYCLE
Carbon Isotopes as Indicators of the Source and Fate of Carbon in Rivers and Estuaries,
W82-00033 5B

CARBON RADIOISOTOPES
Carbon Isotopes as Indicators of the Source and Fate of Carbon in Rivers and Estuaries,
W82-00033 5B

CARCINOGENS
Effectiveness of Activated Carbon for Removal of Toxic and/or Carcinogenic Compounds From Water Supplies,
W82-00383 5F

Nitrosamines in Tap Water After Concentration by a Carbonaceous Adsorbent,
W82-00459 5A

Chlorinated Drinking Water,
W82-00467 5F

CATCHMENT AREAS
Enteric Bacterial Concentrations in Reservoir Feeder Streams: Baseflow Characteristics and Response to Hydrograph Events,
W82-00462 5B

CAVITATION
Cavitation and Wear on Hydraulic Machines,
W82-00331 8C

CENTRAL VALLEY
Irrigation Tailwater Management,
W82-00392 3C

CENTRIFUGATION
The Effect of Centrifugation on the Suspended Particles of River Waters,
W82-00124 5A

CHANNEL EROSION
Erosion and Sedimentation in the Kenai River, Alaska,
W82-00015 2J

CHANNEL FLOW
Flow Resistance in Vegetated Waterways,
W82-00152 2E

CHEMICAL ANALYSIS
Chemistry of Precipitation at Gainesville, Florida,
W82-00185 2K

Total Organic Halogen as a Parameter for the Characterization of Reclaimed Waters: Measurement, Occurrence, Formation, and Removal,
W82-00197 5D

Methods for Level 2 Analysis by Organic Compound Category,
W82-00384 5A

The Analysis of Oil Shale Wastes: A Review,
W82-00388 5A

Garrett County Water-Well Records, Chemical-Quality Data Ground-Water Use, Coal Test-Hole Data and Surface-Water Data.
W82-00395 2F

CHEMICAL COMPOSITION
Geochemistry of a Subarctic Salt Marsh Environment,
W82-00148 2L

Water-Rock Partition Coefficients and the Composition of Natural Waters - A Reassessment,
W82-00284 2K

Basin Landscape-Halogeochemical Method of Evaluating the Natural and Reclamation Conditions of Irrigated Territories,
W82-00303 2K

Shallow Core Snow Chemistry of Athabasca Glacier, Alberta,
W82-00320 2C

Hydrochemistry of a Dolomite Karst: The Bruce Peninsula of Ontario,
W82-00321 2K

CHEMICAL INTERFERENCE
Interference of Sulphide in Inorganic Phosphate Determination in Natural Waters,
W82-00154 5A

CHEMICAL OXYGEN DEMAND
Energy Recovery System,
W82-00059 5D

A Realistic Assessment of the Effect of Settlement on Sewage,
W82-00324 5D

CHEMICAL PROPERTIES
Element Mass Balances for South Carolina Coastal Plain Watersheds,
W82-00175 5B

Hydrochemistry of a Dolomite Karst: The Bruce Peninsula of Ontario,
W82-00321 2K

CHEMICAL REACTIONS
Water Pollution Potential of Coal-Slurry Pipelines,
W82-00096 6A

CHEMICAL RECOVERY
Chemical Recovery from Coal Conversion Wastes by Concentration,
W82-00436 5D

CHEMICAL TREATMENT
Limestone-Lime Treatment of Acid Mine Drainage - Full Scale,
W82-00377 5D

CHESAPEAKE BAY
Perpetual Shoals at the Entrance to Chesapeake Bay: Flow-Substrate Interactions and Mutually Evasive Net Currents,
W82-00149 2L

CHINA
Environmental Impact Assessment of China's Water Transfer Project,
W82-00129 6D

Dam Construction in China.
W82-00334 8A

A New Era for China's Hydropower,
W82-00335 8A

China's Potential for Hydro Development,
W82-00336 8A

CHLORINATED HYDROCARBONS
Effects of Halogenated Organic Compounds on Photosynthesis in Estuarine Phytoplankton,
W82-00266 5C

CHLORINATION
Distribution and Balance of Volatile Halogenated Hydrocarbons in the Water and Air of Covered Swimming Pools Using Chlorine for Water Disinfection,
W82-00128 5F

Reactions of Chlorine with Selected Aromatic Models of Aquatic Humic Material,
W82-00254 5F

Determination of Organically Combined Chlorine in High Molecular Weight Aquatic Organics,
W82-00258 5A

The Consultant's Viewpoint on Alternative Disinfectants,
W82-00286 6A

Chlorinated Drinking Water,
W82-00467 5F

CHLORINE
Determination of Organically Combined Chlorine in High Molecular Weight Aquatic Organics,
W82-00258 5A

CHLOROFORM
Chlorinated Drinking Water,
W82-00467 5F

CHROMATOGRAPHY
Measurement of the Solubilities of Slightly Soluble Organic Liquids in Water by Elution Chromatography,
W82-00207 5A

CLARIFICATION
History of a Water Chemical,
W82-00074 5F

CLARK FORK-PEND OREILLE RIVER BASIN
Water Resources Appraisal for Hydroelectric Licensing: Clark Fork-Pend Oreille River Basin, Montana, Idaho, Washington.
W82-00374 6B

CLASSIFICATION
An Appraisal of Pond-Net Samples for Biological Monitoring of Lotic Macroinvertebrates,
W82-00308 7B

CLAYS
Dewatering of Industrial Clay Wastes,
W82-00041 5D

Dewatering Florida Phosphatic Clay Wastes With Moving Screens,
W82-00049 5D

The Effect of Bentonite Clay on Ozone Disinfection of Bacteria and Viruses in Water,
W82-00292 5F

CLEAR-CUTTING
Slash Treatment After Clearcutting Lodgepole Pine Affects Nutrients in Soil Water,
W82-00130 4C

Aerial Biomass Distribution in an Undisturbed and Disturbed Subarctic Bog,
W82-00211 2C

CLIMATOLOGY
The World Climate Programme,
W82-00317 6A

Historical Nile Floods and Their Implications for Climatic Change,
W82-00326 2E

CLINTON
Facultative Lagoon Effluent Polishing Using Phase Isolation Ponds,
W82-00092 5D

CLOSTRIDIUM BOTULINUM
Distribution of Clostridium Botulinum,
W82-00349 5A

CLYDE RIVER
The Effect of Centrifugation on the Suspended Particles of River Waters,
W82-00124 5A

COAL
Planning Study to Model and Monitor Coal Pile Run-Off,
W82-00091 6A

Water Pollution Potential of Coal-Slurry Pipelines,
W82-00096 6A

Hydraulic Properties of Coal and Related Materials, Northern Great Plains,
W82-00278 2F

The U.S. Geological Survey Coal Hydrology Program and the Potential of Hydrologic Models for Impact Assessments,
W82-00429 6E

Assessment of Environmental Control Technology for Coal Conversion Processes,
W82-00432 5D

COAL GASIFICATION
Processing Needs and Methodology for Wastewaters from the Conversion of Coal, Oil Shale and Biomass to Synfuels.
W82-00431 5D

Assessment of Environmental Control Technology for Coal Conversion Processes,
W82-00432 5D

Slagging Fixed-Bed Gasifier (SFBG) Wastewater Pretreatment,
W82-00433 5D

Treatment of Coal Gasification Process Wastewaters,
W82-00434 5D

Environmental Control Technology for the Flash Hydropyrolysis of Coal,
W82-00435 5D

Chemical Recovery from Coal Conversion Wastes by Concentration,
W82-00436 5D

Improved Water Management of Coal Conversion Processes by Preliminary Absorption of Halides,
W82-00437 5D

Solvent Extraction of Phenols,
W82-00438 5D

Assessment of Solvent Extraction for Treatment of Coal Gasifier Wastewater,
W82-00439 5D

Characterization and Processing of Coal Conversion Process Wastewaters,
W82-00441 5D

Biological Oxidation of Aqueous Thiocyanate,
W82-00442 5D

COAL GASIFICATION PLANTS
Energy Recovery System,
W82-00059 5D

COAL MINES
Selective Overburden Placement,
W82-00053 5G

Premining Hydrologic Conditions of Five Southeastern Ohio Watersheds,
W82-00054 4C

COAL MINING
Environmental Planning for Coal Strip Mining,
W82-00214 5G

Effects of Surface Mining on Water Quality in a Small Watershed, Sullivan County, Indiana,
W82-00427 5C

COAL PILE RUNOFF
Planning Study to Model and Monitor Coal Pile Run-Off,
W82-00091 6A

COAL-TAR DERIVATIVES
Preliminary Evaluation of Ground-Water Contamination by Coal-Tar Derivatives, St. Louis Park Area, Minnesota,
W82-00430 5B

COHESION
Erodibility of Streambank Materials of Low Cohesion,
W82-00136 2J

COLD REGIONS
Anaerobic Treatment of Human Waste in Northern Communities,
W82-00249 5E

COLIFORMS
Comparison of Nine Brands of Membrane Filter and the Most-Probable-Number Methods for Total Coliform Enumeration in Sewage-Contaminated Drinking Water,
W82-00203 5A

High-Level Ozone Disinfection of Municipal Wastewater Effluents,
W82-00379 5D

COLIFORMS

Enteric Bacterial Concentrations in Reservoir Feeder Streams: Baseflow Characteristics and Response to Hydrograph Events,
W82-00462 5B

Impact of Verification Media and Resuscitation on Accuracy of the Membrane Filter Total Coliform Enumeration Technique,
W82-00494 5A

COLOR REMOVAL
Textile Effluents Lose Their Color.
W82-00342 5D

COLORADO
Selected Hydrologic Data, Arkansas River Basin, Pueblo and Southeastern Fremont Counties, Colorado, 1975-80,
W82-00020 7C

Water-Resources Investigations of the U.S. Geological Survey in Colorado--Fiscal Year 1981.
W82-00088 7C

Furrow Irrigation Practices in Northern Colorado,
W82-00139 3F

Water-Level Records for the Northern High Plains of Colorado, 1977-81,
W82-00422 7C

Alkylpyridines in Surface Waters, Groundwaters, and Subsoils of a Drainage Located Adjacent to an Oil Shale Facility,
W82-00481 5B

COLORADO PLATEAU
Ground-Water Flow and Uranium in Colorado Plateau,
W82-00282 2F

COLORIMETRY
Comparison of Automated Segmented-Flow and Discrete Analyzers for the Determination of Nutrients in Water,
W82-00483 5A

COMPOSTING
Engineering Assessment of Vermicomposting Municipal Wastewater Sludges,
W82-00385 5E

COMPUTER APPLICATIONS
Basin Management in the San Bernardino Basin Area,
W82-00280 6A

COMPUTER MODELS
Computer Modeling of Fluid Flow During Production and Environmental Restoration Phases of In Situ Uranium Leaching,
W82-00043 6A

Modeling Ammonium Exchange and Regeneration on Clinoptilolite,
W82-00125 5D

Field Test of an Irrigation Scheduling Computer Model,
W82-00184 3F

Mathematical Efficiency Concerns in Water Distribution Network Considerations,
W82-00339 5F

COMPUTER PROGRAMS
Ground-Water Modeling: Recent Developments,
W82-00281 2F

COMPUTERS
Water, Energy and Labor Requirements for Future Pacific Northwest Irrigation,
W82-00143 6A

CONDENSATES
Improved Water Management of Coal Conversion Processes by Preliminary Absorption of Halides,
W82-00437 5D

CONFINED GROUNDWATER
Digital Model of the Unconsolidated Aquifer System in the Modesto Area, Stanislaus and San Joaquin Counties, California,
W82-00415 4B

CONSTRUCTION
Report of Survey of Corps of Engineers Construction Workforce,
W82-00102 6B

Final Environmental Impact Statement; Dinkey Creek Project No. 2890 - California.
W82-00352 6G

Final Environmental Impact Statement; Terror Lake Project No. 2743 - Alaska.
W82-00353 6G

Final Environmental Impact Statement; Tyee Lake Project FERC No. 3015 - Alaska.
W82-00354 6G

Rocky Mountain Pipeline Project: Environmental Impact Statement,
W82-00394 5G

CONTAMINATION
Toxicity and Ecological Significance of Trace Elements in Aquatic Environments,
W82-00498 5B

CONTOURS
Altitude of Water Table, Biscayne Aquifer, Dade County, Florida, May 1980,
W82-00409 7C

Altitude of Water Table, Biscayne Aquifer, Dade County, Florida, October 1979,
W82-00410 7C

Altitude of Water Table, Biscayne Aquifer, Dade County, Florida, March 1979,
W82-00411 7C

CONVEYANCE STRUCTURES
Final Environmental Impact Statement; South Fork American River Development, Upper Mountain Project No. 2761 - California.
W82-00367 6G

COOLING WATER
Domestic Water Supplies for Power Plant Cooling,
W82-00180 6D

Ice Problems at a Cooling Water Intake in a Tidal Estuary at Lingan, N.S.,
W82-00230 8A

COPEPODS
Seasonal Particle-Size Selection by Diaptomus Sicilis in Offshore Lake Michigan,
W82-00485 2H

COPPER
Effect of Kaolin Concentration on Distribution Coefficient of Copper,
W82-00153 5B

Effect of Cations on Copper Adsorption by Kaolin,
W82-00172 2K

CORN
Reduced Transpiration and Increased Water Efficiency by Diuron in Corn (Zea Mays),
W82-00196 2D

CORPS OF ENGINEERS
Report of Survey of Corps of Engineers Construction Workforce,
W82-00102 6B

COST ANALYSIS
Optimal Design of Water Conveyance Systems,
W82-00160 6B

Optimization of Pump Turbines,
W82-00181 8C

COST-BENEFIT ANALYSIS
Review of Reports for Flood Control; Westchester County Streams, New York.
W82-00103 4A

Economics of Snow Management for Agriculture in the Great Plains,
W82-00178 3F

CROP PRODUCTION
Effect of Crop Residue on Soil Loss from Continuous Row Cropping,
W82-00145 2J

Economics of Snow Management for Agriculture in the Great Plains,
W82-00178 3F

Environmental Resources and Restraints to Agricultural Production in a Mediterranean-Type Environment,
W82-00329 2I

Effects of Topsoil and Subsoil Thickness on Soil Water Content and Crop Production on a Disturbed Soil,
W82-00465 2G

Sodium-Potassium Ratios in Soil Solution and Plant Response Under Saline Conditions,
W82-00469 3C

CROP YIELD
Cropping Systems for Treatment and Utilization of Municipal Wastewater and Sludge,
W82-00097 5E

Modeling Grain Sorghum Ratoon Cropping and Associated Runoff and Sediment Losses,
W82-00113 2G

Effect of Irrigation and Tree Density on Peach Production,
W82-00120 2I

Nitrogen Availability from Sewage Sludge,
W82-00158 5E

Effects of Water Regime on Growth, Yield, and Nitrogen Uptake of Rice,
W82-00330 2I

CROPLAND
Variation in Microbial Activity in Histosols and Its Relationship to Soil Moisture,
W82-00244 2G

CRUSTACEANS
Effect of Microcrustaceans on Blue-Green Algae in Flooded Soil,
W82-00146 6G

CRYSTAL LAKE
Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 1: Crystal Lake Area Sewage Disposal Authority, Benzie County, Michigan.
W82-00362 5D

CRYSTALLINE ROCKS
Strategy for Radioactive Waste Disposal in Crystalline Rocks,
W82-00299 5E

CULTIVATED LANDS
Effect of Crop Residue on Soil Loss from Continuous Row Cropping,
W82-00145 2J

CYANOPHYTA
Toxicity of Mount St. Helens Ash Leachate to a Blue-Green Alga,
W82-00001 5C

CYCLING NUTRIENTS
Modeling Phosphorus Loading and Lake Response Under Uncertainty: A Manual and Compilation of Export Coefficients.
W82-00039 5B

CYCLONES
Recent Variations in Winter Extratropical Cyclone Activity for the Australian Region,
W82-00315 2B

CYPRESS SWAMPS
Effects of Sewage Effluent Application on Litter Fall and Litter Decomposition in Cypress Swamps,
W82-00499 5E

DAIRY INDUSTRY
Soil as a Medium for Dairy Liquid Waste Disposal,
W82-00165 5E

DAM CONSTRUCTION
Dam Construction in China.
W82-00334 8A

A New Era for China's Hydropower,
W82-00335 8A

A Laboratory Model for Under-Water Construction of a Dam,
W82-00347 8D

DAM DESIGN
Dam Construction in China.
W82-00334 8A

DAM EFFECTS
Final Environmental Impact Statement; Dinkey Creek Project No. 2890 - California.
W82-00352 6G

Final Environmental Impact Statement; Terror Lake Project No. 2743 - Alaska.
W82-00353 6G

Final Environmental Impact Statement; South Fork American River Development, Upper Mountain Project No. 2761 - California.
W82-00367 6G

DAMS
Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Kentucky.
W82-00450 6E

DATA COLLECTIONS
Selected Hydrologic Data, Arkansas River Basin, Pueblo and Southeastern Fremont Counties, Colorado, 1975-80,
W82-00020 7C

Preliminary Data From a Series of Artificial Recharge Experiments at Stanton, Texas,
W82-00085 7C

Water Level Data for Wells in and Near Burial Ground 3, Oak Ridge National Laboratory, Tennessee, 1975-1979,
W82-00423 7C

DATA STORAGE AND RETRIEVAL
Directory of Member Organizations of the National Water Data Exchange (NAWDEX),
W82-00089 10D

National Water Data Exchange (NAWDEX) System 2000 Data Retrieval Manual,
W82-00420 10B

DDT
Behavior of DDT, Kepone, and Permethrin in Sediment-Water Systems Under Different Oxidation-Reduction and PH Conditions,
W82-00382 5B

DECISION MAKING
Environmental Impact Assessment of China's Water Transfer Project,
W82-00129 6D

The Consultant's Viewpoint on Alternative Disinfectants,
W82-00286 6A

DECOMPOSITION
Carbon Transformations in the Land Areas Receiving Organic Wastes in Relation to Nonpoint Source Pollution: A Conceptual Model,
W82-00179 5B

DEGRADATION
Hydrolysis of Fenitrothion in Model and Natural Aquatic Systems,
W82-00157 5B

Fenitrothion Sprayed on a Pond: Kinetics of Its Distribution and Transformation in Water and Sediment,
W82-00159 5B

Photolysis of N-Nitrosodi-n-Propylamine in Water,
W82-00164 5B

DELAWARE
Enumeration and Relative Importance of Acetylene-Reducing (Nitrogen-Fixing) Bacteria in a Delaware Salt Marsh,
W82-00248 2L

DENITRIFICATION
Effects of Water Regime on Growth, Yield, and Nitrogen Uptake of Rice,
W82-00330 2I

Low Temperature Removal of Nitrate by Bacterial Denitrification,
W82-00461 5D

DEPOSITION
Deposition of Riverborne Organic Carbon in Floodplain Wetlands and Deltas,
W82-00034 2J

DEPOSITION RATES
Predictions for Particle Deposition on Natural Waters,
W82-00264 5B

DESIGN CONSIDERATIONS
The Case for Specifying AWWA Butterfly Valves.
W82-00213 8C

DESIGN CRITERIA
Optimal Design of Water Conveyance Systems,
W82-00160 6B

Design Guidelines for Incompletely Mixed or Aerobic-Anaerobic Aerated Lagoons,
W82-00250 5D

Effects of Alpha, Beta and Theta Factor Upon the Design, Specification and Operation of Aeration Systems,
W82-00291 5D

Treatment Works--The Designer's Problems,
W82-00312 5F

Cavitation and Wear on Hydraulic Machines,
W82-00331 8C

Hydraulic Gates: The State-of-the-Art,
W82-00332 8C

Mathematical Efficiency Concerns in Water Distribution Network Considerations,
W82-00339 5F

DEVELOPING COUNTRIES
Hygiene of Drinking Water in Developing Countries,
W82-00269 5F

DEWATERING
Dewatering of Industrial Clay Wastes,
W82-00041 5D

Dewatering Florida Phosphatic Clay Wastes With Moving Screens,
W82-00049 5D

DIMETHYLSULFOXIDE
Determination of Trace Quantities of Dimethylsulfoxide in Aqueous Solutions,
W82-00205 5A

DINKEY CREEK PROJECT
Final Environmental Impact Statement; Dinkey Creek Project No. 2890 - California.
W82-00352 6G

DISINFECTION
The Consultant's Viewpoint on Alternative Disinfectants,
W82-00286 6A

The Effect of Bentonite Clay on Ozone Disinfection of Bacteria and Viruses in Water,
W82-00292 5F

High-Level Ozone Disinfection of Municipal Wastewater Effluents,
W82-00379 5D

High pH Treatment of Combined Water Softening and Wastewater Sludges,
W82-00403 5D

Ozone Treatment of Potable Water--Part 2,
W82-00452 5F

DISSOLVED OXYGEN
Biological Consequences of Treating a Lake with Hydrogen Peroxide on the Plankton Biocenosis (Biologiques Du Traitement D'Un Lac Avec Du Peroxyde D'Hydrogene Sur La Biocenose Planctonique),
W82-00305 2H

DISTRIBUTION PATTERNS
Occurrence of Aphanomyces Ovidestruens, a Fungus Parasitic on Copepods, in Two Eutrophic Lakes,
W82-00304 2H

Distribution of Clostridium Botulinum,
W82-00349 5A

DISTRICT OF COLUMBIA
Isolation, Enumeration, and Characterization of Aeromonas from Polluted Waters Encountered in Diving Operations,
W82-00224 5C

DIURON
Reduced Transpiration and Increased Water Efficiency by Diuron in Corn (Zea Mays),
W82-00196 2D

DIVERSION
A Successful Transfer,
W82-00309 4A

DIVERSION DAMS
Hydraulic Sediment Model Study for Proposed Blanco Diversion Dam Modification,
W82-00446 8A

DIVERSITY INDICES
The Influence of Stream Order and Selected Stream Bed Parameters on Fish Diversity in

DIVERSITY INDICES

Raystown Branch, Susquehanna River Drainage, Pennsylvania,
W82-00109 2E

DOMESTIC WASTES
Final Environmental Impact Statement for Proposed Sewerage Facilities in the Marion County Lake Improvement District, Marion County, Kansas.
W82-00355 6G

DRAINAGE
Effect of Agricultural Land Development on Drainage Waters in the North Carolina Tidewater Region,
W82-00094 5B

DRAINAGE AREAS
Mudflows Resulting From the May 18, 1980, Eruption of Mount St. Helens, Washington,
W82-00003 5B

DRAINAGE BASINS
Basin Management in the San Bernardino Basin Area,
W82-00280 6A

DRAINAGE SYSTEMS
A Qualitative Appraisal of the Hydrology of the Yemen Arab Republic from Landsat Images,
W82-00022 7B

DRAWDOWN
Predicted Effects on Ground Water of Construction of Divide Cut Section, Tennessee-Tombigbee Waterway, Northeastern Mississippi Using a Digital Model,
W82-00428 2F

DREDGING
Development of Bioassay Procedures for Defining Pollution of Harbor Sediments,
W82-00387 5C

DRILLING FLUIDS
Land Restoration Following Oil-Well Drilling,
W82-00057 5D

DRINKING WATER
A/C Pipe - Assessment or Advocacy,
W82-00070 5F

An Alternative Solution to the THM Problem,
W82-00072 5F

Bacterial Contamination of Drinking Water Supplies in a Modern Rural Neighborhood,
W82-00198 5A

Transformation of the Mouse Clonal Cell Line R846-DP8 by Mississippi River, Raw, and Finished Water Samples from Southeastern Louisiana,
W82-00215 5C

Staphylococcus Aureus in Rural Drinking Water,
W82-00223 5B

Temporal Variations in Trihalomethane Content of Drinking Water,
W82-00255 5A

Identification of Organic Compounds in a Mutagenic Extract of a Surface Drinking Water by a Computerized Gas Chromatography/Mass Spectrometry System (GC/MS/COM),
W82-00256 5A

Concentration and Size of Asbestos in Water Supplies,
W82-00262 5B

Hygiene of Drinking Water in Developing Countries,
W82-00269 5F

Concentration of Seeded Simian Rotavirus SA-11 from Potable Waters by Using Talc-Celite Layers and Hydroextraction,
W82-00272 5A

A 13-Month Survey of Nematodes at Three Water Treatment Plants in Southern Ontario, Canada,
W82-00294 5F

Nitrosamines in Tap Water After Concentration by a Carbonaceous Adsorbent,
W82-00459 5A

Chlorinated Drinking Water,
W82-00467 5F

DROUGHT
Northeastern New Jersey Grapples With a Drought,
W82-00289 8A

EARTH DAMS
A Laboratory Model for Under-Water Construction of a Dam,
W82-00347 8D

EARTHWORM FEEDING
Engineering Assessment of Vermicomposting Municipal Wastewater Sludges,
W82-00385 5E

ECOLOGICAL EFFECTS
Effects of the Mount St. Helens Eruption on the Benthic Fauna of the Toutle River, Muddy River, and Pine Creek Drainage Basins, Washington,
W82-00005 5C

Power Plant Water Intake Assessment,
W82-00216 6G

ECONOMIC ASPECTS
Conflicts and Barriers Working Group Report.
W82-00031 6E

Worthless, Valuable, or What. An Appraisal of Wetlands,
W82-00177 6B

Executive Summary, Legal Obstacles and Incentives to Small-Scale Hydroelectric Development in the Six Middle Atlantic States.
W82-00448 6E

Summary of the Midwest Conference on Small-Scale Hydropower in the Midwest: An Old Technology Whose Time Has Come.
W82-00449 6E

ECONOMIC FEASIBILITY
Water Resources Appraisal for Hydroelectric Licensing: Skagit River Basin, Washington.
W82-00368 6D

Water Resources Appraisal for Hydroelectric Licensing: Little Tennessee River Basin, Tennessee, North Carolina, and Georgia.
W82-00372 6B

Water Resources Appraisal for Hydroelectric Licensing: Pit River Basin, California.
W82-00373 6B

Water Resources Appraisal for Hydroelectric Licensing: Clark Fork-Pend Oreille River Basin, Montana, Idaho, Washington.
W82-00374 6B

ECONOMIC IMPACT
Report of Survey of Corps of Engineers Construction Workforce,
W82-00102 6B

ECONOMICS
Ground Water Alternatives and Solutions,
W82-00029 6D

ECOSYSTEMS
Effects of the Mount St. Helens Eruption on the Benthic Fauna of the Toutle River, Muddy River, and Pine Creek Drainage Basins, Washington,
W82-00005 5C

Behavior of Trifluralin in Aquatic Model Ecosystems,
W82-00233 5C

EFFLUENT STANDARDS
Graphical Effluent Quality Control for Compliance Monitoring: What Is a Violation,
W82-00261 5G

Determination of Marine Consent Conditions,
W82-00323 5G

EFFLUENTS
Organic Micropollution Indices of Effluents and Renovated Waters,
W82-00123 5A

Projected Tile Effluent Effects on the Oldman River,
W82-00333 5C

Methods for Level 2 Analysis by Organic Compound Category,
W82-00384 5A

ELECTRIC POWER PRODUCTION
Optimization of Pump Turbines,
W82-00181 8C

Water Resources Appraisal for Hydroelectric Licensing: Skagit River Basin, Washington.
W82-00368 6D

Water Resources Appraisal for Hydroelectric Licensing: Lewis River Basin, Washington.
W82-00370 6B

Water Resources Appraisal for Hydroelectric Licensing: Elwha River Basin, Washington.
W82-00371 6B

Water Resources Appraisal for Hydroelectric Licensing: Little Tennessee River Basin, Tennessee, North Carolina, and Georgia.
W82-00372 6B

Water Resources Appraisal for Hydroelectric Licensing: Pit River Basin, California.
W82-00373 6B

Water Resources Appraisal for Hydroelectric Licensing: Clark Fork-Pend Oreille River Basin, Montana, Idaho, Washington.
W82-00374 6B

ELECTROPLATING
Electroplating Wastewater Sludge Characterization,
W82-00095 5E

ELWHA RIVER BASIN
Water Resources Appraisal for Hydroelectric Licensing: Elwha River Basin, Washington.
W82-00371 6B

EMBANKMENTS
Estimating End-Of-Construction Pore-Pressures in Unsaturated Earth Embankments,
W82-00194 8D

EMPLOYMENT
Report of Survey of Corps of Engineers Construction Workforce,
W82-00102 6B

ENGINEERING PERSONNEL
Report of Survey of Corps of Engineers Construction Workforce,
W82-00102 6B

ENGINEERING STRUCTURES
Floating Breakwater,
W82-00067 8A

ENTERIC BACTERIA
Enteric Bacterial Concentrations in Reservoir Feeder Streams: Baseflow Characteristics and Response to Hydrograph Events,
W82-00462 5B

Response of Bacteria in Wastewater Sludge to Moisture Loss by Evaporation and Effect of Moisture Content on Bacterial Inactivation by Ionizing Radiation,
W82-00489 5D

Effects of Moisture Content on Long-Term Survival and Regrowth of Bacteria in Wastewater Sludge,
W82-00493 5E

ENTEROVIRUSES
Thermostabilization of Enteroviruses by Estuarine Sediment,
W82-00263 2L

Survival of Enteroviruses in Rapid-Infiltration Basins During the Land Application of Wastewater,
W82-00496 5D

ENVIRONMENTAL EFFECTS
Mount St. Helens Volcanic-Ash Fall in the Bull Run Watershed, Oregon, March-June 1980,
W82-00002 5B

Conflicts and Barriers Working Group Report.
W82-00031 6E

Water Quality Issues and Energy Assessments,
W82-00036 6B

Domestic Water Supplies for Power Plant Cooling,
W82-00180 6D

Power Plant Water Intake Assessment,
W82-00216 6G

Impact of Construction of a Hydroelectric Project on the Water Quality of Five Lakes in Nova Scotia,
W82-00227 5C

The Significance of the Submarine Geology of Upper Spencer Gulf, South Australia, to Environmental Decision-Making,
W82-00314 2L

Final Environmental Impact Statement; Terror Lake Project No. 2743 - Alaska.
W82-00353 6G

Human Use in a Dispersed Recreation Area and its Effect on Water Quality,
W82-00393 5B

Rocky Mountain Pipeline Project: Environmental Impact Statement,
W82-00394 5G

Longitudinal Succession in Impact Assessment of River System Fish Communities,
W82-00399 5C

ENVIRONMENTAL IMPACT STATEMENT
Geographic Information Systems and Environmental Impact Assessment,
W82-00338 7C

Final Environmental Impact Statement; Dinkey Creek Project No. 2890 - California.
W82-00352 6G

Final Environmental Impact Statement; Terror Lake Project No. 2743 - Alaska.
W82-00353 6G

Final Environmental Impact Statement; Tyee Lake Project FERC No. 3015 - Alaska.
W82-00354 6G

Final Environmental Impact Statement for Proposed Sewerage Facilities in the Marion County Lake Improvement District, Marion County, Kansas.
W82-00355 6G

Final Environmental Impact Statement, City of Portage Wastewater System, Columbia County, Wisconsin.
W82-00356 6G

Final Environmental Impact Statement for Wastewater Treatment Facilities; City of Olathe, Johnson County, Kansas.
W82-00357 5D

Final Environmental Impact Statement; Bemidji Wastewater Treatment System, Beltrami County, Minnesota.
W82-00358 5D

Final Environmental Impact Statement; Wastewater Treatment Facilities, South Shore Lake Tahoe Basin.
W82-00359 5D

Final Environmental Impact Statement; Sludge Disposal and Land Reclamation in Fulton County, Illinois.
W82-00360 5E

Final Environmental Impact Statement; Rehabilitation of Wastewater Facilities, Streator, Illinois.
W82-00361 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 1: Crystal Lake Area Sewage Disposal Authority, Benzie County, Michigan.
W82-00362 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 2: The Green Lake Sanitary Sewer and Waste District, Kandiyohi County, Minnesota.
W82-00363 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 3: Springvale-Bear Creek Sewage Disposal Authority, Emmet County, Michigan.
W82-00364 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 4: Steuben Lakes Regional Waste District, Steuben County, Indiana.
W82-00365 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 5: Otter Tail County Board of Commissioners, Otter Tail County, Minnesota.
W82-00366 5D

Final Environmental Impact Statement; South Fork American River Development, Upper Mountain Project No. 2761 - California.
W82-00367 6G

Final Environmental Impact Statement; South Tahoe Public Utility District and Douglas County Sewer Improvement District No. 1, Appendix B: Mitigation Program.
W82-00369 6G

Rocky Mountain Pipeline Project: Environmental Impact Statement,
W82-00394 5G

ENVIRONMENTAL PROTECTION
Final Environmental Impact Statement; South Tahoe Public Utility District and Douglas County Sewer Improvement District No. 1, Appendix B: Mitigation Program.
W82-00369 6G

EROSION
Impact of Construction of a Hydroelectric Project on the Water Quality of Five Lakes in Nova Scotia,
W82-00227 5C

EROSION CONTROL
Performance of Granular Soil Covers on Canals,
W82-00047 8D

Terrace Planning Criteria for Runoff Control for Deep Loess Soil,
W82-00144 4D

Protecting Agriculture's Natural Resource Base,
W82-00176 4D

Rocky Mountain Pipeline Project: Environmental Impact Statement,
W82-00394 5G

Effects of Small Amounts of Residue on Furrow Erosion,
W82-00470 2J

ESCHERICHIA COLI
Membrane Filter Method for Enumerating Escherichia Coli,
W82-00487 5A

ESTUARIES
Neap-Spring Tide Sequences of Intertidal Shoal Deposits in a Mesotidal Estuary,
W82-00112 2L

Influence of Estuarine Sediment on Virus Survival Under Field Conditions,
W82-00199 5A

Lethality of a Suspended Clay to a Diverse Selection of Marine and Estuarine Macrofauna,
W82-00268 5C

The Abundance of Estuarine Larval and Juvenile Fish in a South Carolina Intertidal Creek,
W82-00276 2L

ESTUARINE ENVIRONMENT
Assessment of 1978 Water Quality Conditions in the Upper Potomac Estuary,
W82-00052 5C

Trace Metal Geochemistry in Sediments from the Miramichi Estuary, New Brunswick,
W82-00236 5A

Effect of Estuarine Sediment pH and Oxidation-Reduction Potential on Microbial Hydrocarbon Degradation,
W82-00243 2L

Thermostabilization of Enteroviruses by Estuarine Sediment,
W82-00263 2L

Effects of Halogenated Organic Compounds on Photosynthesis in Estuarine Phytoplankton,
W82-00266 5C

Effect of Solar Radiation and Predacious Microorganisms on Survival of Fecal and Other Bacteria,
W82-00491 2L

LIBRARY U. OF ILLINOIS-CHAMPAIGN

EUTROPHIC LAKES
Occurrence of Aphanomyces Ovidestruens, a Fungus Parasitic on Copepods, in Two Eutrophic Lakes,
W82-00304 2H

Reduction of Sulfur Compounds in the Sediments of a Eutrophic Lake Basin,
W82-00488 2H

EUTROPHICATION
Modeling Phosphorus Loading and Lake Response Under Uncertainty: A Manual and Compilation of Export Coefficients.
W82-00039 5B

Nitrogen Fixation and the Nitrogen Budget of a Eutrophic Impoundment,
W82-00127 2H

Experimental Studies on the Effect of Arsenic on Microbial Degradation of Organic Matter and Algal Growth,
W82-00237 2H

EVAPOTRANSPIRATION
A Proposed Technique to Measure Evapotranspiration Using Micrometeorological Methods,
W82-00183 2D

Field Test of an Irrigation Scheduling Computer Model,
W82-00184 3F

EVOLUTION
Geomorphic and Hydraulic Evolution of Tidal Creeks on a Subsiding Beach Ridge Plain, North Inlet, S.C.,
W82-00150 2L

EXPERIMENTAL DESIGN
Sediment Trap Dynamics and Calibration: A Laboratory Evaluation,
W82-00104 7B

EXPERIMENTAL FARMS
Effect of Crop Residue on Soil Loss from Continuous Row Cropping,
W82-00145 2J

FALLOUT
Dispersal of Aspergillus Fumigatus from Sewage Sludge Compost Piles Subjected to Mechanical Agitation in Open Air,
W82-00273 5E

FATE OF POLLUTANTS
Distribution and Balance of Volatile Halogenated Hydrocarbons in the Water and Air of Covered Swimming Pools Using Chlorine for Water Disinfection,
W82-00128 5F

FATTY ACIDS
Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aquatic Environments. II. Features of Fatty Acids for Polluted and Unpolluted Waters,
W82-00454 5A

FAUNA
Lethality of a Suspended Clay to a Diverse Selection of Marine and Estuarine Macrofauna,
W82-00268 5C

FEDERAL JURISDICTION
Summary of the New England Conference on Legal and Institutional Incentives to Small-Scale Hydroelectric Development, January 30-31, 1979, Boston, Massachusetts.
W82-00447 6E

Water Regulations,
W82-00482 6E

FENITROTHION
Hydrolysis of Fenitrothion in Model and Natural Aquatic Systems,
W82-00157 5B

Fenitrothion Sprayed on a Pond: Kinetics of Its Distribution and Transformation in Water and Sediment,
W82-00159 5B

FENS
Vegetation and Nutrient Status of Northern Michigan Bogs and Conifer Swamps with a Comparison to Fens,
W82-00484 2I

FERTILIZERS
Coastal Bermudagrass Yield and Soil Properties as Affected by Surface-Applied Dairy Manure and Its Residue,
W82-00195 3C

Does Salt Marsh Fertilization Enhance Shellfish Production. An Application of Flow Analysis,
W82-00259 2L

The Conservative Effect of Rainfall Variation on Fertiliser Response in a Humid Environment,
W82-00316 2A

FILTERS
Concentration of Coliphages from Large Volumes of Water and Wastewater,
W82-00247 5A

Continuous Bioregeneration of Granular Activated Carbon During the Anaerobic Degradation of Catechol,
W82-00408 5D

FILTRATION
Concentration of Poliovirus in Water by Molecular Filtration,
W82-00246 5A

Upflow Water Filtration Unit, Test Results,
W82-00407 5F

Application of a Multiple Alginate Filter Method for the Determination of Water Viruses Concentration (Conception D'Une Membrane Filtrante a Base D'Alginate Pour La Concentration Des Virus Hydriques),
W82-00458 5A

FINANCING
A 201 Pollution Control Planning Tragedy,
W82-00285 6E

FISH
Relationship Between Biotransformation and the Toxicity and Fate of Xenobiotic Chemicals in Fish,
W82-00186 5C

Evaluation of Methodologies for the Determination of Acute Toxicity in Pulp and Paper Effluents,
W82-00297 5A

Clinical Tests in Aquatic Toxicology: State of the Art,
W82-00464 5A

FISH PONDS
The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 2: Studies of the Fish Ponds,
W82-00456 3C

The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 3: Maize Cultivation Experiment, Bacteriological Studies, and Economic Assessment,
W82-00457 3C

FISH POPULATIONS
The Influence of Stream Order and Selected Stream Bed Parameters on Fish Diversity in Raystown Branch, Susquehanna River Drainage, Pennsylvania,
W82-00109 2E

The Abundance of Estuarine Larval and Juvenile Fish in a South Carolina Intertidal Creek,
W82-00276 2L

Natural Variation in Abundance of Salmonid Populations in Streams and its Implications for Design of Impact Studies,
W82-00389 5C

Longitudinal Succession in Impact Assessment of River System Fish Communities,
W82-00399 5C

FISHERIES
The Valuation of Recreational Fisheries,
W82-00348 6C

FLOCCULATION
Dewatering of Industrial Clay Wastes,
W82-00041 5D

A Realistic Assessment of the Effect of Settlement on Sewage,
W82-00324 5D

Testing the Flocculation/Coagulation of Wastewater by Granulometric Analysis of Suspended Solids in the Water Using a Laser Diffraction Meter,
W82-00463 5D

FLOOD CONTROL
Channel Conditions in the Lower Toutle and Cowlitz Rivers Resulting From the Mudflows of May 18, 1980,
W82-00004 5B

Review of Reports for Flood Control; Westchester County Streams, New York.
W82-00103 4A

Water Resources Appraisal for Hydroelectric Licensing: Skagit River Basin, Washington.
W82-00368 6D

Water Resources Appraisal for Hydroelectric Licensing: Lewis River Basin, Washington.
W82-00370 6B

Water Resources Appraisal for Hydroelectric Licensing: Pit River Basin, California.
W82-00373 6B

FLOOD DAMAGE
Review of Reports for Flood Control; Westchester County Streams, New York.
W82-00103 4A

FLOOD DATA
Flood Data for the Sacramento River and Butte Basin 1875 to 1978, Sacramento Valley, California,
W82-00019 2E

FLOOD FORECASTING
Predicting Lake Levels by Exponential Smoothing,
W82-00118 2A

Flood Forecast and Warning System Evaluation, Susquehanna River Basin, New York, Pennsylvania and Maryland.
W82-00351 6F

FLOOD IRRIGATION
Effects of Water Regime on Growth, Yield, and Nitrogen Uptake of Rice,
W82-00330 2I

FLOOD PLAINS
Deposition of Riverborne Organic Carbon in Floodplain Wetlands and Deltas,
W82-00034 2J

FLOOD PROFILES
Flood Data for the Sacramento River and Butte Basin 1875 to 1978, Sacramento Valley, California,
W82-00019 2E

FLOOD PROTECTION
Flood Forecast and Warning System Evaluation, Susquehanna River Basin, New York, Pennsylvania and Maryland.
W82-00351 6F

FLOOD STAGES
Flood Data for the Sacramento River and Butte Basin 1875 to 1978, Sacramento Valley, California,
W82-00019 2E

FLOODING
Historical Nile Floods and Their Implications for Climatic Change,
W82-00326 2E

FLOODWATER
Channel Conditions in the Lower Toutle and Cowlitz Rivers Resulting From the Mudflows of May 18, 1980,
W82-00004 5B

Effect of Microcrustaceans on Blue-Green Algae in Flooded Soil,
W82-00146 6G

FLORIDA
Chemical, Physical, and Radiological Quality of Selected Public Water Supplies in Florida, February-April 1980,
W82-00010 5F

Potentiometric Surface of the Floridan Aquifer in the Suwannee River Water Management District, Florida, May 1980,
W82-00024 7C

Potentiometric Surface of the Floridan Aquifer in the Northwest Florida Water Management District, May 1980,
W82-00025 7C

Chemistry of Precipitation at Gainesville, Florida,
W82-00185 2K

A 201 Pollution Control Planning Tragedy,
W82-00285 6E

Altitude of Water Table, Biscayne Aquifer, Dade County, Florida, May 1980,
W82-00409 7C

Altitude of Water Table, Biscayne Aquifer, Dade County, Florida, October 1979,
W82-00410 7C

Altitude of Water Table, Biscayne Aquifer, Dade County, Florida, March 1979,
W82-00411 7C

Hydrogeologic Data for Rocky Creek Landfill and Adjacent Area, Northwest Hillsborough County, Florida, 1969-73,
W82-00417 5B

Summary of U.S. Geological Survey Investigations and Hydrologic Conditions in Southwest Florida for 1979,
W82-00419 10C

Hydrogeologic Data from Test Drilling near Verna Beach, Florida, 1978,
W82-00424 2F

Index to Active Hydrologic Data Collection Sites in Florida, 1980-81,
W82-00425 7C

Effects of Sewage Effluent Application on Litter Fall and Litter Decomposition in Cypress Swamps,
W82-00499 5E

FLOTATION
Pilot Scales Tests on the Flotation of Abattoir Wastes by Deep U Tubes,
W82-00322 5D

FLOW
Does Salt Marsh Fertilization Enhance Shellfish Production. An Application of Flow Analysis,
W82-00259 2L

Ground-Water Flow and Uranium in Colorado Plateau,
W82-00282 2F

FLOW CHARACTERISTICS
Unsaturated Water Flow Through a Simulated Wheel Track,
W82-00473 2G

FLOW DISCHARGE
Areal Predictions of Water and Solute Flux in the Unsaturated Zone,
W82-00381 6A

FLOW DURATION
Use of Flow-Duration Curves to Evaluate Effects of Urbanization on Streamflow Patterns on Long Island, New York,
W82-00416 4C

FLOW PATTERN
Areal Predictions of Water and Solute Flux in the Unsaturated Zone,
W82-00381 6A

FLOW RESISTANCE
Flow Resistance in Vegetated Waterways,
W82-00152 2E

FLUID FLOW
Transient Soil Moisture Movement Through Layered Soils Using a Finite Element Approach,
W82-00133 2G

FLUMES
Field Assessment of Sediment Traps,
W82-00105 7B

Measuring Flumes of Simplified Construction,
W82-00140 7B

FLUORIDATION
Fluoridation System,
W82-00061 5F

FOAM SEPARATION
Foam Control in Aeration Tanks,
W82-00171 5D

FOAMING
Foam Control in Aeration Tanks,
W82-00171 5D

FOOD HABITS
Seasonal Particle-Size Selection by Diaptomus Sicilis in Offshore Lake Michigan,
W82-00485 2H

FOOD PROCESSING INDUSTRY
Gerber Saves 465,000 Gallons of Water/Day,
W82-00187 3E

Assimilation of Lemonade-Processing Wastewater by Yeasts,
W82-00204 5D

Treatment of Potato-Processing Waste Water by an Anaerobic Lagoon-Filter System,
W82-00226 5D

FOOD PROCESSING WASTES
Odorous Compounds from Potato Processing Waste Effluent Irrigation Fields: Volatile Acids,
W82-00156 5E

Design, Evaluation and Effluent Water Quality Analysis of Three Oyster Shellstock Washers,
W82-00406 5D

FORECASTING
Predicted Effects on Ground Water of Construction of Divide Cut Section, Tennessee-Tombigbee Waterway, Northeastern Mississippi Using a Digital Model,
W82-00428 2F

FOREIGN RESEARCH
A Qualitative Appraisal of the Hydrology of the Yemen Arab Republic from Landsat Images,
W82-00022 7B

FOREST SOILS
Slash Treatment After Clearcutting Lodgepole Pine Affects Nutrients in Soil Water,
W82-00130 4C

FRANCE
Biological Consequences of Treating a Lake with Hydrogen Peroxide on the Plankton Biocenosis (Biologiques Du Traitement D'Un Lac Avec Du Peroxyde D'Hydrogene Sur La Biocenose Planctonique),
W82-00305 2H

FROGS
Tadpoles as Indicators of Harmful Levels of Pollution in the Field,
W82-00478 5A

FRUIT CROPS
Performance of Bearing Cherry and Prune Trees Under Very Low Irrigation Rates,
W82-00119 3F

FUEL
Water Quality Issues and Energy Assessments,
W82-00036 6B

Refuse-To-Energy Wastewater Treatment,
W82-00168 5D

Water-Related Environmental Control Requirements of Waste-to-Energy Conversion,
W82-00443 5D

FULTON COUNTY
Final Environmental Impact Statement; Sludge Disposal and Land Reclamation in Fulton County, Illinois.
W82-00360 5E

FUNGI
Dispersal of Aspergillus Fumigatus from Sewage Sludge Compost Piles Subjected to Mechanical Agitation in Open Air,
W82-00273 5E

FURROW IRRIGATION
Optimal Design of Furrow Irrigation Systems,
W82-00138 3F

Furrow Irrigation Practices in Northern Colorado,
W82-00139 3F

GAS CHROMATOGRAPHY
Gas Chromatographic Determination of Selenium (-II, O), -(IV), and -(VI) in Natural Waters,
W82-00257 5A

GAS LIQUID CHROMATOGRAPHY
Determination of Aminocarb in Water by High Performance Liquid Chromatography,
W82-00232 5A

GEOCHEMISTRY
Ground-Water Flow and Uranium in Colorado Plateau,
W82-00282 2F

GEOHYDROLOGY
Supply Working Group Report.
W82-00030 6D

Possibilities of Using Helium and Tritium Surveys for Studying Recharge Conditions of Subsurface Waters,
W82-00302 7B

Digital Model of the Unconsolidated Aquifer System in the Modesto Area, Stanislaus and San Joaquin Counties, California,
W82-00415 4B

Hydrogeologic Data for Rocky Creek Landfill and Adjacent Area, Northwest Hillsborough County, Florida, 1969-73,
W82-00417 5B

Hydrogeologic Data from Test Drilling near Verna Beach, Florida, 1978,
W82-00424 2F

GEOLOGICAL SURVEY PROJECTS
Summary of U.S. Geological Survey Investigations and Hydrologic Conditions in Southwest Florida for 1979,
W82-00419 10C

GEOLOGY
Water Resources of the Santa Ysabel and Mesa Grande Indian Reservations, San Diego County, California,
W82-00021 7C

GEOTHERMAL RESOURCES
State-of-the-Art of Liquid Waste Disposal for Geothermal Energy Systems: 1979,
W82-00375 5E

GLACIERS
Effects of Volcanism on the Glaciers of Mount St. Helens,
W82-00007 2C

Shallow Core Snow Chemistry of Athabasca Glacier, Alberta,
W82-00320 2C

GOVERNMENTAL INTERRELATIONS
A 201 Pollution Control Planning Tragedy,
W82-00285 6E

GRASSES
Coastal Bermudagrass Yield and Soil Properties as Affected by Surface-Applied Dairy Manure and Its Residue,
W82-00195 3C

GRAVITY FILTERS
Management and Design Implications of a Mathematical Model of a Rapid Gravity Sand Filter Backwash,
W82-00460 5D

GREAT BRITAIN
Cutting the Water Losses,
W82-00310 5F

Engineering Research and the Water Industry,
W82-00313 8A

GREECE
Greece Won't Be Letting Wastewater Problems Slide.
W82-00182 5D

GREEN LAKE
Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 2: The Green Lake Sanitary Sewer and Waste District, Kandiyohi County, Minnesota.
W82-00363 5D

GROUND WATER
Selective Overburden Placement,
W82-00053 5G

GROUNDWATER
Water Resources Investigations in New York--1980.
W82-00011 7C

January 1980 Water Levels, and Data Related to Water-level Changes, Western and South-Central Kansas,
W82-00016 2F

Evaluation of Ground-Water Monitoring Network, Santa Cruz County, California,
W82-00023 7A

Water Resources Data for New Hampshire and Vermont, Water Year 1980.
W82-00076 7C

Water Resources Data for West Virginia, Water Year 1980.
W82-00077 7C

Water Resources Data for Kansas, Water Year 1980--Volume 1. Missouri River Basin.
W82-00078 7C

Water Resources Data for Kansas, Water Year 1980--Volume 2. Arkansas River Basin.
W82-00079 7C

A 10-Year Plan to Study the Aquifer System of Indian Wells Valley, California,
W82-00086 6D

Water-Resources Investigations of the U.S. Geological Survey in Wyoming, Fiscal Year 1980,
W82-00087 7C

Water-Resources Investigations of the U.S. Geological Survey in Colorado--Fiscal Year 1981.
W82-00088 7C

Geologic, Hydrologic and Chemical Data From Test Wells in the Dickson Area, Tennessee,
W82-00090 7C

A Comparison of Nitrogen in Shallow Ground Water from Sewered and Unsewered Areas, Nassau County, New York, from 1952 Through 1976,
W82-00277 5B

Hydraulic Properties of Coal and Related Materials, Northern Great Plains,
W82-00278 2F

An Evaluation of Sources of Nitrogen as Causes of Ground-Water Contamination in Nassau County, Long Island,
W82-00279 5B

Ground-Water Modeling: Recent Developments,
W82-00281 2F

Ground-Water Flow and Uranium in Colorado Plateau,
W82-00282 2F

Garrett County Water-Well Records, Chemical-Quality Data Ground-Water Use, Coal Test-Hole Data and Surface-Water Data.
W82-00395 2F

Water in the Elizabethtown Area - A Study of Limestone Terrane in North-Central Kentucky,
W82-00413 5B

Index to Active Hydrologic Data Collection Sites in Florida, 1980-81,
W82-00425 7C

Proposed Observation-Well Networks and Ground-Water Level Program for North Carolina,
W82-00426 4B

Predicted Effects on Ground Water of Construction of Divide Cut Section, Tennessee-Tombigbee Waterway, Northeastern Mississippi Using a Digital Model,
W82-00428 2F

GROUNDWATER AVAILABILITY
Groundwater Availability in Acadia National Park and Vicinity, Hancock and Knox Counties, Maine,
W82-00017 2F

Ground Water Availability,
W82-00027 6D

Alternatives Working Group Report.
W82-00032 6B

Digital Model of the Unconsolidated Aquifer System in the Modesto Area, Stanislaus and San Joaquin Counties, California,
W82-00415 4B

GROUNDWATER MANAGEMENT
An Observation-Well Network Concept as Applied to North Carolina,
W82-00414 4B

GROUNDWATER MOVEMENT
Computer Modeling of Fluid Flow During Production and Environmental Restoration Phases of In Situ Uranium Leaching,
W82-00043 6A

Ground-Water Resources of the White River Basin, Madison County, Indiana,
W82-00412 2A

GROUNDWATER POLLUTION
Strategy for Radioactive Waste Disposal in Crystalline Rocks,
W82-00299 5E

Preliminary Evaluation of Ground-Water Contamination by Coal-Tar Derivatives, St. Louis Park Area, Minnesota,
W82-00430 5B

GROUNDWATER POTENTIAL
Ground Water Conflicts and Barriers,
W82-00028 6E

Ground Water Alternatives and Solutions,
W82-00029 6D

Supply Working Group Report.
W82-00030 6D

Conflicts and Barriers Working Group Report.
W82-00031 6E

Alternatives Working Group Report.
W82-00032 6B

Ground-Water Resources of the White River Basin, Madison County, Indiana,
W82-00412 2A

GROUNDWATER RECHARGE
Possibilities of Using Helium and Tritium Surveys for Studying Recharge Conditions of Subsurface Waters,
W82-00302 7B

GROUNDWATER RESOURCES
Ground-Water Data for Michigan, 1979,
W82-00014 2F

GROWTH
SOYROOT - A Dynamic Model of Soybean Root Growth and Water Uptake,
W82-00114 2I

The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 2: Studies of the Fish Ponds,
W82-00456 3C

GULLY EROSION
Gully Development in the Deep Loess Hills Region of Central Missouri,
W82-00472 2J

GYPSUM
Effects of Tillage and Gypsum Incorporation on Rain Runoff and Crust Strength in Field Soils Irrigated With Saline-Sodic Water,
W82-00327 2A

HALOGENS
Improved Water Management of Coal Conversion Processes by Preliminary Absorption of Halides,
W82-00437 5D

HARBORS
Resonator Studies for Kincardine Harbour, Lake Huron,
W82-00228 8B

HARDNESS (WATER)
Process for Removing Alkalinity and Hardness From Waters,
W82-00063 5F

HEAVY METALS
Distribution and Transport of Heavy Metals in the Sediments of a Small Northern Eutrophic Lake,
W82-00235 5B

Comparative Analysis of Sludge and Refuse Leachate: A Preliminary Report,
W82-00287 5E

Deposition of Heavy Elements on Belgian Agricultural Soils,
W82-00306 5B

Microplate Technique for Determining Accumulation of Metals by Algae,
W82-00492 5A

HERBICIDES
Photolysis of N-Nitrosodi-n-Propylamine in Water,
W82-00164 5B

Reduced Transpiration and Increased Water Efficiency by Diuron in Corn (Zea Mays),
W82-00196 2D

Picloram Dissipation in a Small Southwestern Stream,
W82-00212 5B

HISTORIC FLOODS
Flood Data for the Sacramento River and Butte Basin 1875 to 1978, Sacramento Valley, California,
W82-00019 2E

HOME-OPERATED FILTER SYSTEMS
Upflow Water Filtration Unit, Test Results,
W82-00407 5F

HUDSON RIVER
Polychlorinated Biphenyl Transport in the Hudson River, New York,
W82-00008 5B

Relationship of Water Quality of Hudson River, New York, During Peak Discharges to Geologic Characteristics of Contributing Subbasins,
W82-00009 5B

HUMIC ACIDS
Reactions of Chlorine with Selected Aromatic Models of Aquatic Humic Material,
W82-00254 5F

HYDRAULIC DESIGN
Model Study of a Box-Inlet Chute Spillway and SAF Stilling Basin,
W82-00046 8A

HYDRAULIC GATES
Hydraulic Gates: The State-of-the-Art,
W82-00332 8C

HYDRAULIC GRADIENT
Soil Hydraulic Stability in a Subsurface Drainage System,
W82-00115 2G

HYDRAULIC MACHINERY
Cavitation and Wear on Hydraulic Machines,
W82-00331 8C

HYDRAULIC MODELS
Hydraulic Sediment Model Study for Proposed Blanco Diversion Dam Modification,
W82-00446 8A

HYDRAULIC PROPERTIES
Preliminary Data From a Series of Artificial Recharge Experiments at Stanton, Texas,
W82-00085 7C

Hydraulic Properties of Coal and Related Materials, Northern Great Plains,
W82-00278 2F

HYDROCARBONS
Development of Oil-In-Water Monitor, Phase II,
W82-00100 5A

Effect of Estuarine Sediment pH and Oxidation-Reduction Potential on Microbial Hydrocarbon Degradation,
W82-00243 2L

Alkylpyridines in Surface Waters, Groundwaters, and Subsoils of a Drainage Located Adjacent to an Oil Shale Facility,
W82-00481 5B

HYDRODYNAMICS
Role of Hydrodynamic Factors in Ammonia Desorption by Diffused Aeration,
W82-00293 5D

HYDROELECTRIC PLANTS
Final Environmental Impact Statement; Dinkey Creek Project No. 2890 - California.
W82-00352 6G

Final Environmental Impact Statement; Tyee Lake Project FERC No. 3015 - Alaska.
W82-00354 6G

Final Environmental Impact Statement; South Fork American River Development, Upper Mountain Project No. 2761 - California.
W82-00367 6G

Water Resources Appraisal for Hydroelectric Licensing: Skagit River Basin, Washington.
W82-00368 6D

Water Resources Appraisal for Hydroelectric Licensing: Lewis River Basin, Washington.
W82-00370 6B

Water Resources Appraisal for Hydroelectric Licensing: Elwha River Basin, Washington.
W82-00371 6B

Water Resources Appraisal for Hydroelectric Licensing: Little Tennessee River Basin, Tennessee, North Carolina, and Georgia.
W82-00372 6B

Water Resources Appraisal for Hydroelectric Licensing: Pit River Basin, California.
W82-00373 6B

Water Resources Appraisal for Hydroelectric Licensing: Clark Fork-Pend Oreille River Basin, Montana, Idaho, Washington.
W82-00374 6B

Summary of the Midwest Conference on Small-Scale Hydropower in the Midwest: An Old Technology Whose Time Has Come.
W82-00449 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Kentucky.
W82-00450 6E

HYDROELECTRIC POWER
Small-Scale Hydro in New England: 1960-1976,
W82-00169 6D

A New Era for China's Hydropower,
W82-00335 8A

China's Potential for Hydro Development,
W82-00336 8A

Summary of the New England Conference on Legal and Institutional Incentives to Small-Scale Hydroelectric Development, January 30-31, 1979, Boston, Massachusetts.
W82-00447 6E

Executive Summary, Legal Obstacles and Incentives to Small-Scale Hydroelectric Development in the Six Middle Atlantic States.
W82-00448 6E

HYDROGEN ION CONCENTRATION
Behavior of DDT, Kepone, and Permethrin in Sediment-Water Systems Under Different Oxidation-Reduction and PH Conditions,
W82-00382 5B

High pH Treatment of Combined Water Softening and Wastewater Sludges,
W82-00403 5D

HYDROGEN PEROXIDE
Biological Consequences of Treating a Lake with Hydrogen Peroxide on the Plankton Biocenosis (Biologiques Du Traitement D'Un Lac Avec Du Peroxyde D'Hydrogene Sur La Biocenose Planctonique),
W82-00305 2H

Rapid Growth Forecast for Peroxide.
W82-00345 5D

Measurements of Hydrogen Peroxide in Rainwater,
W82-00497 2K

HYDROGEN SULFIDE
Chemistry of Septicity,
W82-00325 5D

Rapid Growth Forecast for Peroxide.
W82-00345 5D

HYDROGEOLOGY
A Comparison of Nitrogen in Shallow Ground Water from Sewered and Unsewered Areas, Nassau County, New York, from 1952 Through 1976,
W82-00277 5B

An Evaluation of Sources of Nitrogen as Causes of Ground-Water Contamination in Nassau County, Long Island,
W82-00279 5B

Ground-Water Modeling: Recent Developments,
W82-00281 2F

HYDROLOGIC BUDGET
Use of River Waters That Did Not Reach the Aral Sea as a Consequence of Economic Activity During 1961-1975,
W82-00190 4A

HYDROLOGIC CYCLE
Supply Working Group Report.
W82-00030 6D

UNIV. OF ILL. URBANA-CHAMPAIGN

HYDROLOGIC DATA
Water Quality Management Studies, Lake Seminole, April-November 1978.
W82-00051 6G

Premining Hydrologic Conditions of Five Southeastern Ohio Watersheds,
W82-00054 4C

Water Resources Data for New Hampshire and Vermont, Water Year 1980.
W82-00076 7C

Water Resources Data for West Virginia, Water Year 1980.
W82-00077 7C

Water Resources Data for Kansas, Water Year 1980--Volume 1. Missouri River Basin.
W82-00078 7C

Water Resources Data for Kansas, Water Year 1980--Volume 2. Arkansas River Basin.
W82-00079 7C

Water Resources Data for Texas, Water Year 1979--Volume 1. Arkansas River Basin, Red River Basin, Sabine River Basin, Neches River Basin, Trinity River Basin, and Intervening Coastal Basins.
W82-00080 7C

Water Resources Data for Texas, Water Year 1979--Volume 2. San Jacinto River Basin, Brazos River Basin, San Bernard River Basin and Intervening Coastal Basins.
W82-00081 7C

Water Resources Data for Texas, Water Year 1979--Volume 3. Colorado River Basin, Lavaca River Basin, Guadalupe River Basin, Nueces River Basin, Rio Grande Basin, and Intervening Coastal Basin.
W82-00082 7C

Hydrologic Data for Urban Studies in the Austin, Texas Metropolitan Area, 1979,
W82-00083 7C

Quality of Water in Tibbee Creek and Tributaries Near West Point, Mississippi,
W82-00084 5B

Water-Resources Investigations of the U.S. Geological Survey in Wyoming, Fiscal Year 1980,
W82-00087 7C

Directory of Member Organizations of the National Water Data Exchange (NAWDEX),
W82-00089 10D

Geologic, Hydrologic and Chemical Data From Test Wells in the Dickson Area, Tennessee,
W82-00090 7C

Garrett County Water-Well Records, Chemical-Quality Data Ground-Water Use, Coal Test-Hole Data and Surface-Water Data.
W82-00395 2F

National Water Data Exchange (NAWDEX) System 2000 Data Retrieval Manual,
W82-00420 10B

Index to Active Hydrologic Data Collection Sites in Florida, 1980-81,
W82-00425 7C

HYDROLOGIC MODELS
Planning Study to Model and Monitor Coal Pile Run-Off,
W82-00091 6A

The U.S. Geological Survey Coal Hydrology Program and the Potential of Hydrologic Models for Impact Assessments,
W82-00429 6E

HYDROLOGY
Water Resources of the Santa Ysabel and Mesa Grande Indian Reservations, San Diego County, California,
W82-00021 7C

Hydrochemistry of a Dolomite Karst: The Bruce Peninsula of Ontario,
W82-00321 2K

ICE
Effects of Volcanism on the Glaciers of Mount St. Helens,
W82-00007 2C

Ice Problems at a Cooling Water Intake in a Tidal Estuary at Lingan, N.S.,
W82-00230 8A

ICEBERGS
On the Estimation of Antarctic Iceberg Melt Rate,
W82-00166 2C

IDAHO
Radionuclide Concentrations in Streams in the Upper Blackfoot River Basin, Southeastern Idaho,
W82-00418 5A

ILLINOIS
Final Environmental Impact Statement; Rehabilitation of Wastewater Facilities, Streator, Illinois.
W82-00361 5D

IMPAIRED WATER USE
Ground Water Alternatives and Solutions,
W82-00029 6D

The Aftermath at Longview,
W82-00073 5C

Irrigation Tailwater Management,
W82-00392 3C

The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 2: Studies of the Fish Ponds,
W82-00456 3C

The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 3: Maize Cultivation Experiment, Bacteriological Studies, and Economic Assessment,
W82-00457 3C

INDEXING
Index to Active Hydrologic Data Collection Sites in Florida, 1980-81,
W82-00425 7C

INDIA
Virus Removal in Waste Stabilization Ponds in India,
W82-00121 5D

INDIAN RESERVATIONS
Water Resources of the Santa Ysabel and Mesa Grande Indian Reservations, San Diego County, California,
W82-00021 7C

INDIANA
Sediment and Nutrient Movement from the Black Creek Watershed,
W82-00135 5B

Ground-Water Resources of the White River Basin, Madison County, Indiana,
W82-00412 2A

Effects of Surface Mining on Water Quality in a Small Watershed, Sullivan County, Indiana,
W82-00427 5C

The U.S. Geological Survey Coal Hydrology Program and the Potential of Hydrologic Models for Impact Assessments,
W82-00429 6E

INDICATORS
Carbon Isotopes as Indicators of the Source and Fate of Carbon in Rivers and Estuaries,
W82-00033 5B

Chemical Indicators of Organic River Sources in Rivers and Estuaries,
W82-00035 5B

INDOOR SWIMMING POOLS
Distribution and Balance of Volatile Halogenated Hydrocarbons in the Water and Air of Covered Swimming Pools Using Chlorine for Water Disinfection,
W82-00128 5F

INDUSTRIAL WASTE
Sludge Settling Hampered by Industrial Discharge,
W82-00290 5D

INDUSTRIAL WASTES
Dewatering of Industrial Clay Wastes,
W82-00041 5D

Process for Removal of Mercury and Mercury Compounds From Aqueous Solutions and Industrial Waste Liquors,
W82-00058 5D

Apparatus for the Purification of Oily Emulsions, Solutions, and Industrial Waste Waters,
W82-00060 5D

Water and Wastewater Reclamation: An Economical Answer to Industrial Wastes and Pollution,
W82-00188 3E

Determination of Marine Consent Conditions,
W82-00323 5G

Physical/Chemical Treatment of Blast Furnace Wastewaters Using Mobile Pilot Units,
W82-00378 5D

Methods for Level 2 Analysis by Organic Compound Category,
W82-00384 5A

Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aquatic Environments - I. Features of Hydrocarbons for Polluted and Unpolluted Waters,
W82-00453 5B

INDUSTRIAL WASTEWATER
Dewatering Florida Phosphatic Clay Wastes With Moving Screens,
W82-00049 5D

Electroplating Wastewater Sludge Characterization,
W82-00095 5E

Evaluation of the Effectiveness of Granular Activated Carbon Adsorption and Aquaculture for Removing Toxic Compounds From Treated Petroleum Refinery Effluents,
W82-00098 5D

The Analysis of Oil Shale Wastes: A Review,
W82-00388 5A

Slagging Fixed-Bed Gasifier (SFBG) Wastewater Pretreatment,
W82-00433 5D

INDUSTRIAL WATER
Treatment of Florida Surface Waters for Use in Phosphate Beneficiation,
W82-00048 5D

Water Supply and Demand in an Energy Supply Model,
W82-00050 6D

Process for the Removal of Inorganic Salts From a Water Stream,
W82-00055 5F

INFILTRATION
A Comparative Study of Three Forms of the Richard Equation Used for Predicting One-Dimensional Infiltration in Unsaturated Soil,
W82-00328 2G

INFORMATION EXCHANGE
Ground-Water Information: NWWA Provides the Resources,
W82-00301 2F

INFORMATION RETRIEVAL
National Water Data Exchange (NAWDEX) System 2000 Data Retrieval Manual,
W82-00420 10B

INJECTION WELLS
Computer Modeling of Fluid Flow During Production and Environmental Restoration Phases of In Situ Uranium Leaching,
W82-00043 6A

Deep Well Injection of Industrial Wastes,
W82-00475 5E

INSECTICIDES
Hydrolysis of Fenitrothion in Model and Natural Aquatic Systems,
W82-00157 5B

Fenitrothion Sprayed on a Pond: Kinetics of Its Distribution and Transformation in Water and Sediment,
W82-00159 5B

INSTITUTIONAL CONSTRAINTS
Summary of the New England Conference on Legal and Institutional Incentives to Small-Scale Hydroelectric Development, January 30-31, 1979, Boston, Massachusetts.
W82-00447 6E

Summary of the Midwest Conference on Small-Scale Hydropower in the Midwest: An Old Technology Whose Time Has Come.
W82-00449 6E

INSTRUMENTATION
Rainwater Gauge,
W82-00068 2B

INTAKES
Power Plant Water Intake Assessment,
W82-00216 6G

Ice Problems at a Cooling Water Intake in a Tidal Estuary at Lingan, N.S.,
W82-00230 8A

INTERSTATE COMPACTS
Report of the Annual Yield of the Arkansas River Basin for the Arkansas River Basin Compact, Arkansas--Oklahoma, 1980 Water Year,
W82-00012 6E

INTERSTATE RIVERS
Report of the Annual Yield of the Arkansas River Basin for the Arkansas River Basin Compact, Arkansas--Oklahoma, 1980 Water Year,
W82-00012 6E

INTERTIDAL AREAS
Neap-Spring Tide Sequences of Intertidal Shoal Deposits in a Mesotidal Estuary,
W82-00112 2L

Specific Inhibition of Nitrite Oxidation by Chlorate and Its Use in Assessing Nitrification in Soils and Sediments,
W82-00242 2L

ION EXCHANGE
Process for the Removal of Inorganic Salts From a Water Stream,
W82-00055 5F

Modeling Ammonium Exchange and Regeneration on Clinoptilolite,
W82-00125 5D

IRRIGATION
January 1980 Water Levels, and Data Related to Water-level Changes, Western and South-Central Kansas,
W82-00016 2F

Water, Energy and Labor Requirements for Future Pacific Northwest Irrigation,
W82-00143 6A

IRRIGATION EFFECTS
Effect of Irrigation and Tree Density on Peach Production,
W82-00120 2I

Effects of Tillage and Gypsum Incorporation on Rain Runoff and Crust Strength in Field Soils Irrigated With Saline-Sodic Water,
W82-00327 2A

IRRIGATION EFFICIENCY
Optimal Design of Furrow Irrigation Systems,
W82-00138 3F

IRRIGATION PRACTICES
Furrow Irrigation Practices in Northern Colorado,
W82-00139 3F

IRRIGATION REQUIREMENTS
Performance of Bearing Cherry and Prune Trees Under Very Low Irrigation Rates,
W82-00119 3F

Field Test of an Irrigation Scheduling Computer Model,
W82-00184 3F

IRRIGATION-RETURN FLOW
Irrigation Tailwater Management,
W82-00392 3C

IRRIGATION SYSTEMS
Water Application Uniformity of Hose Towed Traveler Irrigators,
W82-00296 3F

IRRIGATION WATER
Irrigation Tailwater Management,
W82-00392 3C

ISOLATION
Technique for Determining Total Bacterial Virus Counts in Complex Aqueous Systems,
W82-00222 5A

ISOTOPE STUDIES
Natural Abundances of 15N as a Source Indicator for Near-Shore Marine Sedimentary and Dissolved Nitrogen,
W82-00283 5B

ISOTOPIC TRACERS
Characterisation of Domestic and Industrial Sewage in Southern California Coastal Sediments Using Nitrogen, Carbon, Sulphur, and Uranium Tracers,
W82-00147 5B

ISRAEL
Ames' Mutagenic Activity in Recycled Water from an Israeli Water Reclamation Project,
W82-00234 5D

JAPAN
Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aquatic Environments - I. Features of Hydrocarbons for Polluted and Unpolluted Waters,
W82-00453 5B

JUDICIAL DECISIONS
Legal Aspects of Subsidence Due to Well Pumping,
W82-00170 6E

JUVENILE FISH
The Abundance of Estuarine Larval and Juvenile Fish in a South Carolina Intertidal Creek,
W82-00276 2L

KANSAS
January 1980 Water Levels, and Data Related to Water-level Changes, Western and South-Central Kansas,
W82-00016 2F

Water Resources Data for Kansas, Water Year 1980--Volume 1. Missouri River Basin.
W82-00078 7C

Water Resources Data for Kansas, Water Year 1980--Volume 2. Arkansas River Basin.
W82-00079 7C

KAOLIN
Effect of Kaolin Concentration on Distribution Coefficient of Copper,
W82-00153 5B

Effect of Cations on Copper Adsorption by Kaolin,
W82-00172 2K

KAOLINITE
Lethality of a Suspended Clay to a Diverse Selection of Marine and Estuarine Macrofauna,
W82-00268 5C

KARST
Hydrochemistry of a Dolomite Karst: The Bruce Peninsula of Ontario,
W82-00321 2K

KENAI RIVER
Erosion and Sedimentation in the Kenai River, Alaska,
W82-00015 2J

KENTUCKY
Water in the Elizabethtown Area - A Study of Limestone Terrane in North-Central Kentucky,
W82-00413 5B

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Kentucky.
W82-00450 6E

KEPONE
Behavior of DDT, Kepone, and Permethrin in Sediment-Water Systems Under Different Oxidation-Reduction and PH Conditions,
W82-00382 5B

KINCARDINE HARBOR
Resonator Studies for Kincardine Harbour, Lake Huron,
W82-00228 8B

KINETICS
Fenitrothion Sprayed on a Pond: Kinetics of Its Distribution and Transformation in Water and Sediment,
W82-00159 5B

LAKE BIWA
Distribution of Obligately Oligotrophic Bacteria in Lake Biwa,
W82-00346 5A

LAKE HURON
Resonator Studies for Kincardine Harbour, Lake Huron,
W82-00228 8B

LAKE ICE
Illustration of the Roles of Snow in the Evolution of the Winter Cover of a Lake,
W82-00267 2C

LAKE MEMPHREMAGOG
The Prediction of Lacustrine Phytoplankton Diversity,
W82-00319 2H

LAKE MICHIGAN
Seasonal Particle-Size Selection by Diaptomus Sicilis in Offshore Lake Michigan,
W82-00485 2H

LAKE SEDIMENTS
Distribution and Transport of Heavy Metals in the Sediments of a Small Northern Eutrophic Lake,
W82-00235 5B

Sulfhydrolase Activity in Sediments of Wintergreen Lake, Kalamazoo County, Michigan,
W82-00241 2H

Factors Affecting Phosphorus Release from Intact Lake Sediment Cores,
W82-00251 2H

Lignocellulose Mineralization by Arctic Lake Sediments in Response to Nutrient Manipulation,
W82-00270 2H

Postdepositional Mobility of Phosphorus in Lake Sediments,
W82-00474 2H

Reduction of Sulfur Compounds in the Sediments of a Eutrophic Lake Basin,
W82-00488 2H

LAKE SEMINOLE
Water Quality Management Studies, Lake Seminole, April-November 1978.
W82-00051 6G

LAKE TAHOE
Final Environmental Impact Statement; Wastewater Treatment Facilities, South Shore Lake Tahoe Basin.
W82-00359 5D

Final Environmental Impact Statement; South Tahoe Public Utility District and Douglas County Sewer Improvement District No. 1, Appendix B: Mitigation Program.
W82-00369 6G

LAKES
Effects of Mount St. Helens Eruption on Selected Lakes in Washington,
W82-00006 2H

Predicting Lake Levels by Exponential Smoothing,
W82-00118 2A

Factors Affecting Phosphorus Release from Intact Lake Sediment Cores,
W82-00251 2H

Occurrence of Aphanomyces Ovidestruens, a Fungus Parasitic on Copepods, in Two Eutrophic Lakes,
W82-00304 2H

Prediction of Total Phosphorus Concentrations, Chlorophyll a, and Secchi Depths in Natural and Artificial Lakes,
W82-00400 2H

LAND APPLICATION
Predicting Runoff Pollutant Reduction in Buffer Zones Adjacent to Land Treatment Sites,
W82-00141 5B

The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 3: Maize Cultivation Experiment, Bacteriological Studies, and Economic Assessment,
W82-00457 3C

LAND DEVELOPMENT
Effect of Agricultural Land Development on Drainage Waters in the North Carolina Tidewater Region,
W82-00094 5B

LAND DISPOSAL
Electroplating Wastewater Sludge Characterization,
W82-00095 5E

Cropping Systems for Treatment and Utilization of Municipal Wastewater and Sludge,
W82-00097 5E

Nitrogen Availability from Sewage Sludge,
W82-00158 5E

Soil as a Medium for Dairy Liquid Waste Disposal,
W82-00165 5E

Leaching of Calcium and Magnesium from Soil Columns as Affected by Form of Nitrogen in Applied Sewage,
W82-00192 5E

Coastal Bermudagrass Yield and Soil Properties as Affected by Surface-Applied Dairy Manure and Its Residue,
W82-00195 3C

Enumeration of Potentially Pathogenic Bacteria from Sewage Sludges,
W82-00221 5A

Viral Transport Through Soil Columns Under Conditions of Saturated Flow,
W82-00295 5B

Final Environmental Impact Statement; Sludge Disposal and Land Reclamation in Fulton County, Illinois.
W82-00360 5E

Survival of Enteroviruses in Rapid-Infiltration Basins During the Land Application of Wastewater,
W82-00496 5D

Effects of Sewage Effluent Application on Litter Fall and Litter Decomposition in Cypress Swamps,
W82-00499 5E

LAND RECLAMATION
Land Restoration Following Oil-Well Drilling,
W82-00057 5D

Final Environmental Impact Statement; Sludge Disposal and Land Reclamation in Fulton County, Illinois.
W82-00360 5E

LAND USE
Geographic Information Systems and Environmental Impact Assessment,
W82-00338 7C

LANDFILLS
Reconnaissance of the Effect of Landfill Leachate on the Water Quality of Marshall Brook, Southwest Harbor, Hancock County, Maine,
W82-00013 5C

A Comparison of Nitrogen in Shallow Ground Water from Sewered and Unsewered Areas, Nassau County, New York, from 1952 Through 1976,
W82-00277 5B

An Evaluation of Sources of Nitrogen as Causes of Ground-Water Contamination in Nassau County, Long Island,
W82-00279 5B

Comparative Analysis of Sludge and Refuse Leachate: A Preliminary Report,
W82-00287 5E

Hydrogeologic Data for Rocky Creek Landfill and Adjacent Area, Northwest Hillsborough County, Florida, 1969-73,
W82-00417 5B

LARVAE
The Abundance of Estuarine Larval and Juvenile Fish in a South Carolina Intertidal Creek,
W82-00276 2L

LASERS
Testing the Flocculation/Coagulation of Wastewater by Granulometric Analysis of Suspended Solids in the Water Using a Laser Diffraction Meter,
W82-00463 5D

LEACHATES
Toxicity of Mount St. Helens Ash Leachate to a Blue-Green Alga,
W82-00001 5C

Reconnaissance of the Effect of Landfill Leachate on the Water Quality of Marshall Brook, Southwest Harbor, Hancock County, Maine,
W82-00013 5C

Lining of Waste Impoundment and Disposal Facilities.
W82-00099 5E

Leachates from Solid Waste Recovery Operations,
W82-00167 5D

Analytical Methods Evaluation for Applicability in Leachate Analysis,
W82-00380 5A

Hydrogeologic Data for Rocky Creek Landfill and Adjacent Area, Northwest Hillsborough County, Florida, 1969-73,
W82-00417 5B

LEACHING
Computer Modeling of Fluid Flow During Production and Environmental Restoration Phases of In Situ Uranium Leaching,
W82-00043 6A

Electroplating Wastewater Sludge Characterization,
W82-00095 5E

Leaching of Calcium and Magnesium from Soil Columns as Affected by Form of Nitrogen in Applied Sewage,
W82-00192 5E

LEAKAGE
Cutting the Water Losses,
W82-00310 5F

LEGAL ASPECTS
Conflicts and Barriers Working Group Report.
W82-00031 6E

Legal Aspects of Subsidence Due to Well Pumping,
W82-00170 6E

Executive Summary, Legal Obstacles and Incentives to Small-Scale Hydroelectric Development in the Six Middle Atlantic States.
W82-00448 6E

Summary of the Midwest Conference on Small-Scale Hydropower in the Midwest: An Old Technology Whose Time Has Come.
W82-00449 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Kentucky.
W82-00450 6E

LEGISLATION
Ground Water Conflicts and Barriers,
W82-00028 6E

Alternatives Working Group Report.
W82-00032 6B

WQM Five Year Strategy (FY 81-Baseline).
W82-00045 5G

Executive Summary, Legal Obstacles and Incentives to Small-Scale Hydroelectric Development in the Six Middle Atlantic States.
W82-00448 6E

LESSER SLAVE LAKE
Predicting Lake Levels by Exponential Smoothing,
W82-00118 2A

LEWIS RIVER BASIN
Water Resources Appraisal for Hydroelectric Licensing: Lewis River Basin, Washington.
W82-00370 6B

LIBRARIES
Ground-Water Information: NWWA Provides the Resources,
W82-00301 2F

LIME
Limestone-Lime Treatment of Acid Mine Drainage - Full Scale,
W82-00377 5D

Lime Stabilization and Ultimate Disposal of Municipal Wastewater Sludges,
W82-00386 5E

High pH Treatment of Combined Water Softening and Wastewater Sludges,
W82-00403 5D

LIMESTONE
Water in the Elizabethtown Area - A Study of Limestone Terrane in North-Central Kentucky,
W82-00413 5B

LIMNOLOGY
Effects of Mount St. Helens Eruption on Selected Lakes in Washington,
W82-00006 2H

Modeling Phosphorus Loading and Lake Response Under Uncertainty: A Manual and Compilation of Export Coefficients.
W82-00039 5B

LINDANE
Sorption-Desorption of Lindane by Anaerobic and Aerobic Soils,
W82-00189 5A

LINING
Lining of Waste Impoundment and Disposal Facilities.
W82-00099 5E

LIPIDS
Reduction, Methylation, and Incorporation of Arsenic into Lipids by the Marine Phytoplankton Dunaliella Tertiolecta,
W82-00239 5B

LIQUID WASTES
State-of-the-Art of Liquid Waste Disposal for Geothermal Energy Systems: 1979,
W82-00375 5E

LITERATURE REVIEW
Ground-Water Information: NWWA Provides the Resources,
W82-00301 2F

LITTER
Effects of Sewage Effluent Application on Litter Fall and Litter Decomposition in Cypress Swamps,
W82-00499 5E

LITTLE TENNESSEE RIVER BASIN
Water Resources Appraisal for Hydroelectric Licensing: Little Tennessee River Basin, Tennessee, North Carolina, and Georgia.
W82-00372 6B

LOESS
Gully Development in the Deep Loess Hills Region of Central Missouri,
W82-00472 2J

LONG ISLAND
Use of Flow-Duration Curves to Evaluate Effects of Urbanization on Streamflow Patterns on Long Island, New York,
W82-00416 4C

LONG-TERM PLANNING
WQM Five Year Strategy (FY 81-Baseline).
W82-00045 5G

MACROINVERTEBRATES
An Appraisal of Pond-Net Samples for Biological Monitoring of Lotic Macroinvertebrates,
W82-00308 7B

MADISON COUNTY
Development of a Rural Water District,
W82-00288 6A

MAGNESIUM
Leaching of Calcium and Magnesium from Soil Columns as Affected by Form of Nitrogen in Applied Sewage,
W82-00192 5E

Consecutive Amperometric Titrations for Calcium and Magnesium,
W82-00208 5A

MAINE
Reconnaissance of the Effect of Landfill Leachate on the Water Quality of Marshall Brook, Southwest Harbor, Hancock County, Maine,
W82-00013 5C

Groundwater Availability in Acadia National Park and Vicinity, Hancock and Knox Counties, Maine,
W82-00017 2F

MAINTENANCE
Cutting the Water Losses,
W82-00310 5F

MANAGEMENT PLANNING
WQM Five Year Strategy (FY 81-Baseline).
W82-00045 5G

Basin Management in the San Bernardino Basin Area,
W82-00280 6A

MANURE
Coastal Bermudagrass Yield and Soil Properties as Affected by Surface-Applied Dairy Manure and Its Residue,
W82-00195 3C

MAPS
Potentiometric Surface of the Floridan Aquifer in the Suwannee River Water Management District, Florida, May 1980,
W82-00024 7C

Potentiometric Surface of the Floridan Aquifer in the Northwest Florida Water Management District, May 1980,
W82-00025 7C

Water Resources of Prince William Forest Park, Virginia,
W82-00026 7C

Altitude of Water Table, Biscayne Aquifer, Dade County, Florida, May 1980,
W82-00409 7C

Altitude of Water Table, Biscayne Aquifer, Dade County, Florida, October 1979,
W82-00410 7C

Altitude of Water Table, Biscayne Aquifer, Dade County, Florida, March 1979,
W82-00411 7C

MARINE ANIMALS
A Salicylate-Hypochlorite Method for Determining Ammonia in Seawater,
W82-00238 5A

MARINE SEDIMENTS
Characterisation of Domestic and Industrial Sewage in Southern California Coastal Sediments Using Nitrogen, Carbon, Sulphur, and Uranium Tracers,
W82-00147 5B

Populations of Methane-Producing Bacteria and In Vitro Methanogenesis in Salt Marsh and Estuarine Sediments,
W82-00202 2L

Natural Abundances of 15N as a Source Indicator for Near-Shore Marine Sedimentary and Dissolved Nitrogen,
W82-00283 5B

MARION COUNTY LAKE
Final Environmental Impact Statement for Proposed Sewerage Facilities in the Marion County Lake Improvement District, Marion County, Kansas.
W82-00355 6G

MARSHALL BROOK
Reconnaissance of the Effect of Landfill Leachate on the Water Quality of Marshall Brook, Southwest Harbor, Hancock County, Maine,
W82-00013 5C

MARSHES
Phosphorus Dynamics of a Florida Freshwater Marsh Receiving Treated Wastewater,
W82-00108 5E

MARYLAND
Garrett County Water-Well Records, Chemical-Quality Data Ground-Water Use, Coal Test-Hole Data and Surface-Water Data.
W82-00395 2F

MASSACHUSETTS
A Model of Natural and Man-Induced Changes in Open Freshwater Wetlands on the Massachusetts Coastal Plain,
W82-00397 2I

MATHEMATICAL EQUATIONS
A Proposed Technique to Measure Evapotranspiration Using Micrometeorological Methods,
W82-00183 2D

A Comparative Study of Three Forms of the Richard Equation Used for Predicting One-Dimensional Infiltration in Unsaturated Soil,
W82-00328 2G

Rainfall Intensity-Kinetic Energy Relationships for Soil Loss Prediction,
W82-00466 2J

MATHEMATICAL MODELS
Modeling Phosphorus Loading and Lake Response Under Uncertainty: A Manual and Compilation of Export Coefficients.
W82-00039 5B

Modeling Grain Sorghum Ratoon Cropping and Associated Runoff and Sediment Losses,
W82-00113 2G

SOYROOT - A Dynamic Model of Soybean Root Growth and Water Uptake,
W82-00114 2I

LIBRARY U. OF L. URBANA-CHAMPAIGN

Transient Soil Moisture Movement Through Layered Soils Using a Finite Element Approach,
W82-00133 2G

An Infiltration Model: Development and Evaluation of Its Parameters,
W82-00137 2G

Characterisation of Domestic and Industrial Sewage in Southern California Coastal Sediments Using Nitrogen, Carbon, Sulphur, and Uranium Tracers,
W82-00147 5B

Modeling the Flux of Atmospheric Polychlorinated Biphenyls Across the Air/Water Interface,
W82-00193 5B

Management and Design Implications of a Mathematical Model of a Rapid Gravity Sand Filter Backwash,
W82-00460 5D

MATHEMATICAL STUDIES
Optimization of Pump Turbines,
W82-00181 8C

MEASUREMENT TECHNIQUES
Comparison of Automated Segmented-Flow and Discrete Analyzers for the Determination of Nutrients in Water,
W82-00483 5A

Microplate Technique for Determining Accumulation of Metals by Algae,
W82-00492 5A

MEASURING INSTRUMENTS
A Proposed Technique to Measure Evapotranspiration Using Micrometeorological Methods,
W82-00183 2D

A More Versatile Soil Water Sampler,
W82-00191 7B

BIONESS, A New Design in Multiple Net Zooplankton Samplers,
W82-00210 7B

Automation of Water Bacteriological Analysis: Running Test of an Experimental Prototype,
W82-00225 5A

MEAT PROCESSING INDUSTRY
Pilot Scales Tests on the Flotation of Abattoir Wastes by Deep U Tubes,
W82-00322 5D

MEDITERRANEAN
Environmental Resources and Restraints to Agricultural Production in a Mediterranean-Type Environment,
W82-00329 2I

MELTING
On the Estimation of Antarctic Iceberg Melt Rate,
W82-00166 2C

MEMBRANE FILTERS
Comparison of Nine Brands of Membrane Filter and the Most-Probable-Number Methods for Total Coliform Enumeration in Sewage-Contaminated Drinking Water,
W82-00203 5A

Application of a Multiple Alginate Filter Method for the Determination of Water Viruses Concentration (Conception D'Une Membrane Filtrante a Base D'Alginate Pour La Concentration Des Virus Hydriques),
W82-00458 5A

Membrane Filter Method for Enumerating Escherichia Coli,
W82-00487 5A

Impact of Verification Media and Resuscitation on Accuracy of the Membrane Filter Total Coliform Enumeration Technique,
W82-00494 5A

MERCURY
Process for Removal of Mercury and Mercury Compounds From Aqueous Solutions and Industrial Waste Liquors,
W82-00058 5D

METABOLISM
Comparison of Two Direct-Count Methods for Determining Metabolizing Bacteria in Freshwater,
W82-00495 5A

METALS
Consecutive Amperometric Titrations for Calcium and Magnesium,
W82-00208 5A

Gas Chromatographic Determination of Selenium (-II, O), -(IV), and -(VI) in Natural Waters,
W82-00257 5A

METHANE
Methane Production from Ozonated Pulp Mill Effluent,
W82-00155 5D

Anaerobic Methane Oxidation: Occurrence and Ecology,
W82-00218 2H

Comparison of In Situ and In Vitro Rates of Methane Release in Freshwater Sediments,
W82-00245 2H

Nitrogen Fixation and Methane Metabolism in a Stream Sediment-Water System Amended with Leaf Material,
W82-00486 2K

METHANE BACTERIA
Populations of Methane-Producing Bacteria and In Vitro Methanogenesis in Salt Marsh and Estuarine Sediments,
W82-00202 2L

MICHIGAN
Ground-Water Data for Michigan, 1979,
W82-00014 2F

Sulfhydrolase Activity in Sediments of Wintergreen Lake, Kalamazoo County, Michigan,
W82-00241 2H

Vegetation and Nutrient Status of Northern Michigan Bogs and Conifer Swamps with a Comparison to Fens,
W82-00484 2I

MICROBIAL DEGRADATION
Experimental Studies on the Effect of Arsenic on Microbial Degradation of Organic Matter and Algal Growth,
W82-00237 2H

Effect of Estuarine Sediment pH and Oxidation-Reduction Potential on Microbial Hydrocarbon Degradation,
W82-00243 2L

Variation in Microbial Activity in Histosols and Its Relationship to Soil Moisture,
W82-00244 2G

MIGRATION
Postdepositional Mobility of Phosphorus in Lake Sediments,
W82-00474 2H

MINE DRAINAGE
Radionuclide Concentrations in Streams in the Upper Blackfoot River Basin, Southeastern Idaho,
W82-00418 5A

MINE WASTES
Absorption of Radium and Thorium From New Mexico Uranium Mill Tailing Solutions,
W82-00040 5D

Distribution and Transport of Heavy Metals in the Sediments of a Small Northern Eutrophic Lake,
W82-00235 5B

Control Technology Strategies for Coal Preparation Waste Drainages,
W82-00440 5D

MINERAL INDUSTRY
Dewatering Florida Phosphatic Clay Wastes With Moving Screens,
W82-00049 5D

MINERALIZATION
Lignocellulose Mineralization by Arctic Lake Sediments in Response to Nutrient Manipulation,
W82-00270 2H

MINING ENGINEERING
Hydraulic Properties of Coal and Related Materials, Northern Great Plains,
W82-00278 2F

MINNESOTA
Preliminary Evaluation of Ground-Water Contamination by Coal-Tar Derivatives, St. Louis Park Area, Minnesota,
W82-00430 5B

MISSISSIPPI
Quality of Water in Tibbee Creek and Tributaries Near West Point, Mississippi,
W82-00084 5B

Facultative Lagoon Effluent Polishing Using Phase Isolation Ponds,
W82-00092 5D

Transformation of the Mouse Clonal Cell Line R846-DP8 by Mississippi River, Raw, and Finished Water Samples from Southeastern Louisiana,
W82-00215 5C

Predicted Effects on Ground Water of Construction of Divide Cut Section, Tennessee-Tombigbee Waterway, Northeastern Mississippi Using a Digital Model,
W82-00428 2F

MISSOURI
Gully Development in the Deep Loess Hills Region of Central Missouri,
W82-00472 2J

MISSOURI RIVER BASIN
Water Resources Data for Kansas, Water Year 1980--Volume 1. Missouri River Basin.
W82-00078 7C

MODEL STUDIES
Conceptual Design of a Regional Water Quality Screening Model,
W82-00038 6A

Model Study of a Box-Inlet Chute Spillway and SAF Stilling Basin,
W82-00046 8A

Water Supply and Demand in an Energy Supply Model,
W82-00050 6D

Ground-Water Modeling: Recent Developments,
W82-00281 2F

Ground-Water Resources of the White River Basin, Madison County, Indiana,
W82-00412 2A

Digital Model of the Unconsolidated Aquifer System in the Modesto Area, Stanislaus and San Joaquin Counties, California,
W82-00415 4B

Water Treatment Model for Pollutant Exposure Assessment,
W82-00500 5F

MOISTURE
Two-Dimensional Linearized Moisture Flow with Water Extraction,
W82-00405 2I

MOISTURE CONTENT
Response of Bacteria in Wastewater Sludge to Moisture Loss by Evaporation and Effect of Moisture Content on Bacterial Inactivation by Ionizing Radiation,
W82-00489 5D

Effects of Moisture Content on Long-Term Survival and Regrowth of Bacteria in Wastewater Sludge,
W82-00493 5E

MOISTURE UPTAKE
SOYROOT - A Dynamic Model of Soybean Root Growth and Water Uptake,
W82-00114 2I

MOLECULAR STRUCTURE
Pollutant Treatability: A Molecular Engineering Approach,
W82-00252 6E

MONITORING
Evaluation of Ground-Water Monitoring Network, Santa Cruz County, California,
W82-00023 7A

Basin Management in the San Bernardino Valley,
W82-00075 4B

Development of Oil-In-Water Monitor, Phase II,
W82-00100 5A

Comparison of Nine Brands of Membrane Filter and the Most-Probable-Number Methods for Total Coliform Enumeration in Sewage-Contaminated Drinking Water,
W82-00203 5A

Hydraulic Properties of Coal and Related Materials, Northern Great Plains,
W82-00278 2F

An Observation-Well Network Concept as Applied to North Carolina,
W82-00414 4B

Proposed Observation-Well Networks and Ground-Water Level Program for North Carolina,
W82-00426 4B

MONSOONS
Report on the Summer MONEX Field Phase,
W82-00265 2B

MOUNT ST. HELENS
Toxicity of Mount St. Helens Ash Leachate to a Blue-Green Alga,
W82-00001 5C

Mount St. Helens Volcanic-Ash Fall in the Bull Run Watershed, Oregon, March-June 1980,
W82-00002 5B

Mudflows Resulting From the May 18, 1980, Eruption of Mount St. Helens, Washington,
W82-00003 5B

Channel Conditions in the Lower Toutle and Cowlitz Rivers Resulting From the Mudflows of May 18, 1980,
W82-00004 5B

Effects of the Mount St. Helens Eruption on the Benthic Fauna of the Toutle River, Muddy River, and Pine Creek Drainage Basins, Washington,
W82-00005 5C

Effects of Mount St. Helens Eruption on Selected Lakes in Washington,
W82-00006 2H

Effects of Volcanism on the Glaciers of Mount St. Helens,
W82-00007 2C

MUDFLOWS
Mudflows Resulting From the May 18, 1980, Eruption of Mount St. Helens, Washington,
W82-00003 5B

Channel Conditions in the Lower Toutle and Cowlitz Rivers Resulting From the Mudflows of May 18, 1980,
W82-00004 5B

MULCHING
Effect of Mulch Rate on Soil Loss by Raindrop Splash,
W82-00468 2J

MUNICIPAL WASTES
Water-Related Environmental Control Requirements at Municipal Solid Waste-to-Energy Conversion Facilities,
W82-00037 5D

Comparative Analysis of Sludge and Refuse Leachate: A Preliminary Report,
W82-00287 5E

MUNICIPAL WASTEWATER
Wastewater Treatment by Rooted Aquatic Plants in Sand and Gravel Trenches,
W82-00093 5D

High-Level Ozone Disinfection of Municipal Wastewater Effluents,
W82-00379 5D

Joint Dry/Wet Weather Treatment of Municipal Wastewater at Clatskanie, Oregon,
W82-00391 5D

NASSAU COUNTY
A Comparison of Nitrogen in Shallow Ground Water from Sewered and Unsewered Areas, Nassau County, New York, from 1952 Through 1976,
W82-00277 5B

An Evaluation of Sources of Nitrogen as Causes of Ground-Water Contamination in Nassau County, Long Island,
W82-00279 5B

NATIONAL PARKS
Water Resources of Prince William Forest Park, Virginia,
W82-00026 7C

Water Resources Appraisal for Hydroelectric Licensing: Elwha River Basin, Washington.
W82-00371 6B

NATURAL WATERS
Hydrolysis of Fenitrothion in Model and Natural Aquatic Systems,
W82-00157 5B

NAWDEX (NATIONAL WATER DATA EXCHANGE)
Directory of Member Organizations of the National Water Data Exchange (NAWDEX),
W82-00089 10D

National Water Data Exchange (NAWDEX) System 2000 Data Retrieval Manual,
W82-00420 10B

NEGEV DESERT
Effects of Tillage and Gypsum Incorporation on Rain Runoff and Crust Strength in Field Soils Irrigated With Saline-Sodic Water,
W82-00327 2A

NEMATODES
Survival of Eggs and Larvae of Swine Nematode Parasites in Aerobic and Anaerobic Waste Treatment Systems,
W82-00161 5D

A 13-Month Survey of Nematodes at Three Water Treatment Plants in Southern Ontario, Canada,
W82-00294 5F

NETHERLANDS
Neap-Spring Tide Sequences of Intertidal Shoal Deposits in a Mesotidal Estuary,
W82-00112 2L

NETWORK DESIGN
Evaluation of Ground-Water Monitoring Network, Santa Cruz County, California,
W82-00023 7A

Mathematical Efficiency Concerns in Water Distribution Network Considerations,
W82-00339 5F

Proposed Observation-Well Networks and Ground-Water Level Program for North Carolina,
W82-00426 4B

NETWORKS
An Observation-Well Network Concept as Applied to North Carolina,
W82-00414 4B

NEUTRALIZATION
Limestone-Lime Treatment of Acid Mine Drainage - Full Scale,
W82-00377 5D

NEW ENGLAND
Small-Scale Hydro in New England: 1960-1976,
W82-00169 6D

Summary of the New England Conference on Legal and Institutional Incentives to Small-Scale Hydroelectric Development, January 30-31, 1979, Boston, Massachusetts.
W82-00447 6E

NEW ENGLAND RIVER BASINS COMMISSION
Before the Well Runs Dry: A Handbook for Designing a Local Water Conservation Plan.
W82-00396 3D

NEW HAMPSHIRE
Water Resources Data for New Hampshire and Vermont, Water Year 1980.
W82-00076 7C

NEW JERSEY
Northeastern New Jersey Grapples With a Drought,
W82-00289 8A

NEW MEXICO
Evaluation of the Malaga Bend Salinity Alleviation Project, Eddy County, New Mexico,
W82-00018 5B

NEW SOUTH WALES
Solar Cycles and Erosional Events on the New South Wales Central and South Coasts,
W82-00318 2J

NEW YORK
Polychlorinated Biphenyl Transport in the Hudson River, New York,
W82-00008 5B

Relationship of Water Quality of Hudson River, New York, During Peak Discharges to Geologic Characteristics of Contributing Subbasins,
W82-00009 5B

Water Resources Investigations in New York--1980.
W82-00011 7C

Use of Flow-Duration Curves to Evaluate Effects of Urbanization on Streamflow Patterns on Long Island, New York,
W82-00416 4C

NEW YORK BIGHT
An Analysis of Factors Affecting Oxygen Depletion in the New York Bight,
W82-00106 5C

NEW ZEALAND
Occurrence of Aphanomyces Ovidestruens, a Fungus Parasitic on Copepods, in Two Eutrophic Lakes,
W82-00304 2H

NILE FLOODS
Historical Nile Floods and Their Implications for Climatic Change,
W82-00326 2E

NITRIFICATION
Specific Inhibition of Nitrite Oxidation by Chlorate and Its Use in Assessing Nitrification in Soils and Sediments,
W82-00242 2L

NITROGEN
Nitrogen Availability from Sewage Sludge,
W82-00158 5E

Effects of Soil Water Regime and Nitrogen Form on Blossom-End Rot, Yield, Water Relations, and Elemental Composition of Tomato,
W82-00162 2I

Amounts and Relative Significance of Runoff Types in the Transport of Nitrogen into a Stream Draining an Agricultural Watershed,
W82-00173 5B

A Comparison of Nitrogen in Shallow Ground Water from Sewered and Unsewered Areas, Nassau County, New York, from 1952 Through 1976,
W82-00277 5B

An Evaluation of Sources of Nitrogen as Causes of Ground-Water Contamination in Nassau County, Long Island,
W82-00279 5B

Natural Abundances of 15N as a Source Indicator for Near-Shore Marine Sedimentary and Dissolved Nitrogen,
W82-00283 5B

The Importance of Regenerated Nitrogen to Phytoplankton Productivity in a Subalpine Lake,
W82-00476 2H

NITROGEN COMPOUNDS
Does Salt Marsh Fertilization Enhance Shellfish Production. An Application of Flow Analysis,
W82-00259 2L

NITROGEN FIXATION
Nitrogen Fixation and the Nitrogen Budget of a Eutrophic Impoundment,
W82-00127 2H

Effect of Microcrustaceans on Blue-Green Algae in Flooded Soil,
W82-00146 6G

Enumeration and Relative Importance of Acetylene-Reducing (Nitrogen-Fixing) Bacteria in a Delaware Salt Marsh,
W82-00248 2L

Nitrogen Fixation and Methane Metabolism in a Stream Sediment-Water System Amended with Leaf Material,
W82-00486 2K

NITROGEN REMOVAL
Luxury Uptake of Nitrogen in Flocculating Algal-Bacterial System,
W82-00307 5D

NITROSAMINES
Photolysis of N-Nitrosodi-n-Propylamine in Water,
W82-00164 5B

Nitrosamines in Tap Water After Concentration by a Carbonaceous Adsorbent,
W82-00459 5A

NONPOINT POLLUTION SOURCES
Predicting Runoff Pollutant Reduction in Buffer Zones Adjacent to Land Treatment Sites,
W82-00141 5B

Pollution From Land Runoff,
W82-00253 5B

Natural Variation in Abundance of Salmonid Populations in Streams and its Implications for Design of Impact Studies,
W82-00389 5C

NORTH CAROLINA
Effect of Agricultural Land Development on Drainage Waters in the North Carolina Tidewater Region,
W82-00094 5B

An Observation-Well Network Concept as Applied to North Carolina,
W82-00414 4B

Proposed Observation-Well Networks and Ground-Water Level Program for North Carolina,
W82-00426 4B

NORTH INLET ESTUARY
The Abundance of Estuarine Larval and Juvenile Fish in a South Carolina Intertidal Creek,
W82-00276 2L

NORTHWEST HILLSBOROUGH COUNTY
A 201 Pollution Control Planning Tragedy,
W82-00285 6E

NOVA SCOTIA
Impact of Construction of a Hydroelectric Project on the Water Quality of Five Lakes in Nova Scotia,
W82-00227 5C

Ice Problems at a Cooling Water Intake in a Tidal Estuary at Lingan, N.S.,
W82-00230 8A

NUCLEAR REACTORS
Field Experiments on Responses of a Freshwater, Benthic Macroinvertebrate Community to Vertebrate Predators,
W82-00477 5C

NUTRIENTS
Slash Treatment After Clearcutting Lodgepole Pine Affects Nutrients in Soil Water,
W82-00130 4C

An Empirical Equation for Predicting Soluble Phosphorus Loads from Agricultural Watersheds,
W82-00134 5B

Sediment and Nutrient Movement from the Black Creek Watershed,
W82-00135 5B

Modeling the Relationship Between Development and Storm Water and Nutrient Runoff,
W82-00260 2A

Lignocellulose Mineralization by Arctic Lake Sediments in Response to Nutrient Manipulation,
W82-00270 2H

Comparison of Automated Segmented-Flow and Discrete Analyzers for the Determination of Nutrients in Water,
W82-00483 5A

Vegetation and Nutrient Status of Northern Michigan Bogs and Conifer Swamps with a Comparison to Fens,
W82-00484 2I

OAK RIDGE NATIONAL LABORATORY
Water Level Data for Wells in and Near Burial Ground 3, Oak Ridge National Laboratory, Tennessee, 1975-1979,
W82-00423 7C

OBSERVATION WELLS
January 1980 Water Levels, and Data Related to Water-level Changes, Western and South-Central Kansas,
W82-00016 2F

An Observation-Well Network Concept as Applied to North Carolina,
W82-00414 4B

Water Level Data for Wells in and Near Burial Ground 3, Oak Ridge National Laboratory, Tennessee, 1975-1979,
W82-00423 7C

Hydrogeologic Data from Test Drilling near Verna Beach, Florida, 1978,
W82-00424 2F

Proposed Observation-Well Networks and Ground-Water Level Program for North Carolina,
W82-00426 4B

ODOR CONTROL
Odorous Compounds from Potato Processing Waste Effluent Irrigation Fields: Volatile Acids,
W82-00156 5E

ODORS
Chemistry of Septicity,
W82-00325 5D

OFF-ROAD VEHICLE EFFECTS
Physical Effects of Vehicular Disturbances on Arid Landscapes,
W82-00111 4C

OGALLALA FORMATION
Water-Level Records for the Northern High Plains of Colorado, 1977-81,
W82-00422 7C

OHIO
Premining Hydrologic Conditions of Five Southeastern Ohio Watersheds,
W82-00054 4C

OIL FIELDS
Land Restoration Following Oil-Well Drilling,
W82-00057 5D

OIL INDUSTRY
Evaluation of the Effectiveness of Granular Activated Carbon Adsorption and Aquaculture for Removing Toxic Compounds From Treated Petroleum Refinery Effluents,
W82-00098 5D

Deep Well Injection of Industrial Wastes,
W82-00475 5E

OIL POLLUTION
Method and Apparatus for Pollutant Spill Control,
W82-00056 5G

Means and Method for Sweeping Material Floating on Water Using Vibrational Energy, W82-00062 5G

Development of Oil-In-Water Monitor, Phase II, W82-00100 5A

OIL SHALE
The Analysis of Oil Shale Wastes: A Review, W82-00388 5A

Assessment of Oil Shale Retort Wastewater Treatment and Control Technology - Phases I and II, W82-00390 5B

Processing Needs and Methodology for Wastewaters from the Conversion of Coal, Oil Shale and Biomass to Synfuels. W82-00431 5D

Environmental Control Technology for Shale Oil Wastewaters, W82-00444 5D

Potential Uses of Spent Shale in the Treatment of Oil Shale Retort Waters, W82-00445 5D

Alkylpyridines in Surface Waters, Groundwaters, and Subsoils of a Drainage Located Adjacent to an Oil Shale Facility, W82-00481 5B

OIL SPILLS
Method and Apparatus for Pollutant Spill Control, W82-00056 5G

Means and Method for Sweeping Material Floating on Water Using Vibrational Energy, W82-00062 5G

OILY WATER
Apparatus for the Purification of Oily Emulsions, Solutions, and Industrial Waste Waters, W82-00060 5D

Development of Oil-In-Water Monitor, Phase II, W82-00100 5A

OKLAHOMA
Report of the Annual Yield of the Arkansas River Basin for the Arkansas River Basin Compact, Arkansas--Oklahoma, 1980 Water Year, W82-00012 6E

OLATHE
Final Environmental Impact Statement for Wastewater Treatment Facilities; City of Olathe, Johnson County, Kansas. W82-00357 5D

OLIGOTROPHY
Distribution of Obligately Oligotrophic Bacteria in Lake Biwa, W82-00346 5A

ON-SITE DATA COLLECTIONS
Hydrogeologic Data from Test Drilling near Verna Beach, Florida, 1978, W82-00424 2F

ONTARIO
Geochemistry of a Subarctic Salt Marsh Environment, W82-00148 2L

Recent Developments in Water Pollution Control, W82-00340 5D

OPEN CHANNEL FLOW
Secondary Flow, Shear Stress and Sediment Transport, W82-00117 2J

OPTIMIZATION
Optimal Design of Furrow Irrigation Systems, W82-00138 3F

ORGANIC ACIDS
Odorous Compounds from Potato Processing Waste Effluent Irrigation Fields: Volatile Acids, W82-00156 5E

ORGANIC CARBON
Deposition of Riverborne Organic Carbon in Floodplain Wetlands and Deltas, W82-00034 2J

Potential Uses of Spent Shale in the Treatment of Oil Shale Retort Waters, W82-00445 5D

ORGANIC COMPOUNDS
Organic Micropollution Indices of Effluents and Renovated Waters, W82-00123 5A

Total Organic Halogen as a Parameter for the Characterization of Reclaimed Waters: Measurement, Occurrence, Formation, and Removal, W82-00197 5D

Measurement of the Solubilities of Slightly Soluble Organic Liquids in Water by Elution Chromatography, W82-00207 5A

Temporal Variations in Trihalomethane Content of Drinking Water, W82-00255 5A

Identification of Organic Compounds in a Mutagenic Extract of a Surface Drinking Water by a Computerized Gas Chromatography/Mass Spectrometry System (GC/MS/COM), W82-00256 5A

Effects of Halogenated Organic Compounds on Photosynthesis in Estuarine Phytoplankton, W82-00266 5C

Methods for Level 2 Analysis by Organic Compound Category, W82-00384 5A

Ozone Treatment of Potable Water--Part 2, W82-00452 5F

Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aquatic Environments - I. Features of Hydrocarbons for Polluted and Unpolluted Waters, W82-00453 5B

Toxicity and Ecological Significance of Trace Elements in Aquatic Environments, W82-00498 5B

Water Treatment Model for Pollutant Exposure Assessment, W82-00500 5F

ORGANIC LOADING
An Analysis of Factors Affecting Oxygen Depletion in the New York Bight, W82-00106 5C

ORGANIC MATTER
Chemical Indicators of Organic River Sources in Rivers and Estuaries, W82-00035 5B

Treatment of Florida Surface Waters for Use in Phosphate Beneficiation, W82-00048 5D

Effects of Small Amounts of Residue on Furrow Erosion, W82-00470 2J

ORGANIC SOLVENTS
Solvent Extraction of Phenols, W82-00438 5D

Assessment of Solvent Extraction for Treatment of Coal Gasifier Wastewater, W82-00439 5D

ORGANIC WASTES
Apparatuses for the Anaerobic Digestion of Natural Organic Waste, W82-00069 5D

OTTER TAIL COUNTY
Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 5: Otter Tail County Board of Commissioners, Otter Tail County, Minnesota. W82-00366 5D

OVERLAND FLOW
Evaluation of the Overland Runoff Mode of Land Wastewater Treatment for Virus Removal, W82-00220 5B

OXIDATION
Anaerobic Methane Oxidation: Occurrence and Ecology, W82-00218 2H

Measurements of Hydrogen Peroxide in Rainwater, W82-00497 2K

OXYGEN
An Analysis of Factors Affecting Oxygen Depletion in the New York Bight, W82-00106 5C

OXYGEN DEPLETION
An Analysis of Factors Affecting Oxygen Depletion in the New York Bight, W82-00106 5C

OXYGENATION
Pressurized Oxygenation System and Method, W82-00064 5D

OYSTERS
Design, Evaluation and Effluent Water Quality Analysis of Three Oyster Shellstock Washers, W82-00406 5D

OZONATION
High-Level Ozone Disinfection of Municipal Wastewater Effluents, W82-00379 5D

Assessment of Environmental Control Technology for Coal Conversion Processes, W82-00432 5D

Ozone Treatment of Potable Water - Part I, W82-00451 5F

OZONE
The Effect of Bentonite Clay on Ozone Disinfection of Bacteria and Viruses in Water, W82-00292 5F

Ozone Treatment of Potable Water--Part 2, W82-00452 5F

PACIFIC NORTHWEST
Water, Energy and Labor Requirements for Future Pacific Northwest Irrigation, W82-00143 6A

PARAMETRIC HYDROLOGY
Aquifer Parameter Identification with Optimum Dimension in Parameterization, W82-00131 2F

PARTICLE SIZE
Sediment Trap Dynamics and Calibration: A Laboratory Evaluation, W82-00104 7B

Field Assessment of Sediment Traps, W82-00105 7B

LIBRARY U. OF ILL. URBANA-CHAMPAIGN

The Effect of Centrifugation on the Suspended Particles of River Waters,
W82-00124 5A

Seasonal Particle-Size Selection by Diaptomus Sicilis in Offshore Lake Michigan,
W82-00485 2H

PARTICULATE MATTER
Enrichment and Association of Bacteria and Particulates in Salt Marsh Surface Water,
W82-00201 2L

PASTURES
The Conservative Effect of Rainfall Variation on Fertiliser Response in a Humid Environment,
W82-00316 2A

PATENTS
Process for the Removal of Inorganic Salts From a Water Stream,
W82-00055 5F

Method and Apparatus for Pollutant Spill Control,
W82-00056 5G

Land Restoration Following Oil-Well Drilling,
W82-00057 5D

Process for Removal of Mercury and Mercury Compounds From Aqueous Solutions and Industrial Waste Liquors,
W82-00058 5D

Energy Recovery System,
W82-00059 5D

Apparatus for the Purification of Oily Emulsions, Solutions, and Industrial Waste Waters,
W82-00060 5D

Fluoridation System,
W82-00061 5F

Means and Method for Sweeping Material Floating on Water Using Vibrational Energy,
W82-00062 5G

Process for Removing Alkalinity and Hardness From Waters,
W82-00063 5F

Pressurized Oxygenation System and Method,
W82-00064 5D

Underwater Aerator,
W82-00065 5D

High Capacity Waste Water Treatment System,
W82-00066 5D

Floating Breakwater,
W82-00067 8A

Rainwater Gauge,
W82-00068 2B

Apparatuses for the Anaerobic Digestion of Natural Organic Waste,
W82-00069 5D

PEACHES
Effect of Irrigation and Tree Density on Peach Production,
W82-00120 2I

PENNSYLVANIA
The Influence of Stream Order and Selected Stream Bed Parameters on Fish Diversity in Raystown Branch, Susquehanna River Drainage, Pennsylvania,
W82-00109 2E

PEOPLE'S REPUBLIC OF CHINA
A New Era for China's Hydropower,
W82-00335 8A

China's Potential for Hydro Development,
W82-00336 8A

PEOPLES REPUBLIC OF CHINA
Dam Construction in China.
W82-00334 8A

PERFORMANCE EVALUATION
Furrow Irrigation Practices in Northern Colorado,
W82-00139 3F

Water Conservation Devices for New or Existing Dwellings,
W82-00401 3D

PERMETHRIN
Behavior of DDT, Kepone, and Permethrin in Sediment-Water Systems Under Different Oxidation-Reduction and PH Conditions,
W82-00382 5B

PESTICIDE RESIDUES
Effect of Agricultural Land Development on Drainage Waters in the North Carolina Tidewater Region,
W82-00094 5B

Determination of Aminocarb in Water by High Performance Liquid Chromatography,
W82-00232 5A

Behavior of DDT, Kepone, and Permethrin in Sediment-Water Systems Under Different Oxidation-Reduction and PH Conditions,
W82-00382 5B

PESTICIDES
Sorption-Desorption of Lindane by Anaerobic and Aerobic Soils,
W82-00189 5A

Behavior of Trifluralin in Aquatic Model Ecosystems,
W82-00233 5C

PHASE ISOLATION PONDS
Facultative Lagoon Effluent Polishing Using Phase Isolation Ponds,
W82-00092 5D

PHENOLS
Determination of Priority Pollutant Phenols in Water by HPLC,
W82-00110 5A

Solvent Extraction of Phenols,
W82-00438 5D

Assessment of Solvent Extraction for Treatment of Coal Gasifier Wastewater,
W82-00439 5D

PHOSPHATE MINING
Treatment of Florida Surface Waters for Use in Phosphate Beneficiation,
W82-00048 5D

Radionuclide Concentrations in Streams in the Upper Blackfoot River Basin, Southeastern Idaho,
W82-00418 5A

PHOSPHATES
Interference of Sulphide in Inorganic Phosphate Determination in Natural Waters,
W82-00154 5A

PHOSPHORUS
Modeling Phosphorus Loading and Lake Response Under Uncertainty: A Manual and Compilation of Export Coefficients.
W82-00039 5B

Factors Affecting Phosphorus Release from Intact Lake Sediment Cores,
W82-00251 2H

Postdepositional Mobility of Phosphorus in Lake Sediments,
W82-00474 2H

PHOSPHORUS COMPOUNDS
Phosphorus Dynamics of a Florida Freshwater Marsh Receiving Treated Wastewater,
W82-00108 5E

An Empirical Equation for Predicting Soluble Phosphorus Loads from Agricultural Watersheds,
W82-00134 5B

Prediction of Total Phosphorus Concentrations, Chlorophyll a, and Secchi Depths in Natural and Artificial Lakes,
W82-00400 2H

PHOSPHORUS REMOVAL
Phosphorus Dynamics of a Florida Freshwater Marsh Receiving Treated Wastewater,
W82-00108 5E

PHYTOPLANKTON
Reduction, Methylation, and Incorporation of Arsenic into Lipids by the Marine Phytoplankton Dunaliella Tertiolecta,
W82-00239 5B

Effects of Halogenated Organic Compounds on Photosynthesis in Estuarine Phytoplankton,
W82-00266 5C

The Prediction of Lacustrine Phytoplankton Diversity,
W82-00319 2H

The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 1: Description of the System and the Study of the High Rate Pond,
W82-00455 5D

The Importance of Regenerated Nitrogen to Phytoplankton Productivity in a Subalpine Lake,
W82-00476 2H

PICLORAM
Picloram Dissipation in a Small Southwestern Stream,
W82-00212 5B

PILOT PLANTS
An Alternative Solution to the THM Problem,
W82-00072 5F

Physical/Chemical Treatment of Blast Furnace Wastewaters Using Mobile Pilot Units,
W82-00378 5D

PIPELINES
A/C Pipe - Assessment or Advocacy,
W82-00070 5F

Water Pollution Potential of Coal-Slurry Pipelines,
W82-00096 6A

Northeastern New Jersey Grapples With a Drought,
W82-00289 8A

Rocky Mountain Pipeline Project: Environmental Impact Statement,
W82-00394 5G

PIT RIVER BASIN
Water Resources Appraisal for Hydroelectric Licensing: Pit River Basin, California.
W82-00373 6B

PLANKTON
Biological Consequences of Treating a Lake with Hydrogen Peroxide on the Plankton Biocenosis (Biologiques Du Traitement D'Un Lac Avec Du Peroxyde D'Hydrogene Sur La Biocenose Planctonique),
W82-00305 2H

PLANKTON NETS
BIONESS, A New Design in Multiple Net Zooplankton Samplers,
W82-00210 7B

PLANNING
Water Related Planning and Design at Energy Firms,
W82-00042 6D

A 10-Year Plan to Study the Aquifer System of Indian Wells Valley, California,
W82-00086 6D

Water, Energy and Labor Requirements for Future Pacific Northwest Irrigation,
W82-00143 6A

Treatment Works--The Designer's Problems,
W82-00312 5F

Before the Well Runs Dry: A Handbook for Designing a Local Water Conservation Plan.
W82-00396 3D

PLANTS
Effects of Soil Water Regime and Nitrogen Form on Blossom-End Rot, Yield, Water Relations, and Elemental Composition of Tomato,
W82-00162 2I

PLUMBING
Water Conservation Devices for New or Existing Dwellings,
W82-00401 3D

PLUTONIUM
Solution Species of Plutonium in the Environment,
W82-00163 5A

POLITICAL ASPECTS
A 201 Pollution Control Planning Tragedy,
W82-00285 6E

POLLUTANT IDENTIFICATION
Development of Oil-In-Water Monitor, Phase II,
W82-00100 5A

A Salicylate-Hypochlorite Method for Determining Ammonia in Seawater,
W82-00238 5A

Concentration of Seeded Simian Rotavirus SA-11 from Potable Waters by Using Talc-Celite Layers and Hydroextraction,
W82-00272 5A

Analytical Methods Evaluation for Applicability in Leachate Analysis,
W82-00380 5A

Radionuclide Concentrations in Streams in the Upper Blackfoot River Basin, Southeastern Idaho,
W82-00418 5A

Application of a Multiple Alginate Filter Method for the Determination of Water Viruses Concentration (Conception D'Une Membrane Filtrante a Base D'Alginate Pour La Concentration Des Virus Hydriques),
W82-00458 5A

Understanding Acid Rain,
W82-00479 5B

POLLUTANTS
Polychlorinated Biphenyl Transport in the Hudson River, New York,
W82-00008 5B

Analytical Methods Evaluation for Applicability in Leachate Analysis,
W82-00380 5A

POLLUTION LOAD
Sediment and Nutrient Movement from the Black Creek Watershed,
W82-00135 5B

Environmental Control Technology for Shale Oil Wastewaters,
W82-00444 5D

POLUTANT IDENTIFICATION
Solution Species of Plutonium in the Environment,
W82-00163 5A

POLYCHLORINATED BIPHENOLS
Polychlorinated Biphenyl Transport in the Hudson River, New York,
W82-00008 5B

Relationship of Water Quality of Hudson River, New York, During Peak Discharges to Geologic Characteristics of Contributing Subbasins,
W82-00009 5B

POLYCHLORINATED BIPHENYLS
Modeling the Flux of Atmospheric Polychlorinated Biphenyls Across the Air/Water Interface,
W82-00193 5B

PONDING
An Infiltration Model: Development and Evaluation of Its Parameters,
W82-00137 2G

PONDS
Fenitrothion Sprayed on a Pond: Kinetics of Its Distribution and Transformation in Water and Sediment,
W82-00159 5B

PORE PRESSURE
Estimating End-Of-Construction Pore-Pressures in Unsaturated Earth Embankments,
W82-00194 8D

POROSITY
Ground-Water Flow and Uranium in Colorado Plateau,
W82-00282 2F

PORTAGE
Final Environmental Impact Statement, City of Portage Wastewater System, Columbia County, Wisconsin.
W82-00356 6G

POTABLE WATER
Chemical, Physical, and Radiological Quality of Selected Public Water Supplies in Florida, February-April 1980,
W82-00010 5F

Ozone Treatment of Potable Water - Part I,
W82-00451 5F

POTASSIUM
Sodium-Potassium Ratios in Soil Solution and Plant Response Under Saline Conditions,
W82-00469 3C

POTATO WASTES
Treatment of Potato-Processing Waste Water by an Anaerobic Lagoon-Filter System,
W82-00226 5D

POTATOES
Odorous Compounds from Potato Processing Waste Effluent Irrigation Fields: Volatile Acids,
W82-00156 5E

POTENTIOMETRIC LEVEL
Potentiometric Surface of the Floridan Aquifer in the Suwannee River Water Management District, Florida, May 1980,
W82-00024 7C

Potentiometric Surface of the Floridan Aquifer in the Northwest Florida Water Management District, May 1980,
W82-00025 7C

POTOMAC RIVER ESTUARY
Assessment of 1978 Water Quality Conditions in the Upper Potomac Estuary,
W82-00052 5C

POWER PLANTS
Power Plant Water Intake Assessment,
W82-00216 6G

POWERPLANTS
Water Related Planning and Design at Energy Firms,
W82-00042 6D

Domestic Water Supplies for Power Plant Cooling,
W82-00180 6D

PRECIPITATION
Chemistry of Precipitation at Gainesville, Florida,
W82-00185 2K

Report on the Summer MONEX Field Phase,
W82-00265 2B

Recent Variations in Winter Extratropical Cyclone Activity for the Australian Region,
W82-00315 2B

PREDICTION
Prediction of Total Phosphorus Concentrations, Chlorophyll a, and Secchi Depths in Natural and Artificial Lakes,
W82-00400 2H

PRETREATMENT OF WATER
Field Evaluation of a Swirl Degritter at Tamworth, New South Wales, Australia,
W82-00376 5F

PRINCE WILLIAM FOREST PARK
Water Resources of Prince William Forest Park, Virginia,
W82-00026 7C

PRIORITIES
Prioritization of Chemicals According to the Degree of Hazard in the Aquatic Environment,
W82-00300 5C

PROBABILISTIC PROCESS
The Limitations and Usefulness of Streamflow Generation Methods: A Case Study,
W82-00229 6A

PROCESS WATER
Processing Needs and Methodology for Wastewaters from the Conversion of Coal, Oil Shale and Biomass to Synfuels.
W82-00431 5D

Treatment of Coal Gasification Process Wastewaters,
W82-00434 5D

Environmental Control Technology for the Flash Hydropyrolysis of Coal,
W82-00435 5D

Characterization and Processing of Coal Conversion Process Wastewaters,
W82-00441 5D

PROJECT PLANNING
Northeastern New Jersey Grapples With a Drought,
W82-00289 8A

PROJECTS
Water Resources Investigations in New York--1980.
W82-00011 7C

PUBLIC HEALTH
A/C Pipe - Assessment or Advocacy,
W82-00070 5F

Distribution and Balance of Volatile Halogenated Hydrocarbons in the Water and Air of Covered Swimming Pools Using Chlorine for Water Disinfection,
W82-00128 5F

Transformation of the Mouse Clonal Cell Line R846-DP8 by Mississippi River, Raw, and Finished Water Samples from Southeastern Louisiana,
W82-00215 5C

PUBLIC OPINION
Reclaiming and Reusing Wastewater,
W82-00402 5D

PUBLICATIONS
Ground-Water Information: NWWA Provides the Resources,
W82-00301 2F

Summary of U.S. Geological Survey Investigations and Hydrologic Conditions in Southwest Florida for 1979,
W82-00419 10C

PULP AND PAPER INDUSTRY
Evaluation of Methodologies for the Determination of Acute Toxicity in Pulp and Paper Effluents,
W82-00297 5A

The Operation of a Waste Treatment Plant. Process Dynamic Considerations,
W82-00298 5D

Pulp Companies Face Billion Dollar Cleanup.
W82-00343 5D

PULP WASTES
Methane Production from Ozonated Pulp Mill Effluent,
W82-00155 5D

PUMP TURBINES
Optimization of Pump Turbines,
W82-00181 8C

PUMPAGE
Legal Aspects of Subsidence Due to Well Pumping,
W82-00170 6E

Northeastern New Jersey Grapples With a Drought,
W82-00289 8A

RADIOACTIVE WASTE DISPOSAL
Absorption of Radium and Thorium From New Mexico Uranium Mill Tailing Solutions,
W82-00040 5D

Strategy for Radioactive Waste Disposal in Crystalline Rocks,
W82-00299 5E

Water Level Data for Wells in and Near Burial Ground 3, Oak Ridge National Laboratory, Tennessee, 1975-1979,
W82-00423 7C

RADIONUCLIDES
Radionuclide Concentrations in Streams in the Upper Blackfoot River Basin, Southeastern Idaho,
W82-00418 5A

RADIUM
Absorption of Radium and Thorium From New Mexico Uranium Mill Tailing Solutions,
W82-00040 5D

RAIN
Effect of Mulch Rate on Soil Loss by Raindrop Splash,
W82-00468 2J

Measurements of Hydrogen Peroxide in Rainwater,
W82-00497 2K

RAIN GAGES
Rainwater Gauge,
W82-00068 2B

RAINFALL
Some Limiting Forms of the Poisson Distribution of Annual Station Precipitation,
W82-00132 2B

Report on the Summer MONEX Field Phase,
W82-00265 2B

RAINFALL DISTRIBUTION
Characterizing Short Duration Rainfall Intensities for Runoff Calculation,
W82-00142 2A

RAINFALL IMPACT
Environmental Resources and Restraints to Agricultural Production in a Mediterranean-Type Environment,
W82-00329 2I

RAINFALL INFILTRATION
Physical Effects of Vehicular Disturbances on Arid Landscapes,
W82-00111 4C

An Infiltration Model: Development and Evaluation of Its Parameters,
W82-00137 2G

RAINFALL INTENSITY
Rainfall Intensity-Kinetic Energy Relationships for Soil Loss Prediction,
W82-00466 2J

RAINFALL-RUNOFF RELATIONSHIPS
Hydrologic Data for Urban Studies in the Austin, Texas Metropolitan Area, 1979,
W82-00083 7C

The Conservative Effect of Rainfall Variation on Fertiliser Response in a Humid Environment,
W82-00316 2A

Effects of Tillage and Gypsum Incorporation on Rain Runoff and Crust Strength in Field Soils Irrigated With Saline-Sodic Water,
W82-00327 2A

RAINWATER
Measurements of Hydrogen Peroxide in Rainwater,
W82-00497 2K

RAW WASTEWATER
Wastewater Treatment by Rooted Aquatic Plants in Sand and Gravel Trenches,
W82-00093 5D

RAW WATER
Transformation of the Mouse Clonal Cell Line R846-DP8 by Mississippi River, Raw, and Finished Water Samples from Southeastern Louisiana,
W82-00215 5C

RECHARGE
Possibilities of Using Helium and Tritium Surveys for Studying Recharge Conditions of Subsurface Waters,
W82-00302 7B

RECLAIMED WATER
Water and Wastewater Reclamation: An Economical Answer to Industrial Wastes and Pollution,
W82-00188 3E

Total Organic Halogen as a Parameter for the Characterization of Reclaimed Waters: Measurement, Occurrence, Formation, and Removal,
W82-00197 5D

Reclaiming and Reusing Wastewater,
W82-00402 5D

RECREATION
Human Use in a Dispersed Recreation Area and its Effect on Water Quality,
W82-00393 5B

RECREATION DEMAND
The Valuation of Recreational Fisheries,
W82-00348 6C

RECREATION FACILITIES
Estimating the Physical Carrying Capacity of Recreation Areas: A Rationale for Application of the Universal Soil Loss Equation,
W82-00274 2J

RECREATION WASTES
Human Use in a Dispersed Recreation Area and its Effect on Water Quality,
W82-00393 5B

RECYCLING
Treatment of Florida Surface Waters for Use in Phosphate Beneficiation,
W82-00048 5D

Ames' Mutagenic Activity in Recycled Water from an Israeli Water Reclamation Project,
W82-00234 5D

REDOX POTENTIAL
Behavior of DDT, Kepone, and Permethrin in Sediment-Water Systems Under Different Oxidation-Reduction and PH Conditions,
W82-00382 5B

REGIONAL ANALYSIS
Geographic Information Systems and Environmental Impact Assessment,
W82-00338 7C

REGIONAL PLANNING
The Horse Creek Basin Project,
W82-00071 5G

REGULATIONS
Graphical Effluent Quality Control for Compliance Monitoring: What Is a Violation,
W82-00261 5G

Summary of the New England Conference on Legal and Institutional Incentives to Small-Scale Hydroelectric Development, January 30-31, 1979, Boston, Massachusetts.
W82-00447 6E

Executive Summary, Legal Obstacles and Incentives to Small-Scale Hydroelectric Development in the Six Middle Atlantic States.
W82-00448 6E

REMOTE SENSING
A Qualitative Appraisal of the Hydrology of the Yemen Arab Republic from Landsat Images,
W82-00022 7B

SEASAT SAR Response from Water Resources Parameters,
W82-00101 7B

RESEARCH PRIORITIES
Engineering Research and the Water Industry,
W82-00313 8A

RESERVOIR CONSTRUCTION
Impact of Construction of a Hydroelectric Project on the Water Quality of Five Lakes in Nova Scotia,
W82-00227 5C

RESERVOIR DESIGN
The Limitations and Usefulness of Streamflow Generation Methods: A Case Study,
W82-00229 6A

RESERVOIR OPERATION
Northeastern New Jersey Grapples With a Drought,
W82-00289 8A

An Analysis of Reservoir Storage Contents for the Proposed Enlargement of Bumping Lake in Washington,
W82-00421 4A

RESERVOIR STORAGE
Analysis of Capacity Requirements for Storage Reservoirs: A Case Study,
W82-00341 6A

An Analysis of Reservoir Storage Contents for the Proposed Enlargement of Bumping Lake in Washington,
W82-00421 4A

RESERVOIRS
Water Quality Management Studies, Lake Seminole, April-November 1978.
W82-00051 6G

Nitrogen Fixation and the Nitrogen Budget of a Eutrophic Impoundment,
W82-00127 2H

RESINS
Removal and Recovery of Organic Pollutants from the Aquatic Enviroment. 2. Removal and Recovery of Dodecylbenzenesulfonate from Aqueous Solution by Cross-Linked Poly(N-Benzyl-4-Vinylpyridinium Halide),
W82-00217 5D

RESONANCE
Resonator Studies for Kincardine Harbour, Lake Huron,
W82-00228 8B

RESOURCE DEVELOPMENT
Water Supply and Demand in an Energy Supply Model,
W82-00050 6D

RESOURCES ALLOCATION
The Valuation of Recreational Fisheries,
W82-00348 6C

RESOURCES DEVELOPMENT
Ground Water Availability,
W82-00027 6D

State-of-the-Art of Liquid Waste Disposal for Geothermal Energy Systems: 1979,
W82-00375 5E

RESPIRATION
An Aquatic Respirometer for Use in Sublethal Studies,
W82-00122 5C

RESPIROMETER
Use of the Electrolytic Respirometer to Measure Biodegradation in Natural Waters,
W82-00126 5A

REVIEWS
Small-Scale Hydro in New England: 1960-1976,
W82-00169 6D

RICE
Effect of Microcrustaceans on Blue-Green Algae in Flooded Soil,
W82-00146 6G

Effects of Water Regime on Growth, Yield, and Nitrogen Uptake of Rice,
W82-00330 2I

RIPRAP
Model Study of a Box-Inlet Chute Spillway and SAF Stilling Basin,
W82-00046 8A

RISKS
Water Treatment Model for Pollutant Exposure Assessment,
W82-00500 5F

RIVER BASIN DEVELOPMENT
Basin Management in the San Bernardino Valley,
W82-00075 4B

Basin Landscape-Halogeochemical Method of Evaluating the Natural and Reclamation Conditions of Irrigated Territories,
W82-00303 2K

RIVERS
Evaluation of the Malaga Bend Salinity Alleviation Project, Eddy County, New Mexico,
W82-00018 5B

Use of River Waters That Did Not Reach the Aral Sea as a Consequence of Economic Activity During 1961-1975,
W82-00190 4A

Method for Recovering Viruses from River Water Solids,
W82-00200 5A

Isolation, Enumeration, and Characterization of Aeromonas from Polluted Waters Encountered in Diving Operations,
W82-00224 5C

Longitudinal Succession in Impact Assessment of River System Fish Communities,
W82-00399 5C

Characterization of Soluble and Colloidal-Phase Metal Complexes in River Water by Ultrafiltration. A Mass-Balance Approach,
W82-00480 5A

ROCK FILL
Shear Strength of Rockfill,
W82-00116 8D

ROCKFILL DAMS
Shear Strength of Rockfill,
W82-00116 8D

A Laboratory Model for Under-Water Construction of a Dam,
W82-00347 8D

ROCKS
Water-Rock Partition Coefficients and the Composition of Natural Waters - A Reassessment,
W82-00284 2K

ROCKY MOUNTAIN PIPELINE PROJECT
Rocky Mountain Pipeline Project: Environmental Impact Statement,
W82-00394 5G

ROOT DEVELOPMENT
SOYROOT - A Dynamic Model of Soybean Root Growth and Water Uptake,
W82-00114 2I

ROTARY DRILLING
Hydrogeologic Data from Test Drilling near Verna Beach, Florida, 1978,
W82-00424 2F

RUNOFF
Terrace Planning Criteria for Runoff Control for Deep Loess Soil,
W82-00144 4D

Amounts and Relative Significance of Runoff Types in the Transport of Nitrogen into a Stream Draining an Agricultural Watershed,
W82-00173 5B

Pollution From Land Runoff,
W82-00253 5B

RUNOFF FORECASTING
Planning Study to Model and Monitor Coal Pile Run-Off,
W82-00091 6A

Characterizing Short Duration Rainfall Intensities for Runoff Calculation,
W82-00142 2A

RURAL AREAS
Bacterial Contamination of Drinking Water Supplies in a Modern Rural Neighborhood,
W82-00198 5A

Staphylococcus Aureus in Rural Drinking Water,
W82-00223 5B

Hygiene of Drinking Water in Developing Countries,
W82-00269 5F

Development of a Rural Water District,
W82-00288 6A

Upflow Water Filtration Unit, Test Results,
W82-00407 5F

SACRAMENTO RIVER
Flood Data for the Sacramento River and Butte Basin 1875 to 1978, Sacramento Valley, California,
W82-00019 2E

SALINE WATER
Effects of Tillage and Gypsum Incorporation on Rain Runoff and Crust Strength in Field Soils Irrigated With Saline-Sodic Water,
W82-00327 2A

SALINITY
Evaluation of the Malaga Bend Salinity Alleviation Project, Eddy County, New Mexico,
W82-00018 5B

Sodium-Potassium Ratios in Soil Solution and Plant Response Under Saline Conditions,
W82-00469 3C

SALMON
Natural Variation in Abundance of Salmonid Populations in Streams and its Implications for Design of Impact Studies,
W82-00389 5C

SALT MARSHES
Geochemistry of a Subarctic Salt Marsh Environment,
W82-00148 2L

Enrichment and Association of Bacteria and Particulates in Salt Marsh Surface Water,
W82-00201 2L

Populations of Methane-Producing Bacteria and In Vitro Methanogenesis in Salt Marsh and Estuarine Sediments,
W82-00202 2L

Enumeration and Relative Importance of Acetylene-Reducing (Nitrogen-Fixing) Bacteria in a Delaware Salt Marsh,
W82-00248 2L

SALTS
Areal Predictions of Water and Solute Flux in the Unsaturated Zone,
W82-00381 6A

SAMPLE PRESERVATION
Redox Stability of Inorganic Arsenic(III) and Arsenic(V) in Aqueous Solution,
W82-00206 5A

SAMPLING
A More Versatile Soil Water Sampler,
W82-00191 7B

Graphical Effluent Quality Control for Compliance Monitoring: What Is a Violation,
W82-00261 5G

An Appraisal of Pond-Net Samples for Biological Monitoring of Lotic Macroinvertebrates,
W82-00308 7B

Understanding Acid Rain,
W82-00479 5B

SAN BERNARDINO VALLEY
Basin Management in the San Bernardino Valley,
W82-00075 4B

Basin Management in the San Bernardino Basin Area,
W82-00280 6A

SAN JUAN-CHAMA PROJECT
Hydraulic Sediment Model Study for Proposed Blanco Diversion Dam Modification,
W82-00446 8A

SAN PEDRO
Characterisation of Domestic and Industrial Sewage in Southern California Coastal Sediments Using Nitrogen, Carbon, Sulphur, and Uranium Tracers,
W82-00147 5B

SANTA BARBARA BASIN
Natural Abundances of 15N as a Source Indicator for Near-Shore Marine Sedimentary and Dissolved Nitrogen,
W82-00283 5B

SANTA CRUZ COUNTY
Evaluation of Ground-Water Monitoring Network, Santa Cruz County, California,
W82-00023 7A

SATELLITE TECHNOLOGY
SEASAT SAR Response from Water Resources Parameters,
W82-00101 7B

SCOTLAND
The Effect of Centrifugation on the Suspended Particles of River Waters,
W82-00124 5A

SEAWATER
A Salicylate-Hypochlorite Method for Determining Ammonia in Seawater,
W82-00238 5A

Water-Rock Partition Coefficients and the Composition of Natural Waters - A Reassessment,
W82-00284 2K

SECONDARY PRODUCTIVITY
Methane Production from Ozonated Pulp Mill Effluent,
W82-00155 5D

SECONDARY WASTEWATER
Phosphorus Dynamics of a Florida Freshwater Marsh Receiving Treated Wastewater,
W82-00108 5E

SECONDARY WASTEWATER TREATMENT
Final Environmental Impact Statement, City of Portage Wastewater System, Columbia County, Wisconsin.
W82-00356 6G

SEDIMENT CONTROL
Hydraulic Sediment Model Study for Proposed Blanco Diversion Dam Modification,
W82-00446 8A

SEDIMENT DEPOSITION
Neap-Spring Tide Sequences of Intertidal Shoal Deposits in a Mesotidal Estuary,
W82-00112 2L

SEDIMENT DISTRIBUTION
Deposition of Riverborne Organic Carbon in Floodplain Wetlands and Deltas,
W82-00034 2J

SEDIMENT TRANSPORT
Relationship of Water Quality of Hudson River, New York, During Peak Discharges to Geologic Characteristics of Contributing Subbasins,
W82-00009 5B

Secondary Flow, Shear Stress and Sediment Transport,
W82-00117 2J

Sediment and Nutrient Movement from the Black Creek Watershed,
W82-00135 5B

Sediment Transport in Norton Sound, Alaska,
W82-00151 2J

SEDIMENTATION
Erosion and Sedimentation in the Kenai River, Alaska,
W82-00015 2J

SEDIMENTS
Water Quality Management Studies, Lake Seminole, April-November 1978.
W82-00051 6G

Sediment Trap Dynamics and Calibration: A Laboratory Evaluation,
W82-00104 7B

Field Assessment of Sediment Traps,
W82-00105 7B

Sorption of Trace Cadmium on Clay Minerals and River Sediments: Effects of pH AND CD(II) Concentrations in a Synthetic River Water Medium,
W82-00174 2K

Influence of Estuarine Sediment on Virus Survival Under Field Conditions,
W82-00199 5A

Anaerobic Methane Oxidation: Occurrence and Ecology,
W82-00218 2H

Effect of Estuarine Sediment pH and Oxidation-Reduction Potential on Microbial Hydrocarbon Degradation,
W82-00243 2L

Comparison of In Situ and In Vitro Rates of Methane Release in Freshwater Sediments,
W82-00245 2H

Factors Affecting Phosphorus Release from Intact Lake Sediment Cores,
W82-00251 2H

Thermostabilization of Enteroviruses by Estuarine Sediment,
W82-00263 2L

Development of Bioassay Procedures for Defining Pollution of Harbor Sediments,
W82-00387 5C

Nitrogen Fixation and Methane Metabolism in a Stream Sediment-Water System Amended with Leaf Material,
W82-00486 2K

SEEPAGE CONTROL
Performance of Granular Soil Covers on Canals,
W82-00047 8D

SELENIUM
Gas Chromatographic Determination of Selenium (-II, O), -(IV), and -(VI) in Natural Waters,
W82-00257 5A

SEPARATION TECHNIQUES
Land Restoration Following Oil-Well Drilling,
W82-00057 5D

Process for Removal of Mercury and Mercury Compounds From Aqueous Solutions and Industrial Waste Liquors,
W82-00058 5D

Apparatus for the Purification of Oily Emulsions, Solutions, and Industrial Waste Waters,
W82-00060 5D

High Capacity Waste Water Treatment System,
W82-00066 5D

Removal and Recovery of Organic Pollutants from the Aquatic Enviroment. 2. Removal and Recovery of Dodecylbenzenesulfonate from Aqueous Solution by Cross-Linked Poly(N-Benzyl-4-Vinylpyridinium Halide),
W82-00217 5D

SEPTICITY
Chemistry of Septicity,
W82-00325 5D

SETTLEABLE SOLIDS
The Operation of a Waste Treatment Plant. Process Dynamic Considerations,
W82-00298 5D

SEWAGE BACTERIA
Incidence of Vibrio Alginolyticus and Bacteria of Sanitary Significance in the Bering Sea,
W82-00490 5A

Effect of Solar Radiation and Predacious Microorganisms on Survival of Fecal and Other Bacteria,
W82-00491 2L

SEWAGE TREATMENT
High Capacity Waste Water Treatment System,
W82-00066 5D

SEWER SYSTEMS
Final Environmental Impact Statement for Proposed Sewerage Facilities in the Marion County Lake Improvement District, Marion County, Kansas.
W82-00355 6G

Final Environmental Impact Statement for Wastewater Treatment Facilities; City of Olathe, Johnson County, Kansas.
W82-00357 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 2: The Green Lake Sanitary Sewer and Waste District, Kandiyohi County, Minnesota.
W82-00363 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 4: Steuben Lakes Regional Waste District, Steuben County, Indiana.
W82-00365 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 5: Otter Tail County Board of Commissioners, Otter Tail County, Minnesota.
W82-00366 5D

SEWERS
Engineering Research and the Water Industry,
W82-00313 8A

SHEAR STRESS
Secondary Flow, Shear Stress and Sediment Transport,
W82-00117 2J

SHELLFISH
An Analysis of Factors Affecting Oxygen Depletion in the New York Bight,
W82-00106 5C

Improved Method and Test Strategy for Recovery of Enteric Viruses from Shellfish,
W82-00219 5A

Does Salt Marsh Fertilization Enhance Shellfish Production. An Application of Flow Analysis,
W82-00259 2L

SHORE PROTECTION
The Significance of the Submarine Geology of Upper Spencer Gulf, South Australia, to Environmental Decision-Making,
W82-00314 2L

SILICATES
Silicates as Nonspecific Adsorbents of Bacteriophage: A Model for Purification of Water From Viruses,
W82-00350 5F

SINKS
Two-Dimensional Linearized Moisture Flow with Water Extraction,
W82-00405 2I

SITES
Index to Active Hydrologic Data Collection Sites in Florida, 1980-81,
W82-00425 7C

SKAGIT RIVER BASIN
Water Resources Appraisal for Hydroelectric Licensing: Skagit River Basin, Washington.
W82-00368 6D

SLATE BELT
The Effects of Surface Slaty Fragments on Soil Erosion by Water,
W82-00471 2J

SLUDGE
Electroplating Wastewater Sludge Characterization,
W82-00095 5E

Nitrogen Availability from Sewage Sludge,
W82-00158 5E

Enumeration of Potentially Pathogenic Bacteria from Sewage Sludges,
W82-00221 5A

Recovery of Indigenous Viruses from Wastewater Sludges, Using a Bentonite Concentration Procedure,
W82-00271 5D

Dispersal of Aspergillus Fumigatus from Sewage Sludge Compost Piles Subjected to Mechanical Agitation in Open Air,
W82-00273 5E

Response of Bacteria in Wastewater Sludge to Moisture Loss by Evaporation and Effect of Moisture Content on Bacterial Inactivation by Ionizing Radiation,
W82-00489 5D

Effects of Moisture Content on Long-Term Survival and Regrowth of Bacteria in Wastewater Sludge,
W82-00493 5E

SLUDGE CONDITIONING
Sludge Settling Hampered by Industrial Discharge,
W82-00290 5D

Lime Stabilization and Ultimate Disposal of Municipal Wastewater Sludges,
W82-00386 5E

SLUDGE DIGESTION
Sludge Settling Hampered by Industrial Discharge,
W82-00290 5D

SLUDGE DISPOSAL
Cropping Systems for Treatment and Utilization of Municipal Wastewater and Sludge,
W82-00097 5E

Comparative Analysis of Sludge and Refuse Leachate: A Preliminary Report,
W82-00287 5E

Final Environmental Impact Statement; Sludge Disposal and Land Reclamation in Fulton County, Illinois.
W82-00360 5E

Engineering Assessment of Vermicomposting Municipal Wastewater Sludges,
W82-00385 5E

Lime Stabilization and Ultimate Disposal of Municipal Wastewater Sludges,
W82-00386 5E

SLUDGE DRYING
Effects of Moisture Content on Long-Term Survival and Regrowth of Bacteria in Wastewater Sludge,
W82-00493 5E

SLURRIES
Water Pollution Potential of Coal-Slurry Pipelines,
W82-00096 6A

SLUSH
Illustration of the Roles of Snow in the Evolution of the Winter Cover of a Lake,
W82-00267 2C

SNOW
Effects of Volcanism on the Glaciers of Mount St. Helens,
W82-00007 2C

SNOW COVER
Illustration of the Roles of Snow in the Evolution of the Winter Cover of a Lake,
W82-00267 2C

SNOW MANAGEMENT
Economics of Snow Management for Agriculture in the Great Plains,
W82-00178 3F

SNOWMELT
Economics of Snow Management for Agriculture in the Great Plains,
W82-00178 3F

SOCIAL ASPECTS
Report of Survey of Corps of Engineers Construction Workforce,
W82-00102 6B

SODIUM
Sodium-Potassium Ratios in Soil Solution and Plant Response Under Saline Conditions,
W82-00469 3C

SOIL COLUMNS
Leaching of Calcium and Magnesium from Soil Columns as Affected by Form of Nitrogen in Applied Sewage,
W82-00192 5E

SOIL COMPACTION
Unsaturated Water Flow Through a Simulated Wheel Track,
W82-00473 2G

SOIL CONSERVATION
Protecting Agriculture's Natural Resource Base,
W82-00176 4D

SOIL CONTAMINATION
Deposition of Heavy Elements on Belgian Agricultural Soils,
W82-00306 5B

SOIL EROSION
Physical Effects of Vehicular Disturbances on Arid Landscapes,
W82-00111 4C

Erodibility of Streambank Materials of Low Cohesion,
W82-00136 2J

Effect of Crop Residue on Soil Loss from Continuous Row Cropping,
W82-00145 2J

Rainfall Intensity-Kinetic Energy Relationships for Soil Loss Prediction,
W82-00466 2J

Effect of Mulch Rate on Soil Loss by Raindrop Splash,
W82-00468 2J

Effects of Small Amounts of Residue on Furrow Erosion,
W82-00470 2J

The Effects of Surface Slaty Fragments on Soil Erosion by Water,
W82-00471 2J

SOIL MANAGEMENT
Estimating the Physical Carrying Capacity of Recreation Areas: A Rationale for Application of the Universal Soil Loss Equation,
W82-00274 2J

SOIL MOISTURE
Variation in Microbial Activity in Histosols and Its Relationship to Soil Moisture,
W82-00244 2G

SOIL PHYSICAL PROPERTIES
Unsaturated Water Flow Through a Simulated Wheel Track,
W82-00473 2G

SOIL PROFILES
Effects of Topsoil and Subsoil Thickness on Soil Water Content and Crop Production on a Disturbed Soil,
W82-00465 2G

SOIL PROPERTIES
The Effects of Surface Slaty Fragments on Soil Erosion by Water,
W82-00471 2J

SOIL SATURATION
Soil Hydraulic Stability in a Subsurface Drainage System,
W82-00115 2G

SOIL STABILITY
Soil Hydraulic Stability in a Subsurface Drainage System,
W82-00115 2G

SOIL STABILIZATION
Performance of Granular Soil Covers on Canals,
W82-00047 8D

SOIL STRENGTH
Effects of Tillage and Gypsum Incorporation on Rain Runoff and Crust Strength in Field Soils Irrigated With Saline-Sodic Water,
W82-00327 2A

SOIL TYPES
Viral Transport Through Soil Columns Under Conditions of Saturated Flow,
W82-00295 5B

SOIL WATER
SEASAT SAR Response from Water Resources Parameters,
W82-00101 7B

Transient Soil Moisture Movement Through Layered Soils Using a Finite Element Approach,
W82-00133 2G

An Infiltration Model: Development and Evaluation of Its Parameters,
W82-00137 2G

A More Versatile Soil Water Sampler,
W82-00191 7B

A Comparative Study of Three Forms of the Richard Equation Used for Predicting One-Dimensional Infiltration in Unsaturated Soil,
W82-00328 2G

Environmental Resources and Restraints to Agricultural Production in a Mediterranean-Type Environment,
W82-00329 2I

Areal Predictions of Water and Solute Flux in the Unsaturated Zone,
W82-00381 6A

Effects of Topsoil and Subsoil Thickness on Soil Water Content and Crop Production on a Disturbed Soil,
W82-00465 2G

SOIL WATER MOVEMENT
Transient Soil Moisture Movement Through Layered Soils Using a Finite Element Approach,
W82-00133 2G

SOIL-WATER-PLANT RELATIONSHIPS
Effects of Soil Water Regime and Nitrogen Form on Blossom-End Rot, Yield, Water Relations, and Elemental Composition of Tomato,
W82-00162 2I

SOLAR RADIATION
Effect of Solar Radiation and Predacious Microorganisms on Survival of Fecal and Other Bacteria,
W82-00491 2L

SOLUBILITY
Measurement of the Solubilities of Slightly Soluble Organic Liquids in Water by Elution Chromatography,
W82-00207 5A

SOLVENTS
Determination of Trace Quantities of Dimethylsulfoxide in Aqueous Solutions,
W82-00205 5A

SORGHUM
Modeling Grain Sorghum Ratoon Cropping and Associated Runoff and Sediment Losses,
W82-00113 2G

SORPTION
Sorption of Trace Cadmium on Clay Minerals and River Sediments: Effects of pH AND CD(II) Concentrations in a Synthetic River Water Medium,
W82-00174 2K

Sorption-Desorption of Lindane by Anaerobic and Aerobic Soils,
W82-00189 5A

SOUNDS
Sediment Transport in Norton Sound, Alaska,
W82-00151 2J

SOUTH AFRICA
Nitrogen Fixation and the Nitrogen Budget of a Eutrophic Impoundment,
W82-00127 2H

Field Test of an Irrigation Scheduling Computer Model,
W82-00184 3F

Environmental Planning for Coal Strip Mining,
W82-00214 5G

SOUTH CAROLINA
Element Mass Balances for South Carolina Coastal Plain Watersheds,
W82-00175 5B

The Abundance of Estuarine Larval and Juvenile Fish in a South Carolina Intertidal Creek,
W82-00276 2L

SOUTH FORK AMERICAN RIVER PROJECT
Final Environmental Impact Statement; South Fork American River Development, Upper Mountain Project No. 2761 - California.
W82-00367 6G

SOUTHERN PIEDMONT
The Effects of Surface Slaty Fragments on Soil Erosion by Water,
W82-00471 2J

SOYBEANS
SOYROOT - A Dynamic Model of Soybean Root Growth and Water Uptake,
W82-00114 2I

SPATIAL DISTRIBUTION
Illustration of the Roles of Snow in the Evolution of the Winter Cover of a Lake,
W82-00267 2C

SPECIES DIVERSITY
The Prediction of Lacustrine Phytoplankton Diversity,
W82-00319 2H

SPECTROPHOTOMETRY
Interference of Sulphide in Inorganic Phosphate Determination in Natural Waters,
W82-00154 5A

SPECTROSCOPY
A Resonance Raman Method for the Rapid Detection and Identification of Bacteria in Water,
W82-00404 5A

SPENCER GULF
The Significance of the Submarine Geology of Upper Spencer Gulf, South Australia, to Environmental Decision-Making,
W82-00314 2L

SPILLWAYS
Model Study of a Box-Inlet Chute Spillway and SAF Stilling Basin,
W82-00046 8A

SPRINGVALE - BEAR CREEK
Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 3: Springvale-Bear Creek Sewage Disposal Authority, Emmet County, Michigan.
W82-00364 5D

SPRINKLER IRRIGATION
Water Application Uniformity of Hose Towed Traveler Irrigators,
W82-00296 3F

STABILIZATION PONDS
Virus Removal in Waste Stabilization Ponds in India,
W82-00121 5D

The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 1: Description of the System and the Study of the High Rate Pond,
W82-00455 5D

STAPHYLOCOCCUS AUREUS
Staphylococcus Aureus in Rural Drinking Water,
W82-00223 5B

STATE JURISDICTION
Summary of the New England Conference on Legal and Institutional Incentives to Small-Scale Hydroelectric Development, January 30-31, 1979, Boston, Massachusetts.
W82-00447 6E

Executive Summary, Legal Obstacles and Incentives to Small-Scale Hydroelectric Development in the Six Middle Atlantic States.
W82-00448 6E

STATISTICAL ANALYSIS
Water-Rock Partition Coefficients and the Composition of Natural Waters - A Reassessment,
W82-00284 2K

STATUTES
Legal Aspects of Subsidence Due to Well Pumping,
W82-00170 6E

STEEL INDUSTRY
Physical/Chemical Treatment of Blast Furnace Wastewaters Using Mobile Pilot Units,
W82-00378 5D

STEUBEN LAKES
Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 4: Steuben Lakes Regional Waste District, Steuben County, Indiana.
W82-00365 5D

STILLING BASIN
Model Study of a Box-Inlet Chute Spillway and SAF Stilling Basin,
W82-00046 8A

STOCHASTIC PROCESS
Analysis of Capacity Requirements for Storage Reservoirs: A Case Study,
W82-00341 6A

STORAGE CAPACITY
An Analysis of Reservoir Storage Contents for the Proposed Enlargement of Bumping Lake in Washington,
W82-00421 4A

STORAGE REQUIREMENTS
Analysis of Capacity Requirements for Storage Reservoirs: A Case Study,
W82-00341 6A

STORM RUNOFF
Hydrologic Data for Urban Studies in the Austin, Texas Metropolitan Area, 1979,
W82-00083 7C

STORM WATER
Modeling the Relationship Between Development and Storm Water and Nutrient Runoff,
W82-00260 2A

STORMS
Some Limiting Forms of the Poisson Distribution of Annual Station Precipitation,
W82-00132 2B

STREAM BANKS
Erodibility of Streambank Materials of Low Cohesion,
W82-00136 2J

STREAM ORDER
The Influence of Stream Order and Selected Stream Bed Parameters on Fish Diversity in Raystown Branch, Susquehanna River Drainage, Pennsylvania,
W82-00109 2E

STREAM POLLUTION
The Horse Creek Basin Project,
W82-00071 5G

STREAMFLOW
Report of the Annual Yield of the Arkansas River Basin for the Arkansas River Basin Compact, Arkansas--Oklahoma, 1980 Water Year,
W82-00012 6E

Quality of Water in Tibbee Creek and Tributaries Near West Point, Mississippi,
W82-00084 5B

Picloram Dissipation in a Small Southwestern Stream,
W82-00212 5B

Use of Flow-Duration Curves to Evaluate Effects of Urbanization on Streamflow Patterns on Long Island, New York,
W82-00416 4C

STREAMFLOW FORECASTING
The Limitations and Usefulness of Streamflow Generation Methods: A Case Study,
W82-00229 6A

STREAMS
Mudflows Resulting From the May 18, 1980, Eruption of Mount St. Helens, Washington,
W82-00003 5B

Relationship of Water Quality of Hudson River, New York, During Peak Discharges to Geologic Characteristics of Contributing Subbasins,
W82-00009 5B

Erosion and Sedimentation in the Kenai River, Alaska,
W82-00015 2J

A Comparison of Nitrogen in Shallow Ground Water from Sewered and Unsewered Areas, Nassau County, New York, from 1952 Through 1976,
W82-00277 5B

An Evaluation of Sources of Nitrogen as Causes of Ground-Water Contamination in Nassau County, Long Island,
W82-00279 5B

STREATOR
Final Environmental Impact Statement; Rehabilitation of Wastewater Facilities, Streator, Illinois.
W82-00361 5D

STRENGTH
Shear Strength of Rockfill,
W82-00116 8D

STRIP MINE WASTES
Hydraulic Properties of Coal and Related Materials, Northern Great Plains,
W82-00278 2F

STRIP MINES
Selective Overburden Placement,
W82-00053 5G

Premining Hydrologic Conditions of Five Southeastern Ohio Watersheds,
W82-00054 4C

The U.S. Geological Survey Coal Hydrology Program and the Potential of Hydrologic Models for Impact Assessments,
W82-00429 6E

SUBARCTIC ZONE
Aerial Biomass Distribution in an Undisturbed and Disturbed Subarctic Bog,
W82-00211 2C

SUBLETHAL EFFECTS
An Aquatic Respirometer for Use in Sublethal Studies,
W82-00122 5C

SUBMERGENCE
Geomorphic and Hydraulic Evolution of Tidal Creeks on a Subsiding Beach Ridge Plain, North Inlet, S.C.,
W82-00150 2L

SUBSIDENCE
Legal Aspects of Subsidence Due to Well Pumping,
W82-00170 6E

SUBSTRATES
Perpetual Shoals at the Entrance to Chesapeake Bay: Flow-Substrate Interactions and Mutually Evasive Net Currents,
W82-00149 2L

SUBSURFACE WATER
Possibilities of Using Helium and Tritium Surveys for Studying Recharge Conditions of Subsurface Waters,
W82-00302 7B

SUCCESSION
A Model of Natural and Man-Induced Changes in Open Freshwater Wetlands on the Massachusetts Coastal Plain,
W82-00397 2I

SULFATES
Sulfhydrolase Activity in Sediments of Wintergreen Lake, Kalamazoo County, Michigan,
W82-00241 2H

SULFIDES
Interference of Sulphide in Inorganic Phosphate Determination in Natural Waters,
W82-00154 5A

SULFUR COMPOUNDS
Reduction of Sulfur Compounds in the Sediments of a Eutrophic Lake Basin,
W82-00488 2H

SUNSPOTS
Solar Cycles and Erosional Events on the New South Wales Central and South Coasts,
W82-00318 2J

SURFACE RUNOFF
Planning Study to Model and Monitor Coal Pile Run-Off,
W82-00091 6A

Physical Effects of Vehicular Disturbances on Arid Landscapes,
W82-00111 4C

The Effects of Surface Slaty Fragments on Soil Erosion by Water,
W82-00471 2J

SURFACE WATER
Effects of the Mount St. Helens Eruption on the Benthic Fauna of the Toutle River, Muddy River, and Pine Creek Drainage Basins, Washington,
W82-00005 5C

Water Resources Investigations in New York--1980.
W82-00011 7C

Selected Hydrologic Data, Arkansas River Basin, Pueblo and Southeastern Fremont Counties, Colorado, 1975-80,
W82-00020 7C

Treatment of Florida Surface Waters for Use in Phosphate Beneficiation,
W82-00048 5D

Water Resources Data for New Hampshire and Vermont, Water Year 1980.
W82-00076 7C

Water Resources Data for West Virginia, Water Year 1980.
W82-00077 7C

Water Resources Data for Kansas, Water Year 1980--Volume 1. Missouri River Basin.
W82-00078 7C

Water Resources Data for Kansas, Water Year 1980--Volume 2. Arkansas River Basin.
W82-00079 7C

Water Resources Data for Texas, Water Year 1979--Volume 1. Arkansas River Basin, Red River Basin, Sabine River Basin, Neches River Basin, Trinity River Basin, and Intervening Coastal Basins.
W82-00080 7C

Water Resources Data for Texas, Water Year 1979--Volume 2. San Jacinto River Basin, Brazos River Basin, San Bernard River Basin and Intervening Coastal Basins.
W82-00081 7C

Water Resources Data for Texas, Water Year 1979--Volume 3. Colorado River Basin, Lavaca River Basin, Guadalupe River Basin, Nueces River Basin, Rio Grande Basin, and Intervening Coastal Basin.
W82-00082 7C

Quality of Water in Tibbee Creek and Tributaries Near West Point, Mississippi,
W82-00084 5B

Water-Resources Investigations of the U.S. Geological Survey in Wyoming, Fiscal Year 1980,
W82-00087 7C

Water-Resources Investigations of the U.S. Geological Survey in Colorado--Fiscal Year 1981.
W82-00088 7C

Areal Predictions of Water and Solute Flux in the Unsaturated Zone,
W82-00381 6A

Water in the Elizabethtown Area - A Study of Limestone Terrane in North-Central Kentucky,
W82-00413 5B

Radionuclide Concentrations in Streams in the Upper Blackfoot River Basin, Southeastern Idaho,
W82-00418 5A

Index to Active Hydrologic Data Collection Sites in Florida, 1980-81,
W82-00425 7C

The U.S. Geological Survey Coal Hydrology Program and the Potential of Hydrologic Models for Impact Assessments,
W82-00429 6E

SURFACTANTS
Use of the Electrolytic Respirometer to Measure Biodegradation in Natural Waters,
W82-00126 5A

Removal and Recovery of Organic Pollutants from the Aquatic Enviroment. 2. Removal and Recovery of Dodecylbenzenesulfonate from Aqueous Solution by Cross-Linked Poly(N-Benzyl-4-Vinylpyridinium Halide),
W82-00217 5D

SURVEYS
Hydraulic Gates: The State-of-the-Art,
W82-00332 8C

SUSPENDED SOLIDS
Polychlorinated Biphenyl Transport in the Hudson River, New York,
W82-00008 5B

The Effect of Centrifugation on the Suspended Particles of River Waters,
W82-00124 5A

Method for Recovering Viruses from River Water Solids,
W82-00200 5A

Lethality of a Suspended Clay to a Diverse Selection of Marine and Estuarine Macrofauna,
W82-00268 5C

Field Evaluation of a Swirl Degritter at Tamworth, New South Wales, Australia,
W82-00376 5F

Testing the Flocculation/Coagulation of Wastewater by Granulometric Analysis of Suspended Solids in the Water Using a Laser Diffraction Meter,
W82-00463 5D

SUSQUEHANNA RIVER BASIN
Flood Forecast and Warning System Evaluation, Susquehanna River Basin, New York, Pennsylvania and Maryland.
W82-00351 6F

SWAMPS
Vegetation and Nutrient Status of Northern Michigan Bogs and Conifer Swamps with a Comparison to Fens,
W82-00484 2I

Effects of Sewage Effluent Application on Litter Fall and Litter Decomposition in Cypress Swamps,
W82-00499 5E

SWIMMING POOLS
Distribution and Balance of Volatile Halogenated Hydrocarbons in the Water and Air of Covered Swimming Pools Using Chlorine for Water Disinfection,
W82-00128 5F

TADPOLES
Tadpoles as Indicators of Harmful Levels of Pollution in the Field,
W82-00478 5A

TAILWATER
Irrigation Tailwater Management,
W82-00392 3C

TANNERY WASTES
Advanced Biological Treatment of Tannery Wastewater,
W82-00337 5D

TAXONOMY
The Prediction of Lacustrine Phytoplankton Diversity,
W82-00319 2H

TENNESSEE
Geologic, Hydrologic and Chemical Data From Test Wells in the Dickson Area, Tennessee,
W82-00090 7C

Water Level Data for Wells in and Near Burial Ground 3, Oak Ridge National Laboratory, Tennessee, 1975-1979,
W82-00423 7C

The U.S. Geological Survey Coal Hydrology Program and the Potential of Hydrologic Models for Impact Assessments,
W82-00429 6E

TENNESSEE-TOMBIGBEE WATERWAY
Predicted Effects on Ground Water of Construction of Divide Cut Section, Tennessee-Tombigbee Waterway, Northeastern Mississippi Using a Digital Model,
W82-00428 2F

TERRACING
Terrace Planning Criteria for Runoff Control for Deep Loess Soil,
W82-00144 4D

TERROR LAKE
Final Environmental Impact Statement; Terror Lake Project No. 2743 - Alaska.
W82-00353 6G

TERTIARY TREATMENT
Continuous Bioregeneration of Granular Activated Carbon During the Anaerobic Degradation of Catechol,
W82-00408 5D

TERTIARY WASTEWATER TREATMENT
Phosphorus Dynamics of a Florida Freshwater Marsh Receiving Treated Wastewater,
W82-00108 5E

TEST WELLS
Geologic, Hydrologic and Chemical Data From Test Wells in the Dickson Area, Tennessee,
W82-00090 7C

TEXAS
Water Resources Data for Texas, Water Year 1979--Volume 1. Arkansas River Basin, Red River Basin, Sabine River Basin, Neches River Basin, Trinity River Basin, and Intervening Coastal Basins.
W82-00080 7C

Water Resources Data for Texas, Water Year 1979--Volume 2. San Jacinto River Basin, Brazos River Basin, San Bernard River Basin and Intervening Coastal Basins.
W82-00081 7C

Water Resources Data for Texas, Water Year 1979--Volume 3. Colorado River Basin, Lavaca River Basin, Guadalupe River Basin, Nueces River Basin, Rio Grande Basin, and Intervening Coastal Basin.
W82-00082 7C

Hydrologic Data for Urban Studies in the Austin, Texas Metropolitan Area, 1979,
W82-00083 7C

Preliminary Data From a Series of Artificial Recharge Experiments at Stanton, Texas,
W82-00085 7C

Optimal Design of Water Conveyance Systems,
W82-00160 6B

TEXTILE MILL WASTES
Textile Effluents Lose Their Color.
W82-00342 5D

THALLIUM
A Direct Differential Pulse Anodic Stripping Voltammetric Method for the Determination of Thallium in Natural Waters,
W82-00209 5A

THERMAL POLLUTION
Domestic Water Supplies for Power Plant Cooling,
W82-00180 6D

Field Experiments on Responses of a Freshwater, Benthic Macroinvertebrate Community to Vertebrate Predators,
W82-00477 5C

THERMAL STRESS
Field Experiments on Responses of a Freshwater, Benthic Macroinvertebrate Community to Vertebrate Predators,
W82-00477 5C

THERMODYNAMICS
Solution Species of Plutonium in the Environment,
W82-00163 5A

THIOCYANATES
Biological Oxidation of Aqueous Thiocyanate,
W82-00442 5D

THORIUM
Absorption of Radium and Thorium From New Mexico Uranium Mill Tailing Solutions,
W82-00040 5D

TIDAL EFFECTS
Neap-Spring Tide Sequences of Intertidal Shoal Deposits in a Mesotidal Estuary,
W82-00112 2L

TIDAL MARSHES
Geomorphic and Hydraulic Evolution of Tidal Creeks on a Subsiding Beach Ridge Plain, North Inlet, S.C.,
W82-00150 2L

TIDE LANDS
Effect of Agricultural Land Development on Drainage Waters in the North Carolina Tidewater Region,
W82-00094 5B

TILE DRAINAGE
Projected Tile Effluent Effects on the Oldman River,
W82-00333 5C

TIME SERIES ANALYSIS
Small-Scale Hydro in New England: 1960-1976,
W82-00169 6D

TOXICITY
Toxicity of Mount St. Helens Ash Leachate to a Blue-Green Alga,
W82-00001 5C

Biological Consequences of Treating a Lake with Hydrogen Peroxide on the Plankton Biocenosis (Biologiques Du Traitement D'Un Lac Avec Du Peroxyde D'Hydrogene Sur La Biocenose Planctonique),
W82-00305 2H

Development of Bioassay Procedures for Defining Pollution of Harbor Sediments,
W82-00387 5C

Clinical Tests in Aquatic Toxicology: State of the Art,
W82-00464 5A

Toxicity and Ecological Significance of Trace Elements in Aquatic Environments,
W82-00498 5B

TOXINS
An Aquatic Respirometer for Use in Sublethal Studies,
W82-00122 5C

Effectiveness of Activated Carbon for Removal of Toxic and/or Carcinogenic Compounds From Water Supplies,
W82-00383 5F

TRACE ELEMENTS
Trace Metal Geochemistry in Sediments from the Miramichi Estuary, New Brunswick,
W82-00236 5A

TRACE LEVELS
Identification of Organic Compounds in a Mutagenic Extract of a Surface Drinking Water by a Computerized Gas Chromatography/Mass Spectrometry System (GC/MS/COM),
W82-00256 5A

TRACE METALS
Characterization of Soluble and Colloidal-Phase Metal Complexes in River Water by Ultrafiltration. A Mass-Balance Approach,
W82-00480 5A

Toxicity and Ecological Significance of Trace Elements in Aquatic Environments,
W82-00498 5B

TRACERS
Carbon Isotopes as Indicators of the Source and Fate of Carbon in Rivers and Estuaries,
W82-00033 5B

Chemical Indicators of Organic River Sources in Rivers and Estuaries,
W82-00035 5B

TRAINING
National Water Data Exchange (NAWDEX) System 2000 Data Retrieval Manual,
W82-00420 10B

TRANSMISSIVITY
Aquifer Parameter Identification with Optimum Dimension in Parameterization,
W82-00131 2F

TRANSPIRATION CONTROL
Reduced Transpiration and Increased Water Efficiency by Diuron in Corn (Zea Mays),
W82-00196 2D

TRAP EFFICIENCY
Sediment Trap Dynamics and Calibration: A Laboratory Evaluation,
W82-00104 7B

Field Assessment of Sediment Traps,
W82-00105 7B

TRIHALOMETHANES
An Alternative Solution to the THM Problem,
W82-00072 5F

Temporal Variations in Trihalomethane Content of Drinking Water,
W82-00255 5A

Ozone Treatment of Potable Water--Part 2,
W82-00452 5F

TROPHIC LEVEL
Occurrence of Aphanomyces Ovidestruens, a Fungus Parasitic on Copepods, in Two Eutrophic Lakes,
W82-00304 2H

TYEE LAKE PROJECT
Final Environmental Impact Statement; Tyee Lake Project FERC No. 3015 - Alaska.
W82-00354 6G

ULTRAFILTRATION
Characterization of Soluble and Colloidal-Phase Metal Complexes in River Water by Ultrafiltration. A Mass-Balance Approach,
W82-00480 5A

UNDERGROUND WASTE DISPOSAL
Strategy for Radioactive Waste Disposal in Crystalline Rocks,
W82-00299 5E

Deep Well Injection of Industrial Wastes,
W82-00475 5E

UNSATURATED FLOW
A Comparative Study of Three Forms of the Richard Equation Used for Predicting One-Dimensional Infiltration in Unsaturated Soil,
W82-00328 2G

URANIUM
Computer Modeling of Fluid Flow During Production and Environmental Restoration Phases of In Situ Uranium Leaching,
W82-00043 6A

Ground-Water Flow and Uranium in Colorado Plateau,
W82-00282 2F

URBAN HYDROLOGY
Hydrologic Data for Urban Studies in the Austin, Texas Metropolitan Area, 1979,
W82-00083 7C

URBAN RUNOFF
Quarterly Progress Report, Nationwide Urban Runoff Program.
W82-00044 5G

Hydrologic Data for Urban Studies in the Austin, Texas Metropolitan Area, 1979,
W82-00083 7C

Modeling the Relationship Between Development and Storm Water and Nutrient Runoff,
W82-00260 2A

Use of Flow-Duration Curves to Evaluate Effects of Urbanization on Streamflow Patterns on Long Island, New York,
W82-00416 4C

URBANIZATION
Use of Flow-Duration Curves to Evaluate Effects of Urbanization on Streamflow Patterns on Long Island, New York,
W82-00416 4C

USSR
Use of River Waters That Did Not Reach the Aral Sea as a Consequence of Economic Activity During 1961-1975,
W82-00190 4A

VALVES
The Case for Specifying AWWA Butterfly Valves.
W82-00213 8C

VEGETATION
SEASAT SAR Response from Water Resources Parameters,
W82-00101 7B

A Model of Natural and Man-Induced Changes in Open Freshwater Wetlands on the Massachusetts Coastal Plain,
W82-00397 2I

VEGETATION EFFECTS
Flow Resistance in Vegetated Waterways,
W82-00152 2E

VERMONT
Water Resources Data for New Hampshire and Vermont, Water Year 1980.
W82-00076 7C

VERNA
Hydrogeologic Data from Test Drilling near Verna Beach, Florida, 1978,
W82-00424 2F

VIBRIO
Incidence of Vibrio Alginolyticus and Bacteria of Sanitary Significance in the Bering Sea,
W82-00490 5A

VIRGINIA
Water Resources of Prince William Forest Park, Virginia,
W82-00026 7C

VIRUSES
Virus Removal in Waste Stabilization Ponds in India,
W82-00121 5D

Influence of Estuarine Sediment on Virus Survival Under Field Conditions,
W82-00199 5A

Method for Recovering Viruses from River Water Solids,
W82-00200 5A

Improved Method and Test Strategy for Recovery of Enteric Viruses from Shellfish,
W82-00219 5A

Evaluation of the Overland Runoff Mode of Land Wastewater Treatment for Virus Removal,
W82-00220 5B

Technique for Determining Total Bacterial Virus Counts in Complex Aqueous Systems,
W82-00222 5A

Concentration of Poliovirus in Water by Molecular Filtration,
W82-00246 5A

Recovery of Indigenous Viruses from Wastewater Sludges, Using a Bentonite Concentration Procedure,
W82-00271 5D

The Effect of Bentonite Clay on Ozone Disinfection of Bacteria and Viruses in Water,
W82-00292 5F

Viral Transport Through Soil Columns Under Conditions of Saturated Flow,
W82-00295 5B

Silicates as Nonspecific Adsorbents of Bacteriophage: A Model for Purification of Water From Viruses,
W82-00350 5F

Application of a Multiple Alginate Filter Method for the Determination of Water Viruses Concentration (Conception D'Une Membrane Filtrante a Base D'Alginate Pour La Concentration Des Virus Hydriques),
W82-00458 5A

VOLCANIC ASH
Toxicity of Mount St. Helens Ash Leachate to a Blue-Green Alga,
W82-00001 5C

Mount St. Helens Volcanic-Ash Fall in the Bull Run Watershed, Oregon, March-June 1980,
W82-00002 5B

Effects of Mount St. Helens Eruption on Selected Lakes in Washington,
W82-00006 2H

VOLCANOES
Toxicity of Mount St. Helens Ash Leachate to a Blue-Green Alga,
W82-00001 5C

Mount St. Helens Volcanic-Ash Fall in the Bull Run Watershed, Oregon, March-June 1980,
W82-00002 5B

Mudflows Resulting From the May 18, 1980, Eruption of Mount St. Helens, Washington,
W82-00003 5B

Channel Conditions in the Lower Toutle and Cowlitz Rivers Resulting From the Mudflows of May 18, 1980,
W82-00004 5B

Effects of the Mount St. Helens Eruption on the Benthic Fauna of the Toutle River, Muddy River, and Pine Creek Drainage Basins, Washington,
W82-00005 5C

Effects of Mount St. Helens Eruption on Selected Lakes in Washington,
W82-00006 2H

Effects of Volcanism on the Glaciers of Mount St. Helens,
W82-00007 2C

VOLCANOES

The Aftermath at Longview,
W82-00073 5C

WALES
A Successful Transfer,
W82-00309 4A

WARNING SYSTEMS
Flood Forecast and Warning System Evaluation, Susquehanna River Basin, New York, Pennsylvania and Maryland.
W82-00351 6F

WASHINGTON
Toxicity of Mount St. Helens Ash Leachate to a Blue-Green Alga,
W82-00001 5C

Mudflows Resulting From the May 18, 1980, Eruption of Mount St. Helens, Washington,
W82-00003 5B

Channel Conditions in the Lower Toutle and Cowlitz Rivers Resulting From the Mudflows of May 18, 1980,
W82-00004 5B

Effects of the Mount St. Helens Eruption on the Benthic Fauna of the Toutle River, Muddy River, and Pine Creek Drainage Basins, Washington,
W82-00005 5C

Effects of Mount St. Helens Eruption on Selected Lakes in Washington,
W82-00006 2H

Effects of Volcanism on the Glaciers of Mount St. Helens,
W82-00007 2C

An Analysis of Reservoir Storage Contents for the Proposed Enlargement of Bumping Lake in Washington,
W82-00421 4A

WASTE CHARACTERISTICS
Slagging Fixed-Bed Gasifier (SFBG) Wastewater Pretreatment,
W82-00433 5D

WASTE DISPOSAL
Water-Related Environmental Control Requirements at Municipal Solid Waste-to-Energy Conversion Facilities,
W82-00037 5D

Lining of Waste Impoundment and Disposal Facilities.
W82-00099 5E

Slash Treatment After Clearcutting Lodgepole Pine Affects Nutrients in Soil Water,
W82-00130 4C

Anaerobic Treatment of Human Waste in Northern Communities,
W82-00249 5E

WASTE RECOVERY
Survival of Eggs and Larvae of Swine Nematode Parasites in Aerobic and Anaerobic Waste Treatment Systems,
W82-00161 5D

Leachates from Solid Waste Recovery Operations,
W82-00167 5D

WASTE STORAGE
Lining of Waste Impoundment and Disposal Facilities.
W82-00099 5E

WASTE TREATMENT
Land Restoration Following Oil-Well Drilling,
W82-00057 5D

Methane Production from Ozonated Pulp Mill Effluent,
W82-00155 5D

Anaerobic Treatment of Human Waste in Northern Communities,
W82-00249 5E

WASTE WATER TREATMENT
Design, Evaluation and Effluent Water Quality Analysis of Three Oyster Shellstock Washers,
W82-00406 5D

Continuous Bioregeneration of Granular Activated Carbon During the Anaerobic Degradation of Catechol,
W82-00408 5D

WASTEWATER
Evaluation of the Overland Runoff Mode of Land Wastewater Treatment for Virus Removal,
W82-00220 5B

Enumeration of Potentially Pathogenic Bacteria from Sewage Sludges,
W82-00221 5A

Technique for Determining Total Bacterial Virus Counts in Complex Aqueous Systems,
W82-00222 5A

WASTEWATER ANALYSIS
The Analysis of Oil Shale Wastes: A Review,
W82-00388 5A

WASTEWATER COMPOSITION
Assessment of Oil Shale Retort Wastewater Treatment and Control Technology - Phases I and II,
W82-00390 5B

WASTEWATER DISPOSAL
Cropping Systems for Treatment and Utilization of Municipal Wastewater and Sludge,
W82-00097 5E

Phosphorus Dynamics of a Florida Freshwater Marsh Receiving Treated Wastewater,
W82-00108 5E

Experimental Studies on the Effect of Arsenic on Microbial Degradation of Organic Matter and Algal Growth,
W82-00237 2H

Final Environmental Impact Statement, City of Portage Wastewater System, Columbia County, Wisconsin.
W82-00356 6G

State-of-the-Art of Liquid Waste Disposal for Geothermal Energy Systems: 1979,
W82-00375 5E

Sodium-Potassium Ratios in Soil Solution and Plant Response Under Saline Conditions,
W82-00469 3C

WASTEWATER FACILITIES
The Horse Creek Basin Project,
W82-00071 5G

Greece Won't Be Letting Wastewater Problems Slide.
W82-00182 5D

Final Environmental Impact Statement for Proposed Sewerage Facilities in the Marion County Lake Improvement District, Marion County, Kansas.
W82-00355 6G

Final Environmental Impact Statement, City of Portage Wastewater System, Columbia County, Wisconsin.
W82-00356 6G

Final Environmental Impact Statement for Wastewater Treatment Facilities; City of Olathe, Johnson County, Kansas.
W82-00357 5D

Final Environmental Impact Statement; Bemidji Wastewater Treatment System, Beltrami County, Minnesota.
W82-00358 5D

Final Environmental Impact Statement; Wastewater Treatment Facilities, South Shore Lake Tahoe Basin.
W82-00359 5D

Final Environmental Impact Statement; Rehabilitation of Wastewater Facilities, Streator, Illinois.
W82-00361 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 1: Crystal Lake Area Sewage Disposal Authority, Benzie County, Michigan.
W82-00362 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 2: The Green Lake Sanitary Sewer and Waste District, Kandiyohi County, Minnesota.
W82-00363 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 3: Springvale-Bear Creek Sewage Disposal Authority, Emmet County, Michigan.
W82-00364 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 4: Steuben Lakes Regional Waste District, Steuben County, Indiana.
W82-00365 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 5: Otter Tail County Board of Commissioners, Otter Tail County, Minnesota.
W82-00366 5D

Final Environmental Impact Statement; South Tahoe Public Utility District and Douglas County Sewer Improvement District No. 1, Appendix B: Mitigation Program.
W82-00369 6G

Joint Dry/Wet Weather Treatment of Municipal Wastewater at Clatskanie, Oregon,
W82-00391 5D

WASTEWATER LAGOONS
Facultative Lagoon Effluent Polishing Using Phase Isolation Ponds,
W82-00092 5D

WASTEWATER RENOVATION
Leachates from Solid Waste Recovery Operations,
W82-00167 5D

Refuse-To-Energy Wastewater Treatment,
W82-00168 5D

Chemical Recovery from Coal Conversion Wastes by Concentration,
W82-00436 5D

WASTEWATER TREATMENT
Water-Related Environmental Control Requirements at Municipal Solid Waste-to-Energy Conversion Facilities,
W82-00037 5D

Treatment of Florida Surface Waters for Use in Phosphate Beneficiation,
W82-00048 5D

Process for Removal of Mercury and Mercury Compounds From Aqueous Solutions and Industrial Waste Liquors,
W82-00058 5D

Energy Recovery System,
W82-00059 5D

Apparatus for the Purification of Oily Emulsions, Solutions, and Industrial Waste Waters,
W82-00060 5D

Pressurized Oxygenation System and Method,
W82-00064 5D

Underwater Aerator,
W82-00065 5D

High Capacity Waste Water Treatment System,
W82-00066 5D

Apparatuses for the Anaerobic Digestion of Natural Organic Waste,
W82-00069 5D

Facultative Lagoon Effluent Polishing Using Phase Isolation Ponds,
W82-00092 5D

Evaluation of the Effectiveness of Granular Activated Carbon Adsorption and Aquaculture for Removing Toxic Compounds From Treated Petroleum Refinery Effluents,
W82-00098 5D

Virus Removal in Waste Stabilization Ponds in India,
W82-00121 5D

Organic Micropollution Indices of Effluents and Renovated Waters,
W82-00123 5A

Modeling Ammonium Exchange and Regeneration on Clinoptilolite,
W82-00125 5D

Leachates from Solid Waste Recovery Operations,
W82-00167 5D

Refuse-To-Energy Wastewater Treatment,
W82-00168 5D

Foam Control in Aeration Tanks,
W82-00171 5D

Assimilation of Lemonade-Processing Wastewater by Yeasts,
W82-00204 5D

Treatment of Potato-Processing Waste Water by an Anaerobic Lagoon-Filter System,
W82-00226 5D

Concentration of Poliovirus in Water by Molecular Filtration,
W82-00246 5A

Design Guidelines for Incompletely Mixed or Aerobic-Anaerobic Aerated Lagoons,
W82-00250 5D

Pollutant Treatability: A Molecular Engineering Approach,
W82-00252 6E

Recovery of Indigenous Viruses from Wastewater Sludges, Using a Bentonite Concentration Procedure,
W82-00271 5D

The Alpha-Beta-Gamma's of Wastewater Treatment,
W82-00275 5D

Effects of Alpha, Beta and Theta Factor Upon the Design, Specification and Operation of Aeration Systems,
W82-00291 5D

Role of Hydrodynamic Factors in Ammonia Desorption by Diffused Aeration,
W82-00293 5D

The Operation of a Waste Treatment Plant. Process Dynamic Considerations,
W82-00298 5D

Luxury Uptake of Nitrogen in Flocculating Algal-Bacterial System,
W82-00307 5D

Small is Environmentally Acceptable . . .,
W82-00311 5D

Pilot Scales Tests on the Flotation of Abattoir Wastes by Deep U Tubes,
W82-00322 5D

A Realistic Assessment of the Effect of Settlement on Sewage,
W82-00324 5D

Advanced Biological Treatment of Tannery Wastewater,
W82-00337 5D

Recent Developments in Water Pollution Control,
W82-00340 5D

Textile Effluents Lose Their Color.
W82-00342 5D

Pulp Companies Face Billion Dollar Cleanup.
W82-00343 5D

Avoiding an Environmental Hangover.
W82-00344 5D

Rapid Growth Forecast for Peroxide.
W82-00345 5D

Final Environmental Impact Statement for Wastewater Treatment Facilities; City of Olathe, Johnson County, Kansas.
W82-00357 5D

Final Environmental Impact Statement; Bemidji Wastewater Treatment System, Beltrami County, Minnesota.
W82-00358 5D

Final Environmental Impact Statement; Wastewater Treatment Facilities, South Shore Lake Tahoe Basin.
W82-00359 5D

Final Environmental Impact Statement; Rehabilitation of Wastewater Facilities, Streator, Illinois.
W82-00361 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 1: Crystal Lake Area Sewage Disposal Authority, Benzie County, Michigan.
W82-00362 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 2: The Green Lake Sanitary Sewer and Waste District, Kandiyohi County, Minnesota.
W82-00363 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 3: Springvale-Bear Creek Sewage Disposal Authority, Emmet County, Michigan.
W82-00364 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 4: Steuben Lakes Regional Waste District, Steuben County, Indiana.
W82-00365 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 5: Otter Tail County Board of Commissioners, Otter Tail County, Minnesota.
W82-00366 5D

Limestone-Lime Treatment of Acid Mine Drainage - Full Scale,
W82-00377 5D

Physical/Chemical Treatment of Blast Furnace Wastewaters Using Mobile Pilot Units,
W82-00378 5D

High-Level Ozone Disinfection of Municipal Wastewater Effluents,
W82-00379 5D

Lime Stabilization and Ultimate Disposal of Municipal Wastewater Sludges,
W82-00386 5E

Assessment of Oil Shale Retort Wastewater Treatment and Control Technology - Phases I and II,
W82-00390 5B

Joint Dry/Wet Weather Treatment of Municipal Wastewater at Clatskanie, Oregon,
W82-00391 5D

High pH Treatment of Combined Water Softening and Wastewater Sludges,
W82-00403 5D

Processing Needs and Methodology for Wastewaters from the Conversion of Coal, Oil Shale and Biomass to Synfuels.
W82-00431 5D

Assessment of Environmental Control Technology for Coal Conversion Processes,
W82-00432 5D

Slagging Fixed-Bed Gasifier (SFBG) Wastewater Pretreatment,
W82-00433 5D

Treatment of Coal Gasification Process Wastewaters,
W82-00434 5D

Environmental Control Technology for the Flash Hydropyrolysis of Coal,
W82-00435 5D

Chemical Recovery from Coal Conversion Wastes by Concentration,
W82-00436 5D

Improved Water Management of Coal Conversion Processes by Preliminary Absorption of Halides,
W82-00437 5D

Solvent Extraction of Phenols,
W82-00438 5D

Assessment of Solvent Extraction for Treatment of Coal Gasifier Wastewater,
W82-00439 5D

Control Technology Strategies for Coal Preparation Waste Drainages,
W82-00440 5D

Characterization and Processing of Coal Conversion Process Wastewaters,
W82-00441 5D

Biological Oxidation of Aqueous Thiocyanate,
W82-00442 5D

Water-Related Environmental Control Requirements of Waste-to-Energy Conversion,
W82-00443 5D

Environmental Control Technology for Shale Oil Wastewaters,
W82-00444 5D

Potential Uses of Spent Shale in the Treatment of Oil Shale Retort Waters,
W82-00445 5D

The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 1: Description of the System and the Study of the High Rate Pond,
W82-00455 5D

The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 2: Studies of the Fish Ponds,
W82-00456 3C

The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 3: Maize Cultivation Experiment, Bacteriological Studies, and Economic Assessment,
W82-00457 3C

Management and Design Implications of a Mathematical Model of a Rapid Gravity Sand Filter Backwash,
W82-00460 5D

Low Temperature Removal of Nitrate by Bacterial Denitrification,
W82-00461 5D

Testing the Flocculation/Coagulation of Wastewater by Granulometric Analysis of Suspended Solids in the Water Using a Laser Diffraction Meter,
W82-00463 5D

Response of Bacteria in Wastewater Sludge to Moisture Loss by Evaporation and Effect of Moisture Content on Bacterial Inactivation by Ionizing Radiation,
W82-00489 5D

Effects of Moisture Content on Long-Term Survival and Regrowth of Bacteria in Wastewater Sludge,
W82-00493 5E

WATER ALLOCATION

Water Related Planning and Design at Energy Firms,
W82-00042 6D

Western Water Resources: Coming Problems and Policy Alternatives,
W82-00107 6D

WATER ANALYSIS

Determination of Priority Pollutant Phenols in Water by HPLC,
W82-00110 5A

Organic Micropollution Indices of Effluents and Renovated Waters,
W82-00123 5A

Determination of Trace Quantities of Dimethylsulfoxide in Aqueous Solutions,
W82-00205 5A

Redox Stability of Inorganic Arsenic(III) and Arsenic(V) in Aqueous Solution,
W82-00206 5A

Consecutive Amperometric Titrations for Calcium and Magnesium,
W82-00208 5A

A Direct Differential Pulse Anodic Stripping Voltammetric Method for the Determination of Thallium in Natural Waters,
W82-00209 5A

Determination of Aminocarb in Water by High Performance Liquid Chromatography,
W82-00232 5A

Identification of Organic Compounds in a Mutagenic Extract of a Surface Drinking Water by a Computerized Gas Chromatography/Mass Spectrometry System (GC/MS/COM),
W82-00256 5A

Gas Chromatographic Determination of Selenium (-II, O), -(IV), and -(VI) in Natural Waters,
W82-00257 5A

Determination of Organically Combined Chlorine in High Molecular Weight Aquatic Organics,
W82-00258 5A

Analytical Methods Evaluation for Applicability in Leachate Analysis,
W82-00380 5A

A Resonance Raman Method for the Rapid Detection and Identification of Bacteria in Water,
W82-00404 5A

Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aquatic Environments. II. Features of Fatty Acids for Polluted and Unpolluted Waters,
W82-00454 5A

Nitrosamines in Tap Water After Concentration by a Carbonaceous Adsorbent,
W82-00459 5A

Comparison of Automated Segmented-Flow and Discrete Analyzers for the Determination of Nutrients in Water,
W82-00483 5A

WATER CONSERVATION

Before the Well Runs Dry: A Handbook for Designing a Local Water Conservation Plan.
W82-00396 3D

Water Conservation Devices for New or Existing Dwellings,
W82-00401 3D

WATER CONVEYANCE

Optimal Design of Water Conveyance Systems,
W82-00160 6B

Cutting the Water Losses,
W82-00310 5F

WATER CURRENTS

Perpetual Shoals at the Entrance to Chesapeake Bay: Flow-Substrate Interactions and Mutually Evasive Net Currents,
W82-00149 2L

WATER DEMAND

Ground Water Availability,
W82-00027 6D

Ground Water Alternatives and Solutions,
W82-00029 6D

Supply Working Group Report.
W82-00030 6D

Water Related Planning and Design at Energy Firms,
W82-00042 6D

Water Supply and Demand in an Energy Supply Model,
W82-00050 6D

WATER DISTRIBUTION

Development of a Rural Water District,
W82-00288 6A

Mathematical Efficiency Concerns in Water Distribution Network Considerations,
W82-00339 5F

WATER LAW

Ground Water Conflicts and Barriers,
W82-00028 6E

Western Water Resources: Coming Problems and Policy Alternatives,
W82-00107 6D

WATER LEVEL

January 1980 Water Levels, and Data Related to Water-level Changes, Western and South-Central Kansas,
W82-00016 2F

Potentiometric Surface of the Floridan Aquifer in the Suwannee River Water Management District, Florida, May 1980,
W82-00024 7C

Potentiometric Surface of the Floridan Aquifer in the Northwest Florida Water Management District, May 1980,
W82-00025 7C

Water-Level Records for the Northern High Plains of Colorado, 1977-81,
W82-00422 7C

Water Level Data for Wells in and Near Burial Ground 3, Oak Ridge National Laboratory, Tennessee, 1975-1979,
W82-00423 7C

WATER LEVEL FLUCTUATIONS

January 1980 Water Levels, and Data Related to Water-level Changes, Western and South-Central Kansas,
W82-00016 2F

Predicting Lake Levels by Exponential Smoothing,
W82-00118 2A

WATER LEVELS

Ground-Water Data for Michigan, 1979,
W82-00014 2F

WATER MAINS

Engineering Research and the Water Industry,
W82-00313 8A

WATER MANAGEMENT

Western Water Resources: Coming Problems and Policy Alternatives,
W82-00107 6D

Before the Well Runs Dry: A Handbook for Designing a Local Water Conservation Plan.
W82-00396 3D

Summary of U.S. Geological Survey Investigations and Hydrologic Conditions in Southwest Florida for 1979,
W82-00419 10C

WATER POLICY

Western Water Resources: Coming Problems and Policy Alternatives,
W82-00107 6D

WATER POLLUTION

Transformation of the Mouse Clonal Cell Line R846-DP8 by Mississippi River, Raw, and Finished Water Samples from Southeastern Louisiana,
W82-00215 5C

Prioritization of Chemicals According to the Degree of Hazard in the Aquatic Environment,
W82-00300 5C

Toxicity and Ecological Significance of Trace Elements in Aquatic Environments,
W82-00498 5B

WATER POLLUTION CONTROL

Quarterly Progress Report, Nationwide Urban Runoff Program.
W82-00044 5G

Selective Overburden Placement,
W82-00053 5G

Method and Apparatus for Pollutant Spill Control,
W82-00056 5G

Predicting Runoff Pollutant Reduction in Buffer Zones Adjacent to Land Treatment Sites,
W82-00141 5B

Environmental Planning for Coal Strip Mining,
W82-00214 5G

Pollutant Treatability: A Molecular Engineering Approach,
W82-00252 6E

Concentration of Seeded Simian Rotavirus SA-11 from Potable Waters by Using Talc-Celite Layers and Hydroextraction,
W82-00272 5A

Determination of Marine Consent Conditions,
W82-00323 5G

Recent Developments in Water Pollution Control,
W82-00340 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 1: Crystal Lake Area Sewage Disposal Authority, Benzie County, Michigan.
W82-00362 5D

Control Technology Strategies for Coal Preparation Waste Drainages,
W82-00440 5D

Water-Related Environmental Control Requirements of Waste-to-Energy Conversion,
W82-00443 5D

Environmental Control Technology for Shale Oil Wastewaters,
W82-00444 5D

Water Regulations,
W82-00482 6E

WATER POLLUTION EFFECTS

Water Quality Issues and Energy Assessments,
W82-00036 6B

Conceptual Design of a Regional Water Quality Screening Model,
W82-00038 6A

Assessment of 1978 Water Quality Conditions in the Upper Potomac Estuary,
W82-00052 5C

The Aftermath at Longview,
W82-00073 5C

Behavior of Trifluralin in Aquatic Model Ecosystems,
W82-00233 5C

Prioritization of Chemicals According to the Degree of Hazard in the Aquatic Environment,
W82-00300 5C

Natural Variation in Abundance of Salmonid Populations in Streams and its Implications for Design of Impact Studies,
W82-00389 5C

Longitudinal Succession in Impact Assessment of River System Fish Communities,
W82-00399 5C

Effects of Surface Mining on Water Quality in a Small Watershed, Sullivan County, Indiana,
W82-00427 5C

Field Experiments on Responses of a Freshwater, Benthic Macroinvertebrate Community to Vertebrate Predators,
W82-00477 5C

Tadpoles as Indicators of Harmful Levels of Pollution in the Field,
W82-00478 5A

WATER POLLUTION PREVENTION

Planning Study to Model and Monitor Coal Pile Run-Off,
W82-00091 6A

Protecting Agriculture's Natural Resource Base,
W82-00176 4D

Pulp Companies Face Billion Dollar Cleanup.
W82-00343 5D

Rocky Mountain Pipeline Project: Environmental Impact Statement,
W82-00394 5G

Water-Related Environmental Control Requirements of Waste-to-Energy Conversion,
W82-00443 5D

WATER POLLUTION SOURCES

Chemical Indicators of Organic River Sources in Rivers and Estuaries,
W82-00035 5B

Water Pollution Potential of Coal-Slurry Pipelines,
W82-00096 6A

Pollution From Land Runoff,
W82-00253 5B

Development of Bioassay Procedures for Defining Pollution of Harbor Sediments,
W82-00387 5C

Assessment of Oil Shale Retort Wastewater Treatment and Control Technology - Phases I and II,
W82-00390 5B

Environmental Control Technology for the Flash Hydropyrolysis of Coal,
W82-00435 5D

Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aquatic Environments - I. Features of Hydrocarbons for Polluted and Unpolluted Waters,
W82-00453 5B

WATER POLLUTION TREATMENT

Process for Removal of Mercury and Mercury Compounds From Aqueous Solutions and Industrial Waste Liquors,
W82-00058 5D

Means and Method for Sweeping Material Floating on Water Using Vibrational Energy,
W82-00062 5G

Underwater Aerator,
W82-00065 5D

WATER PURIFICATION

Upflow Water Filtration Unit, Test Results,
W82-00407 5F

Ozone Treatment of Potable Water - Part I,
W82-00451 5F

WATER QUALITY

Mount St. Helens Volcanic-Ash Fall in the Bull Run Watershed, Oregon, March-June 1980,
W82-00002 5B

Effects of Mount St. Helens Eruption on Selected Lakes in Washington,
W82-00006 2H

Polychlorinated Biphenyl Transport in the Hudson River, New York,
W82-00008 5B

Relationship of Water Quality of Hudson River, New York, During Peak Discharges to Geologic Characteristics of Contributing Subbasins,
W82-00009 5B

Chemical, Physical, and Radiological Quality of Selected Public Water Supplies in Florida, February-April 1980,
W82-00010 5F

Water Resources Investigations in New York--1980.
W82-00011 7C

Reconnaissance of the Effect of Landfill Leachate on the Water Quality of Marshall Brook, Southwest Harbor, Hancock County, Maine,
W82-00013 5C

Ground-Water Data for Michigan, 1979,
W82-00014 2F

Evaluation of the Malaga Bend Salinity Alleviation Project, Eddy County, New Mexico,
W82-00018 5B

Selected Hydrologic Data, Arkansas River Basin, Pueblo and Southeastern Fremont Counties, Colorado, 1975-80,
W82-00020 7C

Evaluation of Ground-Water Monitoring Network, Santa Cruz County, California,
W82-00023 7A

Water Resources of Prince William Forest Park, Virginia,
W82-00026 7C

Water Quality Issues and Energy Assessments,
W82-00036 6B

Conceptual Design of a Regional Water Quality Screening Model,
W82-00038 6A

Assessment of 1978 Water Quality Conditions in the Upper Potomac Estuary,
W82-00052 5C

Premining Hydrologic Conditions of Five Southeastern Ohio Watersheds,
W82-00054 4C

Water Resources Data for New Hampshire and Vermont, Water Year 1980.
W82-00076 7C

Water Resources Data for West Virginia, Water Year 1980.
W82-00077 7C

Water Resources Data for Kansas, Water Year 1980--Volume 1. Missouri River Basin.
W82-00078 7C

Water Resources Data for Kansas, Water Year 1980--Volume 2. Arkansas River Basin.
W82-00079 7C

Water Resources Data for Texas, Water Year 1979--Volume 1. Arkansas River Basin, Red River Basin, Sabine River Basin, Neches River Basin, Trinity River Basin, and Intervening Coastal Basins.
W82-00080 7C

Water Resources Data for Texas, Water Year 1979--Volume 2. San Jacinto River Basin, Brazos River Basin, San Bernard River Basin and Intervening Coastal Basins.
W82-00081 7C

Water Resources Data for Texas, Water Year 1979--Volume 3. Colorado River Basin, Lavaca River Basin, Guadalupe River Basin, Nueces River Basin, Rio Grande Basin, and Intervening Coastal Basin.
W82-00082 7C

Quality of Water in Tibbee Creek and Tributaries Near West Point, Mississippi,
W82-00084 5B

Water-Resources Investigations of the U.S. Geological Survey in Wyoming, Fiscal Year 1980,
W82-00087 7C

Water-Resources Investigations of the U.S. Geological Survey in Colorado--Fiscal Year 1981.
W82-00088 7C

Geologic, Hydrologic and Chemical Data From Test Wells in the Dickson Area, Tennessee,
W82-00090 7C

Comparison of Nine Brands of Membrane Filter and the Most-Probable-Number Methods for Total Coliform Enumeration in Sewage-Contaminated Drinking Water,
W82-00203 5A

Automation of Water Bacteriological Analysis: Running Test of an Experimental Prototype,
W82-00225 5A

Impact of Construction of a Hydroelectric Project on the Water Quality of Five Lakes in Nova Scotia,
W82-00227 5C

Projected Tile Effluent Effects on the Oldman River,
W82-00333 5C

Human Use in a Dispersed Recreation Area and its Effect on Water Quality,
W82-00393 5B

Garrett County Water-Well Records, Chemical-Quality Data Ground-Water Use, Coal Test-Hole Data and Surface-Water Data.
W82-00395 2F

Water in the Elizabethtown Area - A Study of Limestone Terrane in North-Central Kentucky,
W82-00413 5B

Hydrogeologic Data for Rocky Creek Landfill and Adjacent Area, Northwest Hillsborough County, Florida, 1969-73,
W82-00417 5B

Radionuclide Concentrations in Streams in the Upper Blackfoot River Basin, Southeastern Idaho,
W82-00418 5A

Hydrogeologic Data from Test Drilling near Verna Beach, Florida, 1978,
W82-00424 2F

Effects of Surface Mining on Water Quality in a Small Watershed, Sullivan County, Indiana,
W82-00427 5C

Preliminary Evaluation of Ground-Water Contamination by Coal-Tar Derivatives, St. Louis Park Area, Minnesota,
W82-00430 5B

WATER QUALITY CONTROL
Quarterly Progress Report, Nationwide Urban Runoff Program.
W82-00044 5G

Means and Method for Sweeping Material Floating on Water Using Vibrational Energy,
W82-00062 5G

Process for Removing Alkalinity and Hardness From Waters,
W82-00063 5F

WATER QUALITY MANAGEMENT
WQM Five Year Strategy (FY 81-Baseline).
W82-00045 5G

Water Quality Management Studies, Lake Seminole, April-November 1978.
W82-00051 6G

WATER QUALITY STANDARDS
Water Regulations,
W82-00482 6E

WATER RESOURCES DEVELOPMENT
Water Resources of the Santa Ysabel and Mesa Grande Indian Reservations, San Diego County, California,
W82-00021 7C

A 10-Year Plan to Study the Aquifer System of Indian Wells Valley, California,
W82-00086 6D

Water Resources Appraisal for Hydroelectric Licensing: Skagit River Basin, Washington.
W82-00368 6D

Water Resources Appraisal for Hydroelectric Licensing: Lewis River Basin, Washington.
W82-00370 6B

Water Resources Appraisal for Hydroelectric Licensing: Elwha River Basin, Washington.
W82-00371 6B

Water Resources Appraisal for Hydroelectric Licensing: Little Tennessee River Basin, Tennessee, North Carolina, and Georgia.
W82-00372 6B

Water Resources Appraisal for Hydroelectric Licensing: Pit River Basin, California.
W82-00373 6B

Water Resources Appraisal for Hydroelectric Licensing: Clark Fork-Pend Oreille River Basin, Montana, Idaho, Washington.
W82-00374 6B

WATER REUSE
Gerber Saves 465,000 Gallons of Water/Day,
W82-00187 3E

Ames' Mutagenic Activity in Recycled Water from an Israeli Water Reclamation Project,
W82-00234 5D

Assessment of Oil Shale Retort Wastewater Treatment and Control Technology - Phases I and II,
W82-00390 5B

Chemical Recovery from Coal Conversion Wastes by Concentration,
W82-00436 5D

WATER RIGHTS
Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Kentucky.
W82-00450 6E

WATER SHORTAGE
Ames' Mutagenic Activity in Recycled Water from an Israeli Water Reclamation Project,
W82-00234 5D

WATER SOFTENING
High pH Treatment of Combined Water Softening and Wastewater Sludges,
W82-00403 5D

WATER STRESS
Effects of Soil Water Regime and Nitrogen Form on Blossom-End Rot, Yield, Water Relations, and Elemental Composition of Tomato,
W82-00162 2I

WATER SUPPLY
Chemical, Physical, and Radiological Quality of Selected Public Water Supplies in Florida, February-April 1980,
W82-00010 5F

Water Resources of the Santa Ysabel and Mesa Grande Indian Reservations, San Diego County, California,
W82-00021 7C

Water Resources of Prince William Forest Park, Virginia,
W82-00026 7C

Ground Water Availability,
W82-00027 6D

Ground Water Alternatives and Solutions,
W82-00029 6D

Water Supply and Demand in an Energy Supply Model,
W82-00050 6D

Before the Well Runs Dry: A Handbook for Designing a Local Water Conservation Plan.
W82-00396 3D

An Analysis of Reservoir Storage Contents for the Proposed Enlargement of Bumping Lake in Washington,
W82-00421 4A

WATER SUPPLY DEVELOPMENT
Alternatives Working Group Report.
W82-00032 6B

Environmental Impact Assessment of China's Water Transfer Project,
W82-00129 6D

A Successful Transfer,
W82-00309 4A

WATER TABLE
Altitude of Water Table, Biscayne Aquifer, Dade County, Florida, May 1980,
W82-00409 7C

Altitude of Water Table, Biscayne Aquifer, Dade County, Florida, October 1979,
W82-00410 7C

Altitude of Water Table, Biscayne Aquifer, Dade County, Florida, March 1979,
W82-00411 7C

WATER TRANSFER
Environmental Impact Assessment of China's Water Transfer Project,
W82-00129 6D

A Successful Transfer,
W82-00309 4A

WATER TRANSPORT
Environmental Impact Assessment of China's Water Transfer Project,
W82-00129 6D

WATER TREATMENT
Chemical, Physical, and Radiological Quality of Selected Public Water Supplies in Florida, February-April 1980,
W82-00010 5F

Process for the Removal of Inorganic Salts From a Water Stream,
W82-00055 5F

Fluoridation System,
W82-00061 5F

Process for Removing Alkalinity and Hardness From Waters,
W82-00063 5F

History of a Water Chemical,
W82-00074 5F

Hygiene of Drinking Water in Developing Countries,
W82-00269 5F

A 13-Month Survey of Nematodes at Three Water Treatment Plants in Southern Ontario, Canada,
W82-00294 5F

Silicates as Nonspecific Adsorbents of Bacteriophage: A Model for Purification of Water From Viruses,
W82-00350 5F

Field Evaluation of a Swirl Degritter at Tamworth, New South Wales, Australia,
W82-00376 5F

Effectiveness of Activated Carbon for Removal of Toxic and/or Carcinogenic Compounds From Water Supplies,
W82-00383 5F

Ozone Treatment of Potable Water - Part I,
W82-00451 5F

Ozone Treatment of Potable Water--Part 2,
W82-00452 5F

Water Treatment Model for Pollutant Exposure Assessment,
W82-00500 5F

WATER TREATMENT FACILITIES
Development of a Rural Water District,
W82-00288 6A

Treatment Works--The Designer's Problems,
W82-00312 5F

WATER USE
Water-Related Environmental Control Requirements at Municipal Solid Waste-to-Energy Conversion Facilities,
W82-00037 5D

WATER YIELD
Groundwater Availability in Acadia National Park and Vicinity, Hancock and Knox Counties, Maine,
W82-00017 2F

WATERSHED MANAGEMENT
Basin Management in the San Bernardino Valley,
W82-00075 4B

Basin Management in the San Bernardino Basin Area,
W82-00280 6A

WATERSHEDS
Element Mass Balances for South Carolina Coastal Plain Watersheds,
W82-00175 5B

WATERWAYS
Predicted Effects on Ground Water of Construction of Divide Cut Section, Tennessee-Tombigbee Waterway, Northeastern Mississippi Using a Digital Model,
W82-00428 2F

WAVES
Resonator Studies for Kincardine Harbour, Lake Huron,
W82-00228 8B

WEATHER
The World Climate Programme,
W82-00317 6A

WEATHER PATTERNS
Recent Variations in Winter Extratropical Cyclone Activity for the Australian Region,
W82-00315 2B

Solar Cycles and Erosional Events on the New South Wales Central and South Coasts,
W82-00318 2J

Historical Nile Floods and Their Implications for Climatic Change,
W82-00326 2E

WELLS
Groundwater Availability in Acadia National Park and Vicinity, Hancock and Knox Counties, Maine,
W82-00017 2F

Potentiometric Surface of the Floridan Aquifer in the Suwannee River Water Management District, Florida, May 1980,
W82-00024 7C

Potentiometric Surface of the Floridan Aquifer in the Northwest Florida Water Management District, May 1980,
W82-00025 7C

Water-Level Records for the Northern High Plains of Colorado, 1977-81,
W82-00422 7C

WEST VIRGINIA
Water Resources Data for West Virginia, Water Year 1980.
W82-00077 7C

WESTCHESTER COUNTY
Review of Reports for Flood Control; Westchester County Streams, New York.
W82-00103 4A

WETLANDS
Deposition of Riverborne Organic Carbon in Floodplain Wetlands and Deltas,
W82-00034 2J

Worthless, Valuable, or What. An Appraisal of Wetlands,
W82-00177 6B

Effects of Water Regime on Growth, Yield, and Nitrogen Uptake of Rice,
W82-00330 2I

A Model of Natural and Man-Induced Changes in Open Freshwater Wetlands on the Massachusetts Coastal Plain,
W82-00397 2I

Effects of Sewage Effluent Application on Litter Fall and Litter Decomposition in Cypress Swamps,
W82-00499 5E

WHITE RIVER BASIN
Ground-Water Resources of the White River Basin, Madison County, Indiana,
W82-00412 2A

WILLIAMSPORT
Sludge Settling Hampered by Industrial Discharge,
W82-00290 5D

WINTERGREEN LAKE
Sulfhydrolase Activity in Sediments of Wintergreen Lake, Kalamazoo County, Michigan,
W82-00241 2H

WORLD METEOROLOGICAL ORGANIZATION
The World Climate Programme,
W82-00317 6A

WYOMING
Water-Resources Investigations of the U.S. Geological Survey in Wyoming, Fiscal Year 1980,
W82-00087 7C

XENOBIOTIC CHEMICALS
Relationship Between Biotransformation and the Toxicity and Fate of Xenobiotic Chemicals in Fish,
W82-00186 5C

YEASTS
Assimilation of Lemonade-Processing Wastewater by Yeasts,
W82-00204 5D

YEMEN ARAB REPUBLIC
A Qualitative Appraisal of the Hydrology of the Yemen Arab Republic from Landsat Images,
W82-00022 7B

YUKON RIVER
Sediment Transport in Norton Sound, Alaska,
W82-00151 2J

ZOOPLANKTON
BIONESS, A New Design in Multiple Net Zooplankton Samplers,
W82-00210 7B

UNIV. OF ILLINOIS LIBRARY

AUTHOR INDEX

AARSTAD, J. S.
Effects of Small Amounts of Residue on Furrow Erosion,
W82-00470 2J

ABBEY, D.
Water Related Planning and Design at Energy Firms,
W82-00042 6D

Water Supply and Demand in an Energy Supply Model,
W82-00050 6D

ABELE, A. C.
Rainwater Gauge,
W82-00068 2B

ACOBAS, F.
Testing the Flocculation/Coagulation of Wastewater by Granulometric Analysis of Suspended Solids in the Water Using a Laser Diffraction Meter,
W82-00463 5D

ADAMS, W. P.
Illustration of the Roles of Snow in the Evolution of the Winter Cover of a Lake,
W82-00267 2C

ADDISON, R. F.
Reduction, Methylation, and Incorporation of Arsenic into Lipids by the Marine Phytoplankton Dunaliella Tertiolecta,
W82-00239 5B

AHMED, S.
Reduced Transpiration and Increased Water Efficiency by Diuron in Corn (Zea Mays),
W82-00196 2D

ALBANESE, A. S.
Environmental Control Technology for the Flash Hydropyrolysis of Coal,
W82-00435 5D

ALEXANDER, M.
Effect of Microcrustaceans on Blue-Green Algae in Flooded Soil,
W82-00146 6G

ALLCOCK, R.
Determination of Marine Consent Conditions,
W82-00323 5G

ALLEN, D. A.
Isolation, Enumeration, and Characterization of Aeromonas from Polluted Waters Encountered in Diving Operations,
W82-00224 5C

AMADON, J. F.
Nitrogen Availability from Sewage Sludge,
W82-00158 5E

AMOOZEGAR-FARD, A.
Areal Predictions of Water and Solute Flux in the Unsaturated Zone,
W82-00381 6A

ANDERSON, C. A.
Development of Bioassay Procedures for Defining Pollution of Harbor Sediments,
W82-00387 5C

ANDREAE, M. O.
Determination of Trace Quantities of Dimethylsulfoxide in Aqueous Solutions,
W82-00205 5A

ANDREN, A. W.
Modeling the Flux of Atmospheric Polychlorinated Biphenyls Across the Air/Water Interface,
W82-00193 5B

ANGIOLETTI, A.
Floating Breakwater,
W82-00067 8A

ANNANDALE, G. W.
Estimating End-Of-Construction Pore-Pressures in Unsaturated Earth Embankments,
W82-00194 8D

ARKIN, G. F.
Modeling Grain Sorghum Ratoon Cropping and Associated Runoff and Sediment Losses,
W82-00113 2G

ARMITAGE, P. D.
An Appraisal of Pond-Net Samples for Biological Monitoring of Lotic Macroinvertebrates,
W82-00308 7B

ARMSTRONG, D. E.
Factors Affecting Phosphorus Release from Intact Lake Sediment Cores,
W82-00251 2H

ASHENMACHER, T. G.
High pH Treatment of Combined Water Softening and Wastewater Sludges,
W82-00403 5D

ASHLEY, C. S.
Response of Bacteria in Wastewater Sludge to Moisture Loss by Evaporation and Effect of Moisture Content on Bacterial Inactivation by Ionizing Radiation,
W82-00489 5D

ASHTON, P. J.
Nitrogen Fixation and the Nitrogen Budget of a Eutrophic Impoundment,
W82-00127 2H

ATHAVALEY, A. S.
Deep Well Injection of Industrial Wastes,
W82-00475 5E

AURAND, T. A.
Identification of Organic Compounds in a Mutagenic Extract of a Surface Drinking Water by a Computerized Gas Chromatography/Mass Spectrometry System (GC/MS/COM),
W82-00256 5A

AXLER, R. P.
The Importance of Regenerated Nitrogen to Phytoplankton Productivity in a Subalpine Lake,
W82-00476 2H

BACHMANN, R. W.
Prediction of Total Phosphorus Concentrations, Chlorophyll a, and Secchi Depths in Natural and Artificial Lakes,
W82-00400 2H

BAHNICK, D. A.
Development of Bioassay Procedures for Defining Pollution of Harbor Sediments,
W82-00387 5C

BALVAY, G.
Biological Consequences of Treating a Lake with Hydrogen Peroxide on the Plankton Biocenosis (Biologiques Du Traitement D'Un Lac Avec Du Peroxyde D'Hydrogene Sur La Biocenose Planctonique),
W82-00305 2H

BANNER, R.
Gerber Saves 465,000 Gallons of Water/Day,
W82-00187 3E

BARBER, L. K.
Advanced Biological Treatment of Tannery Wastewater,
W82-00337 5D

BARILA, T. Y.
The Influence of Stream Order and Selected Stream Bed Parameters on Fish Diversity in Raystown Branch, Susquehanna River Drainage, Pennsylvania,
W82-00109 2E

BARKER, M.
Hydrogeologic Data from Test Drilling near Verna Beach, Florida, 1978,
W82-00424 2F

BARNES, J. S.
Effect of Agricultural Land Development on Drainage Waters in the North Carolina Tidewater Region,
W82-00094 5B

BARNES, V. C.
Environmental Planning for Coal Strip Mining,
W82-00214 5G

BARONE, K. A.
Identification of Organic Compounds in a Mutagenic Extract of a Surface Drinking Water by a Computerized Gas Chromatography/Mass Spectrometry System (GC/MS/COM),
W82-00256 5A

BARTELLS, J. H.
An Analysis of Reservoir Storage Contents for the Proposed Enlargement of Bumping Lake in Washington,
W82-00421 4A

BARTON, N.
Shear Strength of Rockfill,
W82-00116 8D

BASSETT, D. A.
Dispersal of Aspergillus Fumigatus from Sewage Sludge Compost Piles Subjected to Mechanical Agitation in Open Air,
W82-00273 5E

BASSETT, R. L.
Preliminary Data From a Series of Artificial Recharge Experiments at Stanton, Texas,
W82-00085 7C

BATJER, K.
Distribution and Balance of Volatile Halogenated Hydrocarbons in the Water and Air of Covered Swimming Pools Using Chlorine for Water Disinfection,
W82-00128 5F

BAYLEY, S. E.
Phosphorus Dynamics of a Florida Freshwater Marsh Receiving Treated Wastewater,
W82-00108 5E

BEARD, H. R.
Absorption of Radium and Thorium From New Mexico Uranium Mill Tailing Solutions,
W82-00040 5D

BEASLEY, D. B.
Sediment and Nutrient Movement from the Black Creek Watershed,
W82-00135 5B

BEASLEY, T. W.
Transformation of the Mouse Clonal Cell Line R846-DP8 by Mississippi River, Raw, and Finished Water Samples from Southeastern Louisiana,
W82-00215 5C

BEATTY, J. S.
Water Level Data for Wells in and Near Burial Ground 3, Oak Ridge National Laboratory, Tennessee, 1975-1979,
W82-00423 7C

BELSER, L. W.
Specific Inhibition of Nitrite Oxidation by Chlorate and Its Use in Assessing Nitrification in Soils and Sediments,
W82-00242 2L

BEND, J. R.
Relationship Between Biotransformation and the Toxicity and Fate of Xenobiotic Chemicals in Fish,
W82-00186 5C

BENEDICT, A. H.
Joint Dry/Wet Weather Treatment of Municipal Wastewater at Clatskanie, Oregon,
W82-00391 5D

BENJAMIN, P. M.
Water Level Data for Wells in and Near Burial Ground 3, Oak Ridge National Laboratory, Tennessee, 1975-1979,
W82-00423 7C

BERBEN, S. A.
Evaluation of Methodologies for the Determination of Acute Toxicity in Pulp and Paper Effluents,
W82-00297 5A

BERG, G.
Method for Recovering Viruses from River Water Solids,
W82-00200 5A

BERGEY, E. A.
Field Experiments on Responses of a Freshwater, Benthic Macroinvertebrate Community to Vertebrate Predators,
W82-00477 5C

BERMAN, D.
Concentration of Poliovirus in Water by Molecular Filtration,
W82-00246 5A

BERTINO, J. P.
Control Technology Strategies for Coal Preparation Waste Drainages,
W82-00440 5D

BICHLER, J.
Process for Removal of Mercury and Mercury Compounds From Aqueous Solutions and Industrial Waste Liquors,
W82-00058 5D

BIESINGER, M. G.
Advanced Biological Treatment of Tannery Wastewater,
W82-00337 5D

BIGGAR, J. W.
Irrigation Tailwater Management,
W82-00392 3C

BINGHAM, S. C.
Predicting Runoff Pollutant Reduction in Buffer Zones Adjacent to Land Treatment Sites,
W82-00141 5B

BLACKARD, J.
Effect of Mulch Rate on Soil Loss by Raindrop Splash,
W82-00468 2J

BLACKWELL, C. D.
Directory of Member Organizations of the National Water Data Exchange (NAWDEX),
W82-00089 10D

BLANCHARD, A. J.
SEASAT SAR Response from Water Resources Parameters,
W82-00101 7B

BLANCHARD, B. J.
SEASAT SAR Response from Water Resources Parameters,
W82-00101 7B

BLANKENBAKER, G. G.
Evaluation of Ground-Water Monitoring Network, Santa Cruz County, California,
W82-00023 7A

BLEDSOE, B.
Evaluation of the Overland Runoff Mode of Land Wastewater Treatment for Virus Removal,
W82-00220 5B

BLODGETT, J. C.
Flood Data for the Sacramento River and Butte Basin 1875 to 1978, Sacramento Valley, California,
W82-00019 2E

BOBENRIETH, M. J.
Reactions of Chlorine with Selected Aromatic Models of Aquatic Humic Material,
W82-00254 5F

BOEGMAN, N.
Environmental Planning for Coal Strip Mining,
W82-00214 5G

BOERSMA, J. R.
Neap-Spring Tide Sequences of Intertidal Shoal Deposits in a Mesotidal Estuary,
W82-00112 2L

BOGDAN, G. F.
Temporal Variations in Trihalomethane Content of Drinking Water,
W82-00255 5A

BOHN, M.
Geomorphic and Hydraulic Evolution of Tidal Creeks on a Subsiding Beach Ridge Plain, North Inlet, S.C.,
W82-00150 2L

BOKIL, S. D.
Luxury Uptake of Nitrogen in Flocculating Algal-Bacterial System,
W82-00307 5D

BOLDING, M. E.
An Alternative Solution to the THM Problem,
W82-00072 5F

BONELLI, J. E.
A Direct Differential Pulse Anodic Stripping Voltammetric Method for the Determination of Thallium in Natural Waters,
W82-00209 5A

BONTOUX, J.
Testing the Flocculation/Coagulation of Wastewater by Granulometric Analysis of Suspended Solids in the Water Using a Laser Diffraction Meter,
W82-00463 5D

BOORAM, C. V.
Survival of Eggs and Larvae of Swine Nematode Parasites in Aerobic and Anaerobic Waste Treatment Systems,
W82-00161 5D

BORMAN, R. G.
Water-Level Records for the Northern High Plains of Colorado, 1977-81,
W82-00422 7C

BOTTCHER, A. B.
Sediment and Nutrient Movement from the Black Creek Watershed,
W82-00135 5B

BOWER, C. E.
A Salicylate-Hypochlorite Method for Determining Ammonia in Seawater,
W82-00238 5A

BOWMAN, G.
Hydrogeologic Data from Test Drilling near Verna Beach, Florida, 1978,
W82-00424 2F

BOX, J. E. JR.
The Effects of Surface Slaty Fragments on Soil Erosion by Water,
W82-00471 2J

BOYCE, D. S.
The Effect of Bentonite Clay on Ozone Disinfection of Bacteria and Viruses in Water,
W82-00292 5F

BOZEMAN, E. L. JR.
The Abundance of Estuarine Larval and Juvenile Fish in a South Carolina Intertidal Creek,
W82-00276 2L

BRADFORD, G. R.
Are Sierra Lakes Becoming Acid,
W82-00231 5C

BRADFORD, J. M.
Gully Development in the Deep Loess Hills Region of Central Missouri,
W82-00472 2J

BRADLEY, M. W.
Geologic, Hydrologic and Chemical Data From Test Wells in the Dickson Area, Tennessee,
W82-00090 7C

BRANDE, J.
Worthless, Valuable, or What. An Appraisal of Wetlands,
W82-00177 6B

BRANDT, L. W.
Dewatering Florida Phosphatic Clay Wastes With Moving Screens,
W82-00049 5D

BRANSON, D. R.
Prioritization of Chemicals According to the Degree of Hazard in the Aquatic Environment,
W82-00300 5C

BRAY, M. M.
Assessment of 1978 Water Quality Conditions in the Upper Potomac Estuary,
W82-00052 5C

BREDEHOEFT, J. D.
Strategy for Radioactive Waste Disposal in Crystalline Rocks,
W82-00299 5E

BREMMON, C. E.
Methane Production from Ozonated Pulp Mill Effluent,
W82-00155 5D

BREZONIK, P. L.
Chemistry of Precipitation at Gainesville, Florida,
W82-00185 2K

BRISTOW, K. L.
A Proposed Technique to Measure Evapotranspiration Using Micrometeorological Methods,
W82-00183 2D

BROADBENT, F. E.
Leaching of Calcium and Magnesium from Soil Columns as Affected by Form of Nitrogen in Applied Sewage,
W82-00192 5E

BROCK, T. D.
Anaerobic Methane Oxidation: Occurrence and Ecology,
W82-00218 2H

BROOKMAN, G. T.
Planning Study to Model and Monitor Coal Pile Run-Off,
W82-00091 6A

BROWN, G. A.
Water Resources of Prince William Forest Park, Virginia,
W82-00026 7C

BROWN, G. J.
Treatment of Potato-Processing Waste Water by an Anaerobic Lagoon-Filter System,
W82-00226 5D

BROWN, J. H.
Temporal Variations in Trihalomethane Content of Drinking Water,
W82-00255 5A

BROWN, P.
Treatment of Florida Surface Waters for Use in Phosphate Beneficiation,
W82-00048 5D

BRUGMAN, M. M.
Effects of Volcanism on the Glaciers of Mount St. Helens,
W82-00007 2C

BRUN, G. L.
Determination of Aminocarb in Water by High Performance Liquid Chromatography,
W82-00232 5A

BRUNSKILL, G. J.
Experimental Studies on the Effect of Arsenic on Microbial Degradation of Organic Matter and Algal Growth,
W82-00237 2H

BRUVOLD, W. H.
Reclaiming and Reusing Wastewater,
W82-00402 5D

BRYNSKIKH, M. N.
Basin Landscape-Halogeochemical Method of Evaluating the Natural and Reclamation Conditions of Irrigated Territories,
W82-00303 2K

BUCK, C. E.
The Effect of Bentonite Clay on Ozone Disinfection of Bacteria and Viruses in Water,
W82-00292 5F

BUDIANSKY, S.
Understanding Acid Rain,
W82-00479 5B

BURNS, C. W.
Occurrence of Aphanomyces Ovidestruens, a Fungus Parasitic on Copepods, in Two Eutrophic Lakes,
W82-00304 2H

BURNS, G. P.
Solvent Extraction of Phenols,
W82-00438 5D

BUTLER, D.
Shallow Core Snow Chemistry of Athabasca Glacier, Alberta,
W82-00320 2C

BUTLER, J. B.
Treatment Works--The Designer's Problems,
W82-00312 5F

BUTTERY, R. G.
Odorous Compounds from Potato Processing Waste Effluent Irrigation Fields: Volatile Acids,
W82-00156 5E

CABELLI, V. J.
Membrane Filter Method for Enumerating Escherichia Coli,
W82-00487 5A

CACCHIONE, D. A.
Sediment Transport in Norton Sound, Alaska,
W82-00151 2J

CAIN, D.
Selected Hydrologic Data, Arkansas River Basin, Pueblo and Southeastern Fremont Counties, Colorado, 1975-80,
W82-00020 7C

CALL, D. J.
Development of Bioassay Procedures for Defining Pollution of Harbor Sediments,
W82-00387 5C

CANFIELD, D. E. JR.
Prediction of Total Phosphorus Concentrations, Chlorophyll a, and Secchi Depths in Natural and Artificial Lakes,
W82-00400 2H

CAPOBIANCO, J. A.
Geochemistry of a Subarctic Salt Marsh Environment,
W82-00148 2L

CARIGNAN, R.
Postdepositional Mobility of Phosphorus in Lake Sediments,
W82-00474 2H

CARLETON, A. M.
Recent Variations in Winter Extratropical Cyclone Activity for the Australian Region,
W82-00315 2B

CARPENTER, P. J.
Channel Conditions in the Lower Toutle and Cowlitz Rivers Resulting From the Mudflows of May 18, 1980,
W82-00004 5B

CARRE, J.
Nitrosamines in Tap Water After Concentration by a Carbonaceous Adsorbent,
W82-00459 5A

CASELLAS-SALHA, C.
Testing the Flocculation/Coagulation of Wastewater by Granulometric Analysis of Suspended Solids in the Water Using a Laser Diffraction Meter,
W82-00463 5D

CAUVIN, D.
The Valuation of Recreational Fisheries,
W82-00348 6C

CEAZAN, M. L.
Preliminary Data From a Series of Artificial Recharge Experiments at Stanton, Texas,
W82-00085 7C

CECH, I.
Temporal Variations in Trihalomethane Content of Drinking Water,
W82-00255 5A

CHANG, S. S.
Design, Evaluation and Effluent Water Quality Analysis of Three Oyster Shellstock Washers,
W82-00406 5D

CHEMBARISOV, E. I.
Basin Landscape-Halogeochemical Method of Evaluating the Natural and Reclamation Conditions of Irrigated Territories,
W82-00303 2K

CHESTERS, G.
Pollution From Land Runoff,
W82-00253 5B

CHIU, C-L.
Secondary Flow, Shear Stress and Sediment Transport,
W82-00117 2J

CHIU, S.
Water Quality Issues and Energy Assessments,
W82-00036 6B

CHRISTENSEN, H. H.
Human Use in a Dispersed Recreation Area and its Effect on Water Quality,
W82-00393 5B

CHRISTMAN, R. F.
Reactions of Chlorine with Selected Aromatic Models of Aquatic Humic Material,
W82-00254 5F

CHYNOWETH, D. P.
Comparison of In Situ and In Vitro Rates of Methane Release in Freshwater Sediments,
W82-00245 2H

CLARK, L. J.
Assessment of 1978 Water Quality Conditions in the Upper Potomac Estuary,
W82-00052 5C

CLARK, P. J.
Concentration and Size of Asbestos in Water Supplies,
W82-00262 5B

CLARK, R. E.
Ground Water Conflicts and Barriers,
W82-00028 6E

CLEMMENS, A. J.
Measuring Flumes of Simplified Construction,
W82-00140 7B

CLIFTON, D. G.
Mount St. Helens Volcanic-Ash Fall in the Bull Run Watershed, Oregon, March-June 1980,
W82-00002 5B

CLYMA, W.
Furrow Irrigation Practices in Northern Colorado,
W82-00139 3F

Optimal Design of Furrow Irrigation Systems,
W82-00138 3F

COFFEY, W. A.
Deep Well Injection of Industrial Wastes,
W82-00475 5E

COILLET, D. W.
Process for the Removal of Inorganic Salts From a Water Stream,
W82-00055 5F

COLEMAN, W. E.
Identification of Organic Compounds in a Mutagenic Extract of a Surface Drinking Water by a Computerized Gas Chromatography/Mass Spectrometry System (GC/MS/COM),
W82-00256 5A

COLLARD, V.
Behavior of DDT, Kepone, and Permethrin in Sediment-Water Systems Under Different Oxidation-Reduction and PH Conditions,
W82-00382 5B

COLLIER, R. L.
Water Application Uniformity of Hose Towed Traveler Irrigators,
W82-00296 3F

COLVIN, T. S.
Effect of Crop Residue on Soil Loss from Continuous Row Cropping,
W82-00145 2J

COLWELL, R. R.
Isolation, Enumeration, and Characterization of Aeromonas from Polluted Waters Encountered in Diving Operations,
W82-00224 5C

CONNERY, P. B.
Treatment Works--The Designer's Problems,
W82-00312 5F

CONROY, L. E.
Determination of Organically Combined Chlorine in High Molecular Weight Aquatic Organics,
W82-00258 5A

COOK, J.
Reclaiming and Reusing Wastewater,
W82-00402 5D

COOKE, A. S.
Tadpoles as Indicators of Harmful Levels of Pollution in the Field,
W82-00478 5A

COOKSEY, B. G.
The Effect of Centrifugation on the Suspended Particles of River Waters,
W82-00124 5A

COOTE, D. R.
Pollution From Land Runoff,
W82-00253 5B

COPLEN, L. E.
The Aftermath at Longview,
W82-00073 5C

CORLEW, P. M.
Development of a Rural Water District,
W82-00288 6A

COUSINS, J. R.
Mathematical Efficiency Concerns in Water Distribution Network Considerations,
W82-00339 5F

COWELL, D. W.
Hydrochemistry of a Dolomite Karst: The Bruce Peninsula of Ontario,
W82-00321 2K

CROSS, W. H.
Continuous Bioregeneration of Granular Activated Carbon During the Anaerobic Degradation of Catechol,
W82-00408 5D

CULLEN, A. J.
Field Evaluation of a Swirl Degritter at Tamworth, New South Wales, Australia,
W82-00376 5F

CUMMANS, J.
Mudflows Resulting From the May 18, 1980, Eruption of Mount St. Helens, Washington,
W82-00003 5B

CURRY, R. B.
SOYROOT - A Dynamic Model of Soybean Root Growth and Water Uptake,
W82-00114 2I

CUTHBERT, D. R.
Resonator Studies for Kincardine Harbour, Lake Huron,
W82-00228 8B

DAGUE, R. R.
High pH Treatment of Combined Water Softening and Wastewater Sludges,
W82-00403 5D

DAHLING, D. R.
Method for Recovering Viruses from River Water Solids,
W82-00200 5A

DANIEL, T. C.
An Empirical Equation for Predicting Soluble Phosphorus Loads from Agricultural Watersheds,
W82-00134 5B

DAVIS, E. I.
The Horse Creek Basin Project,
W82-00071 5G

DAVIS, M. J.
Conceptual Design of a Regional Water Quality Screening Model,
W82-00038 6A

Water Quality Issues and Energy Assessments,
W82-00036 6B

DAY, J. W. JR.
Modeling the Relationship Between Development and Storm Water and Nutrient Runoff,
W82-00260 2A

DAY, W. J.
The Horse Creek Basin Project,
W82-00071 5G

DE JAGER, J. M.
A Proposed Technique to Measure Evapotranspiration Using Micrometeorological Methods,
W82-00183 2D

DE JONGE, V. N.
Interference of Sulphide in Inorganic Phosphate Determination in Natural Waters,
W82-00154 5A

DEAN, J. M.
The Abundance of Estuarine Larval and Juvenile Fish in a South Carolina Intertidal Creek,
W82-00276 2L

DEBYLE, N. V.
Slash Treatment After Clearcutting Lodgepole Pine Affects Nutrients in Soil Water,
W82-00130 4C

DEFFERDING, L. J.
State-of-the-Art of Liquid Waste Disposal for Geothermal Energy Systems: 1979,
W82-00375 5E

DEGHI, G. S.
Effects of Sewage Effluent Application on Litter Fall and Litter Decomposition in Cypress Swamps,
W82-00499 5E

DELAUNE, R. D.
Effect of Estuarine Sediment pH and Oxidation-Reduction Potential on Microbial Hydrocarbon Degradation,
W82-00243 2L

DENHAM, S. J.
Pilot Scales Tests on the Flotation of Abattoir Wastes by Deep U Tubes,
W82-00322 5D

DEVITT, D.
Sodium-Potassium Ratios in Soil Solution and Plant Response Under Saline Conditions,
W82-00469 3C

DEWALLE, F. B.
Analytical Methods Evaluation for Applicability in Leachate Analysis,
W82-00380 5A

DHAWAN, K. L.
Hydrolysis of Fenitrothion in Model and Natural Aquatic Systems,
W82-00157 5B

DICKER, H. J.
Enumeration and Relative Importance of Acetylene-Reducing (Nitrogen-Fixing) Bacteria in a Delaware Salt Marsh,
W82-00248 2L

DICKSON, A. G.
Water-Rock Partition Coefficients and the Composition of Natural Waters - A Reassessment,
W82-00284 2K

DION, N. P.
Effects of Mount St. Helens Eruption on Selected Lakes in Washington,
W82-00006 2H

DODGE, R. A.
Hydraulic Sediment Model Study for Proposed Blanco Diversion Dam Modification,
W82-00446 8A

DOLAN, T. J.
Phosphorus Dynamics of a Florida Freshwater Marsh Receiving Treated Wastewater,
W82-00108 5E

DONOVAN, J.
Engineering Assessment of Vermicomposting Municipal Wastewater Sludges,
W82-00385 5E

DOOLEY, C. J.
Nitrosamines in Tap Water After Concentration by a Carbonaceous Adsorbent,
W82-00459 5A

DORSEY, M. E.
Hydrologic Data for Urban Studies in the Austin, Texas Metropolitan Area, 1979,
W82-00083 7C

DOSKEY, P. V.
Modeling the Flux of Atmospheric Polychlorinated Biphenyls Across the Air/Water Interface,
W82-00193 5B

DOSS, B. D.
Coastal Bermudagrass Yield and Soil Properties as Affected by Surface-Applied Dairy Manure and Its Residue,
W82-00195 3C

DOVER, V. L. JR.
Land Restoration Following Oil-Well Drilling,
W82-00057 5D

DOYLE, W. H. JR.
The U.S. Geological Survey Coal Hydrology Program and the Potential of Hydrologic Models for Impact Assessments,
W82-00429 6E

DRAKE, D. E.
Sediment Transport in Norton Sound, Alaska,
W82-00151 2J

DRAPEAU, A. J.
Application of a Multiple Alginate Filter Method for the Determination of Water Viruses Concentration (Conception D'Une Membrane Filtrante a Base D'Alginate Pour La Concentration Des Virus Hydriques),
W82-00458 5A

DRUMMOND, C. J.
Characterization and Processing of Coal Conversion Process Wastewaters,
W82-00441 5D

DUCRET, G. L. JR.
Report of the Annual Yield of the Arkansas River Basin for the Arkansas River Basin Compact, Arkansas--Oklahoma, 1980 Water Year,
W82-00012 6E

DUDLEY, D. J.
Enumeration of Potentially Pathogenic Bacteria from Sewage Sludges,
W82-00221 5A

DUERR, A. D.
Hydrogeologic Data for Rocky Creek Landfill and Adjacent Area, Northwest Hillsborough County, Florida, 1969-73,
W82-00417 5B

DUFOUR, A. P.
Membrane Filter Method for Enumerating Escherichia Coli,
W82-00487 5A

DUNCAN, M.
Western Water Resources: Coming Problems and Policy Alternatives,
W82-00107 6D

DUNNING, C. M.
Report of Survey of Corps of Engineers Construction Workforce,
W82-00102 6B

DUSZELN, J. V.
Distribution and Balance of Volatile Halogenated Hydrocarbons in the Water and Air of Covered Swimming Pools Using Chlorine for Water Disinfection,
W82-00128 5F

DUTONG,
Cavitation and Wear on Hydraulic Machines,
W82-00331 8C

DUVAL, W. S.
An Aquatic Respirometer for Use in Sublethal Studies,
W82-00122 5C

EAGLESON, P. S.
Some Limiting Forms of the Poisson Distribution of Annual Station Precipitation,
W82-00132 2B

ECKERSON, D.
Improved Method and Test Strategy for Recovery of Enteric Viruses from Shellfish,
W82-00219 5A

EDELMANN, P.
Selected Hydrologic Data, Arkansas River Basin, Pueblo and Southeastern Fremont Counties, Colorado, 1975-80,
W82-00020 7C

EDWARDS, P.
The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 1: Description of the System and the Study of the High Rate Pond,
W82-00455 5D

The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 2: Studies of the Fish Ponds,
W82-00456 3C

The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 3: Maize Cultivation Experiment, Bacteriological Studies, and Economic Assessment,
W82-00457 3C

EIMHJELLEN, K.
Low Temperature Removal of Nitrate by Bacterial Denitrification,
W82-00461 5D

EISENREICH, S. J.
Characterization of Soluble and Colloidal-Phase Metal Complexes in River Water by Ultrafiltration. A Mass-Balance Approach,
W82-00480 5A

ELLIS, B. G.
Cropping Systems for Treatment and Utilization of Municipal Wastewater and Sludge,
W82-00097 5E

EMBREY, S. S.
Effects of Mount St. Helens Eruption on Selected Lakes in Washington,
W82-00006 2H

ENGMAN, E. T.
Characterizing Short Duration Rainfall Intensities for Runoff Calculation,
W82-00142 2A

ERBISTE, P. C.
Hydraulic Gates: The State-of-the-Art,
W82-00332 8C

ERICKSON, A. E.
Cropping Systems for Treatment and Utilization of Municipal Wastewater and Sludge,
W82-00097 5E

ERICKSON, S. J.
Effects of Halogenated Organic Compounds on Photosynthesis in Estuarine Phytoplankton,
W82-00266 5C

ETHRIDGE, F. G.
Ground-Water Flow and Uranium in Colorado Plateau,
W82-00282 2F

EVANS, T. M.
Impact of Verification Media and Resuscitation on Accuracy of the Membrane Filter Total Coliform Enumeration Technique,
W82-00494 5A

EWEL, K. C.
Effects of Sewage Effluent Application on Litter Fall and Litter Decomposition in Cypress Swamps,
W82-00499 5E

EWERT, D. L.
Technique for Determining Total Bacterial Virus Counts in Complex Aqueous Systems,
W82-00222 5A

FALBESANER, E.
Process for Removal of Mercury and Mercury Compounds From Aqueous Solutions and Industrial Waste Liquors,
W82-00058 5D

FALKOWSKI, P. G.
An Analysis of Factors Affecting Oxygen Depletion in the New York Bight,
W82-00106 5C

FARRAR, C. D.
Evaluation of Ground-Water Monitoring Network, Santa Cruz County, California,
W82-00023 7A

FASS, R.
Silicates as Nonspecific Adsorbents of Bacteriophage: A Model for Purification of Water From Viruses,
W82-00350 5F

FAUST, C. R.
Ground-Water Modeling: Recent Developments,
W82-00281 2F

FEDER, G. L.
Toxicity of Mount St. Helens Ash Leachate to a Blue-Green Alga,
W82-00001 5C

FEDERLE, T. W.
Lignocellulose Mineralization by Arctic Lake Sediments in Response to Nutrient Manipulation,
W82-00270 2H

FEIN, J. S.
Report on the Summer MONEX Field Phase,
W82-00265 2B

FERENTCHAK, J. A.
Ground-Water Flow and Uranium in Colorado Plateau,
W82-00282 2F

FIDDLER, W.
Nitrosamines in Tap Water After Concentration by a Carbonaceous Adsorbent,
W82-00459 5A

FINK, R. P.
An Aquatic Respirometer for Use in Sublethal Studies,
W82-00122 5C

FINLAYSON, D.
Legal Aspects of Subsidence Due to Well Pumping,
W82-00170 6E

FINN, J. T.
Does Salt Marsh Fertilization Enhance Shellfish Production. An Application of Flow Analysis,
W82-00259 2L

FITZGERALD, R. A.
Trace Metal Geochemistry in Sediments from the Miramichi Estuary, New Brunswick,
W82-00236 5A

FLETCHER, R. A.
Reduced Transpiration and Increased Water Efficiency by Diuron in Corn (Zea Mays),
W82-00196 2D

FLETT, R. J.
Postdepositional Mobility of Phosphorus in Lake Sediments,
W82-00474 2H

FONG, M.
Continuous Bioregeneration of Granular Activated Carbon During the Anaerobic Degradation of Catechol,
W82-00408 5D

FOOSE, D. W.
Index to Active Hydrologic Data Collection Sites in Florida, 1980-81,
W82-00425 7C

FORD, D. C.
Hydrochemistry of a Dolomite Karst: The Bruce Peninsula of Ontario,
W82-00321 2K

FOX, J. P.
Potential Uses of Spent Shale in the Treatment of Oil Shale Retort Waters,
W82-00445 5D

FRANKS, B. J.
Chemical, Physical, and Radiological Quality of Selected Public Water Supplies in Florida, February-April 1980,
W82-00010 5F

FRASER, W. B.
BIONESS, A New Design in Multiple Net Zooplankton Samplers,
W82-00210 7B

FRAZAR, J. H.
Development of Oil-In-Water Monitor, Phase II,
W82-00100 5A

FRECKLETON, J. R.
Water Resources of the Santa Ysabel and Mesa Grande Indian Reservations, San Diego County, California,
W82-00021 7C

FRENKEL, H.
Effects of Tillage and Gypsum Incorporation on Rain Runoff and Crust Strength in Field Soils Irrigated With Saline-Sodic Water,
W82-00327 2A

FUJITA, T.
Underwater Aerator,
W82-00065 5D

FULTON, J. M.
Effect of Irrigation and Tree Density on Peach Production,
W82-00120 2I

FUNDERBURG, S. W.
Viral Transport Through Soil Columns Under Conditions of Saturated Flow,
W82-00295 5B

FUNK, R. J.
Deep Well Injection of Industrial Wastes,
W82-00475 5E

FURSE, M. T.
An Appraisal of Pond-Net Samples for Biological Monitoring of Lotic Macroinvertebrates,
W82-00308 7B

FUSTE, L. A.
Effects of the Mount St. Helens Eruption on the Benthic Fauna of the Toutle River, Muddy River, and Pine Creek Drainage Basins, Washington,
W82-00005 5C

GABEL, B.
Distribution and Balance of Volatile Halogenated Hydrocarbons in the Water and Air of Covered Swimming Pools Using Chlorine for Water Disinfection,
W82-00128 5F

GAMBRELL, R. P.
Behavior of DDT, Kepone, and Permethrin in Sediment-Water Systems Under Different Oxidation-Reduction and PH Conditions,
W82-00382 5B

GARDNER, L. R.
Element Mass Balances for South Carolina Coastal Plain Watersheds,
W82-00175 5B

Geomorphic and Hydraulic Evolution of Tidal Creeks on a Subsiding Beach Ridge Plain, North Inlet, S.C.,
W82-00150 2L

GARDNER, W.
Sediment Trap Dynamics and Calibration: A Laboratory Evaluation,
W82-00104 7B

GARDNER, W. D.
Field Assessment of Sediment Traps,
W82-00105 7B

GARIBALDI, J. A.
Odorous Compounds from Potato Processing Waste Effluent Irrigation Fields: Volatile Acids,
W82-00156 5E

GARLAND, T. R.
Alkylpyridines in Surface Waters, Groundwaters, and Subsoils of a Drainage Located Adjacent to an Oil Shale Facility,
W82-00481 5B

GARTON, J. E.
Upflow Water Filtration Unit, Test Results,
W82-00407 5F

GAYLORD, J. L.
Hydrologic Data for Urban Studies in the Austin, Texas Metropolitan Area, 1979,
W82-00083 7C

GEEN, G. H.
An Aquatic Respirometer for Use in Sublethal Studies,
W82-00122 5C

GEINOPOLOS, A.
Physical/Chemical Treatment of Blast Furnace Wastewaters Using Mobile Pilot Units,
W82-00378 5D

GERARDI, M. H.
Sludge Settling Hampered by Industrial Discharge,
W82-00290 5D

GERBA, C. P.
Concentration of Coliphages from Large Volumes of Water and Wastewater,
W82-00247 5A

Influence of Estuarine Sediment on Virus Survival Under Field Conditions,
W82-00199 5A

Survival of Enteroviruses in Rapid-Infiltration Basins During the Land Application of Wastewater,
W82-00496 5D

Thermostabilization of Enteroviruses by Estuarine Sediment,
W82-00263 2L

GILBERT, R. G.
Effects of Alpha, Beta and Theta Factor Upon the Design, Specification and Operation of Aeration Systems,
W82-00291 5D

GILLIAM, J. W.
Effect of Agricultural Land Development on Drainage Waters in the North Carolina Tidewater Region,
W82-00094 5B

GILLIGAN, D. S.
Comparative Analysis of Sludge and Refuse Leachate: A Preliminary Report,
W82-00287 5E

GINAVEN, M. E.
High Capacity Waste Water Treatment System,
W82-00066 5D

GLOOSCHENKO, W. A.
Geochemistry of a Subarctic Salt Marsh Environment,
W82-00148 2L

GODSY, E. M.
Isolation of Methanobacterium Bryantii from a Deep Aquifer by Using a Novel Broth-Antibiotic Disk Method,
W82-00240 5A

GOLDMAN, C. R.
The Importance of Regenerated Nitrogen to Phytoplankton Productivity in a Subalpine Lake,
W82-00476 2H

GOLDSTEIN, R. M.
Longitudinal Succession in Impact Assessment of River System Fish Communities,
W82-00399 5C

GOODMAN, P.
A Successful Transfer,
W82-00309 4A

GORDON, J. D.
Hydrologic Data for Urban Studies in the Austin, Texas Metropolitan Area, 1979,
W82-00083 7C

GOSTIN, V. A.
The Significance of the Submarine Geology of Upper Spencer Gulf, South Australia, to Environmental Decision-Making,
W82-00314 2L

GOYAL, S. M.
Concentration of Coliphages from Large Volumes of Water and Wastewater,
W82-00247 5A

GRAHAM, B. W.
Experimental Studies on the Effect of Arsenic on Microbial Degradation of Organic Matter and Algal Growth,
W82-00237 2H

GRANAT, M. A.
Perpetual Shoals at the Entrance to Chesapeake Bay: Flow-Substrate Interactions and Mutually Evasive Net Currents,
W82-00149 2L

GRANDT, A. F.
Limestone-Lime Treatment of Acid Mine Drainage - Full Scale,
W82-00377 5D

GRANGE, G. H.
Environmental Planning for Coal Strip Mining,
W82-00214 5G

GRANGER, H. C.
Ground-Water Flow and Uranium in Colorado Plateau,
W82-00282 2F

GREEN, G.
Behavior of DDT, Kepone, and Permethrin in Sediment-Water Systems Under Different Oxidation-Reduction and PH Conditions,
W82-00382 5B

GREEN, G. C.
Field Test of an Irrigation Scheduling Computer Model,
W82-00184 3F

GREEN, S. L.
Water-Resources Investigations of the U.S. Geological Survey in Wyoming, Fiscal Year 1980,
W82-00087 7C

GREENE, S.
Effect of Microcrustaceans on Blue-Green Algae in Flooded Soil,
W82-00146 6G

GREENHALGH, R.
Hydrolysis of Fenitrothion in Model and Natural Aquatic Systems,
W82-00157 5B

GREMINGER, D. C.
Solvent Extraction of Phenols,
W82-00438 5D

GRIFFITH, C.
Geographic Information Systems and Environmental Impact Assessment,
W82-00338 7C

GRISSINGER, E. H.
Erodibility of Streambank Materials of Low Cohesion,
W82-00136 2J

GROENEWOLD, G. H.
Hydraulic Properties of Coal and Related Materials, Northern Great Plains,
W82-00278 2F

GROLIER, M. J.
A Qualitative Appraisal of the Hydrology of the Yemen Arab Republic from Landsat Images,
W82-00022 7B

GRUTSCH, J. F.
The Alpha-Beta-Gamma's of Wastewater Treatment,
W82-00275 5D

GUENTZEL, M. N.
Enumeration of Potentially Pathogenic Bacteria from Sewage Sludges,
W82-00221 5A

GULVAS, J. A.
Power Plant Water Intake Assessment,
W82-00216 6G

GUPTA, G. C.
Effect of Cations on Copper Adsorption by Kaolin,
W82-00172 2K

Effect of Kaolin Concentration on Distribution Coefficient of Copper,
W82-00153 5B

GUPTA, S.
Mathematical Efficiency Concerns in Water Distribution Network Considerations,
W82-00339 5F

GWINN, W. R.
Model Study of a Box-Inlet Chute Spillway and SAF Stilling Basin,
W82-00046 8A

HADAS, A.
Effects of Tillage and Gypsum Incorporation on Rain Runoff and Crust Strength in Field Soils Irrigated With Saline-Sodic Water,
W82-00327 2A

HAILS, J. R.
The Significance of the Submarine Geology of Upper Spencer Gulf, South Australia, to Environmental Decision-Making,
W82-00314 2L

HALE, D. R.
Comparison of Automated Segmented-Flow and Discrete Analyzers for the Determination of Nutrients in Water,
W82-00483 5A

HALE, E. J.
Fenitrothion Sprayed on a Pond: Kinetics of Its Distribution and Transformation in Water and Sediment,
W82-00159 5B

HALE, O. M.
Survival of Eggs and Larvae of Swine Nematode Parasites in Aerobic and Anaerobic Waste Treatment Systems,
W82-00161 5D

HALL, J. D.
Natural Variation in Abundance of Salmonid Populations in Streams and its Implications for Design of Impact Studies,
W82-00389 5C

HALLET, B.
Physical Effects of Vehicular Disturbances on Arid Landscapes,
W82-00111 4C

HALMO, G.
Low Temperature Removal of Nitrate by Bacterial Denitrification,
W82-00461 5D

HAMBRICK, G. A. III
Effect of Estuarine Sediment pH and Oxidation-Reduction Potential on Microbial Hydrocarbon Degradation,
W82-00243 2L

HAMMERTON, D.
Determination of Marine Consent Conditions,
W82-00323 5G

HANG, Y. D.
Assimilation of Lemonade-Processing Wastewater by Yeasts,
W82-00204 5D

HANOUNE, N.
Automation of Water Bacteriological Analysis: Running Test of an Experimental Prototype,
W82-00225 5A

HANSEN, B. P.
Groundwater Availability in Acadia National Park and Vicinity, Hancock and Knox Counties, Maine,
W82-00017 2F

Reconnaissance of the Effect of Landfill Leachate on the Water Quality of Marshall Brook, Southwest Harbor, Hancock County, Maine,
W82-00013 5C

HANSON, D. N.
Solvent Extraction of Phenols,
W82-00438 5D

HANYA, T.
Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aquatic Environments - I. Features of Hydrocarbons for Polluted and Unpolluted Waters,
W82-00453 5B

HARKER, D. B.
Projected Tile Effluent Effects on the Oldman River,
W82-00333 5C

HARKNESS, N.
Chemistry of Septicity,
W82-00325 5D

HARRIS, G. F.
Development of a Rural Water District,
W82-00288 6A

HARRIS, H. C.
Environmental Resources and Restraints to Agricultural Production in a Mediterranean-Type Environment,
W82-00329 2I

HARRIS, J. C.
Methods for Level 2 Analysis by Organic Compound Category,
W82-00384 5A

HARRISON, A. D.
A 13-Month Survey of Nematodes at Three Water Treatment Plants in Southern Ontario, Canada,
W82-00294 5F

HARRISON, F. L.
Effect of Cations on Copper Adsorption by Kaolin,
W82-00172 2K

Effect of Kaolin Concentration on Distribution Coefficient of Copper,
W82-00153 5B

HART, G. E.
Slash Treatment After Clearcutting Lodgepole Pine Affects Nutrients in Soil Water,
W82-00130 4C

HARVEY, R. W.
Enrichment and Association of Bacteria and Particulates in Salt Marsh Surface Water,
W82-00201 2L

HASS, J. R.
Reactions of Chlorine with Selected Aromatic Models of Aquatic Humic Material,
W82-00254 5F

HASSAN, F. A.
Historical Nile Floods and Their Implications for Climatic Change,
W82-00326 2E

HASSETT, J. M.
Microplate Technique for Determining Accumulation of Metals by Algae,
W82-00492 5A

HASSINGER, J.
Shallow Core Snow Chemistry of Athabasca Glacier, Alberta,
W82-00320 2C

HATLEN, J. B.
Analytical Methods Evaluation for Applicability in Leachate Analysis,
W82-00380 5A

HAVERKAMP, R.
A Comparative Study of Three Forms of the Richard Equation Used for Predicting One-Dimensional Infiltration in Unsaturated Soil,
W82-00328 2G

HAWKES, D. L.
Apparatuses for the Anaerobic Digestion of Natural Organic Waste,
W82-00069 5D

HAWKINS, C. E.
Effects of Halogenated Organic Compounds on Photosynthesis in Estuarine Phytoplankton,
W82-00266 5C

HEDDEN, K. F.
Water Treatment Model for Pollutant Exposure Assessment,
W82-00500 5F

HEDGES, J. I.
Chemical Indicators of Organic River Sources in Rivers and Estuaries,
W82-00035 5B

HELLICKSON, M. L.
Water, Energy and Labor Requirements for Future Pacific Northwest Irrigation,
W82-00143 6A

HENDRY, C. D.
Chemistry of Precipitation at Gainesville, Florida,
W82-00185 2K

HENNES, R. W.
Slash Treatment After Clearcutting Lodgepole Pine Affects Nutrients in Soil Water,
W82-00130 4C

HENRY, J. G.
Recent Developments in Water Pollution Control,
W82-00340 5D

HERMANN, A. J.
Phosphorus Dynamics of a Florida Freshwater Marsh Receiving Treated Wastewater,
W82-00108 5E

HERSHFIELD, D. M.
Characterizing Short Duration Rainfall Intensities for Runoff Calculation,
W82-00142 2A

HILTON, J.
Management and Design Implications of a Mathematical Model of a Rapid Gravity Sand Filter Backwash,
W82-00460 5D

HINCKLEY, B. S.
Physical Effects of Vehicular Disturbances on Arid Landscapes,
W82-00111 4C

HOEFLIN, J. R.
Assessment of Oil Shale Retort Wastewater Treatment and Control Technology - Phases I and II,
W82-00390 5B

HOFFMANN, M. R.
Characterization of Soluble and Colloidal-Phase Metal Complexes in River Water by Ultrafiltration. A Mass-Balance Approach,
W82-00480 5A

HOFFMASTER, W. W.
Foam Control in Aeration Tanks,
W82-00171 5D

HOLDREN, G. C. JR.
Factors Affecting Phosphorus Release from Intact Lake Sediment Cores,
W82-00251 2H

HOLM-HANSEN, T.
A Salicylate-Hypochlorite Method for Determining Ammonia in Seawater,
W82-00238 5A

HOPKINS, T. S.
An Analysis of Factors Affecting Oxygen Depletion in the New York Bight,
W82-00106 5C

HOPKINSON, C. S. JR.
Modeling the Relationship Between Development and Storm Water and Nutrient Runoff,
W82-00260 2A

HORNER, G. L.
Irrigation Tailwater Management,
W82-00392 3C

HORTON, R.
Apparatuses for the Anaerobic Digestion of Natural Organic Waste,
W82-00069 5D

HOWARD, W. F.
A Resonance Raman Method for the Rapid Detection and Identification of Bacteria in Water,
W82-00404 5A

HOWELL, T. A.
Modeling Grain Sorghum Ratoon Cropping and Associated Runoff and Sediment Losses,
W82-00113 2G

HSIUNG, D. E.
Secondary Flow, Shear Stress and Sediment Transport,
W82-00117 2J

HUDGINS, J. S.
The Operation of a Waste Treatment Plant. Process Dynamic Considerations,
W82-00298 5D

HUDSON, H. H.
Ground Water Availability,
W82-00027 6D

HUFFMAN, G. C.
Ground-Water Data for Michigan, 1979,
W82-00014 2F

HULT, M. F.
Preliminary Evaluation of Ground-Water Contamination by Coal-Tar Derivatives, St. Louis Park Area, Minnesota,
W82-00430 5B

HURST, C. J.
Survival of Enteroviruses in Rapid-Infiltration Basins During the Land Application of Wastewater,
W82-00496 5D

HUSS, H. H.
Distribution of Clostridium Botulinum,
W82-00349 5A

IBARRA, M. J.
Enumeration of Potentially Pathogenic Bacteria from Sewage Sludges,
W82-00221 5A

IBRAHIM, M. M.
A Qualitative Appraisal of the Hydrology of the Yemen Arab Republic from Landsat Images,
W82-00022 7B

INNISS, W. E.
Nitrogen Fixation and Methane Metabolism in a Stream Sediment-Water System Amended with Leaf Material,
W82-00486 2K

IRWIN, G. A.
Chemical, Physical, and Radiological Quality of Selected Public Water Supplies in Florida, February-April 1980,
W82-00010 5F

ISENSEE, A. R.
Behavior of Trifluralin in Aquatic Model Ecosystems,
W82-00233 5C

ISHIDA, Y.
Distribution of Obligately Oligotrophic Bacteria in Lake Biwa,
W82-00346 5A

IVERSON, R. M.
Physical Effects of Vehicular Disturbances on Arid Landscapes,
W82-00111 4C

JACKSON, D. L.
Potential Uses of Spent Shale in the Treatment of Oil Shale Retort Waters,
W82-00445 5D

JACKSON, L. L.
Consecutive Amperometric Titrations for Calcium and Magnesium,
W82-00208 5A

JACOBSON, P.
Terrace Planning Criteria for Runoff Control for Deep Loess Soil,
W82-00144 4D

JAMES, W.
Resonator Studies for Kincardine Harbour, Lake Huron,
W82-00228 8B

JANARDAN, K. G.
Graphical Effluent Quality Control for Compliance Monitoring: What Is a Violation,
W82-00261 5G

JARNIS, R. N.
High-Level Ozone Disinfection of Municipal Wastewater Effluents,
W82-00379 5D

JAROSZYNSKI, L. O.
BIONESS, A New Design in Multiple Net Zooplankton Samplers,
W82-00210 7B

JARRELL, W. M.
Sodium-Potassium Ratios in Soil Solution and Plant Response Under Saline Conditions,
W82-00469 3C

JARRETT, A. R.
Transient Soil Moisture Movement Through Layered Soils Using a Finite Element Approach,
W82-00133 2G

JEFFS, D. N.
Pollution From Land Runoff,
W82-00253 5B

JEKEL, M. R.
Total Organic Halogen as a Parameter for the Characterization of Reclaimed Waters: Measurement, Occurrence, Formation, and Removal,
W82-00197 5D

JENNETT, J. C.
Microplate Technique for Determining Accumulation of Metals by Algae,
W82-00492 5A

JOHNSEN, T. N.
Picloram Dissipation in a Small Southwestern Stream,
W82-00212 5B

JOHNSON, D. G.
A Bacterial Bioassay for Assessment of Wastewater Toxicity,
W82-00398 5A

JOHNSON, G. E.
Characterization and Processing of Coal Conversion Process Wastewaters,
W82-00441 5D

JOHNSON, J. D.
Reactions of Chlorine with Selected Aromatic Models of Aquatic Humic Material,
W82-00254 5F

JOHNSON, L. D.
Water-Related Environmental Control Requirements at Municipal Solid Waste-to-Energy Conversion Facilities,
W82-00037 5D

JONAS, J.
Geologic, Hydrologic and Chemical Data From Test Wells in the Dickson Area, Tennessee,
W82-00090 7C

JONES, C.
SEASAT SAR Response from Water Resources Parameters,
W82-00101 7B

JONES, C. W.
Performance of Granular Soil Covers on Canals,
W82-00047 8D

JONES, J. H.
Soil as a Medium for Dairy Liquid Waste Disposal,
W82-00165 5E

JONES, W. J.
Populations of Methane-Producing Bacteria and In Vitro Methanogenesis in Salt Marsh and Estuarine Sediments,
W82-00202 2L

JOSBERGER, E. G.
On the Estimation of Antarctic Iceberg Melt Rate,
W82-00166 2C

JOSEPH, S. W.
Isolation, Enumeration, and Characterization of Aeromonas from Polluted Waters Encountered in Diving Operations,
W82-00224 5C

JOSEPHSON, J.
Water Regulations,
W82-00482 6E

JURGENSEN, M. F.
Methane Production from Ozonated Pulp Mill Effluent,
W82-00155 5D

JURY, W. A.
Domestic Water Supplies for Power Plant Cooling,
W82-00180 6D

KADOTA, H.
Distribution of Obligately Oligotrophic Bacteria in Lake Biwa,
W82-00346 5A

KALIL, E. K.
Characterisation of Domestic and Industrial Sewage in Southern California Coastal Sediments Using Nitrogen, Carbon, Sulphur, and Uranium Tracers,
W82-00147 5B

KALKHOFF, S. J.
Quality of Water in Tibbee Creek and Tributaries Near West Point, Mississippi,
W82-00084 5B

KALMAZ, E. V.
Toxicity and Ecological Significance of Trace Elements in Aquatic Environments,
W82-00498 5B

KANE, J.
Physical/Chemical Treatment of Blast Furnace Wastewaters Using Mobile Pilot Units,
W82-00378 5D

KAPLAN, I. R.
Characterisation of Domestic and Industrial Sewage in Southern California Coastal Sediments Using Nitrogen, Carbon, Sulphur, and Uranium Tracers,
W82-00147 5B

Natural Abundances of 15N as a Source Indicator for Near-Shore Marine Sedimentary and Dissolved Nitrogen,
W82-00283 5B

KATZ, B. G.
A Comparison of Nitrogen in Shallow Ground Water from Sewered and Unsewered Areas, Nassau County, New York, from 1952 Through 1976,
W82-00277 5B

KATZ, P. B.
Planning Study to Model and Monitor Coal Pile Run-Off,
W82-00091 6A

KAWABATA, N.
Removal and Recovery of Organic Pollutants from the Aquatic Enviroment. 2. Removal and Recovery of Dodecylbenzenesulfonate from Aqueous Solution by Cross-Linked Poly(N-Benzyl-4-Vinylpyridinium Halide),
W82-00217 5D

KAWAUCHI, S.
Underwater Aerator,
W82-00065 5D

KAY, D.
Enteric Bacterial Concentrations in Reservoir Feeder Streams: Baseflow Characteristics and Response to Hydrograph Events,
W82-00462 5B

KAYSNER, C. A.
Incidence of Vibrio Alginolyticus and Bacteria of Sanitary Significance in the Bering Sea,
W82-00490 5A

KEINKE, G. W.
Anaerobic Treatment of Human Waste in Northern Communities,
W82-00249 5E

KELLY, C. A.
Comparison of In Situ and In Vitro Rates of Methane Release in Freshwater Sediments,
W82-00245 2H

KELLY, D. M.
Impact of Construction of a Hydroelectric Project on the Water Quality of Five Lakes in Nova Scotia,
W82-00227 5C

KENYON, K. F.
Evaluation of the Overland Runoff Mode of Land Wastewater Treatment for Virus Removal,
W82-00220 5B

KERSTER, H. W.
Graphical Effluent Quality Control for Compliance Monitoring: What Is a Violation,
W82-00261 5G

KHALEEL, R.
Carbon Transformations in the Land Areas Receiving Organic Wastes in Relation to Nonpoint Source Pollution: A Conceptual Model,
W82-00179 5B

KHIND, C. S.
Effects of Water Regime on Growth, Yield, and Nitrogen Uptake of Rice,
W82-00330 2I

KILLILEA, W. R.
Chemical Recovery from Coal Conversion Wastes by Concentration,
W82-00436 5D

KIMOTO, W. I.
Nitrosamines in Tap Water After Concentration by a Carbonaceous Adsorbent,
W82-00459 5A

KING, C. J.
Solvent Extraction of Phenols,
W82-00438 5D

KING, G. M.
Sulfhydrolase Activity in Sediments of Wintergreen Lake, Kalamazoo County, Michigan,
W82-00241 2H

KING, L. D.
Water, Energy and Labor Requirements for Future Pacific Northwest Irrigation,
W82-00143 6A

KINNELL, P. I. A.
Rainfall Intensity-Kinetic Energy Relationships for Soil Loss Prediction,
W82-00466 2J

KIRSHEN, P. H.
Small-Scale Hydro in New England: 1960-1976,
W82-00169 6D

KJAERNSLI, B.
Shear Strength of Rockfill,
W82-00116 8D

KLEIN, J. A.
Assessment of Environmental Control Technology for Coal Conversion Processes,
W82-00432 5D

KLIEVE, J.
Modeling Ammonium Exchange and Regeneration on Clinoptilolite,
W82-00125 5D

KLIEVE, J. R.
Assessment of Oil Shale Retort Wastewater Treatment and Control Technology - Phases I and II,
W82-00390 5B

KLUG, M. J.
Reduction of Sulfur Compounds in the Sediments of a Eutrophic Lake Basin,
W82-00488 2H

Sulfhydrolase Activity in Sediments of Wintergreen Lake, Kalamazoo County, Michigan,
W82-00241 2H

KNECHT, W. A.
National Water Data Exchange (NAWDEX) System 2000 Data Retrieval Manual,
W82-00420 10B

KNIGHT, N. J.
Natural Variation in Abundance of Salmonid Populations in Streams and its Implications for Design of Impact Studies,
W82-00389 5C

KNIGHTON, M. D.
A More Versatile Soil Water Sampler,
W82-00191 7B

KNOCHENMUS, D. D.
A 10-Year Plan to Study the Aquifer System of Indian Wells Valley, California,
W82-00086 6D

KOBLANSKI, J. N.
Means and Method for Sweeping Material Floating on Water Using Vibrational Energy,
W82-00062 5G

KOCHERT, T. L.
The Consultant's Viewpoint on Alternative Disinfectants,
W82-00286 6A

KOK, G. L.
Measurements of Hydrogen Peroxide in Rainwater,
W82-00497 2K

KONRAD, J. C.
Pollution From Land Runoff,
W82-00253 5B

KONWINSKI, G. R.
Rocky Mountain Pipeline Project: Environmental Impact Statement,
W82-00394 5G

KOPFLER, F. C.
Identification of Organic Compounds in a Mutagenic Extract of a Surface Drinking Water by a Computerized Gas Chromatography/Mass Spectrometry System (GC/MS/COM),
W82-00256 5A

KOPPER, W.
Legal Aspects of Subsidence Due to Well Pumping,
W82-00170 6E

KOPPULA, S. D.
Predicting Lake Levels by Exponential Smoothing,
W82-00118 2A

KOROL, T.
Ice Problems at a Cooling Water Intake in a Tidal Estuary at Lingan, N.S.,
W82-00230 8A

KOUWEN, N.
Flow Resistance in Vegetated Waterways,
W82-00152 2E

KOVALEVSKII, V. S.
Possibilities of Using Helium and Tritium Surveys for Studying Recharge Conditions of Subsurface Waters,
W82-00302 7B

KRESCH, D. L.
Channel Conditions in the Lower Toutle and Cowlitz Rivers Resulting From the Mudflows of May 18, 1980,
W82-00004 5B

KROLL, R.
Ames' Mutagenic Activity in Recycled Water from an Israeli Water Reclamation Project,
W82-00234 5D

KUETTNER, J. P.
Report on the Summer MONEX Field Phase,
W82-00265 2B

KUNKLER, J. L.
Evaluation of the Malaga Bend Salinity Alleviation Project, Eddy County, New Mexico,
W82-00018 5B

KURSTAK, E.
Application of a Multiple Alginate Filter Method for the Determination of Water Viruses Concentration (Conception D'Une Membrane Filtrante a Base D'Alginate Pour La Concentration Des Virus Hydriques),
W82-00458 5A

KUSHNER, D. J.
Comparison of Nine Brands of Membrane Filter and the Most-Probable-Number Methods for Total Coliform Enumeration in Sewage-Contaminated Drinking Water,
W82-00203 5A

KUSS, F. R.
Estimating the Physical Carrying Capacity of Recreation Areas: A Rationale for Application of the Universal Soil Loss Equation,
W82-00274 2J

LA FRANCE, P.
Application of a Multiple Alginate Filter Method for the Determination of Water Viruses Concentration (Conception D'Une Membrane Filtrante a Base D'Alginate Pour La Concentration Des Virus Hydriques),
W82-00458 5A

LABELLE, R. L.
Influence of Estuarine Sediment on Virus Survival Under Field Conditions,
W82-00199 5A

LABHSETWAR, V. K.
The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 3: Maize Cultivation Experiment, Bacteriological Studies, and Economic Assessment,
W82-00457 3C

LAFLEN, J. M.
Effect of Crop Residue on Soil Loss from Continuous Row Cropping,
W82-00145 2J

LAHL, U.
Distribution and Balance of Volatile Halogenated Hydrocarbons in the Water and Air of Covered Swimming Pools Using Chlorine for Water Disinfection,
W82-00128 5F

LAING, A.
Western Water Resources: Coming Problems and Policy Alternatives,
W82-00107 6D

LAKHE, S. B.
Virus Removal in Waste Stabilization Ponds in India,
W82-00121 5D

LAMBERT, T. W.
Water in the Elizabethtown Area - A Study of Limestone Terrane in North-Central Kentucky,
W82-00413 5B

LAMBETH, V. N.
Effects of Soil Water Regime and Nitrogen Form on Blossom-End Rot, Yield, Water Relations, and Elemental Composition of Tomato,
W82-00162 2I

LAMKA, K. G.
Bacterial Contamination of Drinking Water Supplies in a Modern Rural Neighborhood,
W82-00198 5A

LANCE, J. C.
Survival of Enteroviruses in Rapid-Infiltration Basins During the Land Application of Wastewater,
W82-00496 5D

LANNON, J. M.
High pH Treatment of Combined Water Softening and Wastewater Sludges,
W82-00403 5D

LAPEN, R. F.
Human Use in a Dispersed Recreation Area and its Effect on Water Quality,
W82-00393 5B

LAPHAM, W. W.
Ground-Water Resources of the White River Basin, Madison County, Indiana,
W82-00412 2A

LARSON, C. L.
An Infiltration Model: Development and Evaluation of Its Parameters,
W82-00137 2G

LARSON, J. S.
A Model of Natural and Man-Induced Changes in Open Freshwater Wetlands on the Massachusetts Coastal Plain,
W82-00397 2I

LARSON, R. J.
Use of the Electrolytic Respirometer to Measure Biodegradation in Natural Waters,
W82-00126 5A

LAYNE, R. E. C.
Effect of Irrigation and Tree Density on Peach Production,
W82-00120 2I

LAZERTE, B. D.
The Prediction of Lacustrine Phytoplankton Diversity,
W82-00319 2H

LEACH, L. E.
Cropping Systems for Treatment and Utilization of Municipal Wastewater and Sludge,
W82-00097 5E

LECH, J. J.
Relationship Between Biotransformation and the Toxicity and Fate of Xenobiotic Chemicals in Fish,
W82-00186 5C

LECHEVALLIER, M. W.
Bacterial Contamination of Drinking Water Supplies in a Modern Rural Neighborhood,
W82-00198 5A

Impact of Verification Media and Resuscitation on Accuracy of the Membrane Filter Total Coliform Enumeration Technique,
W82-00494 5A

Staphylococcus Aureus in Rural Drinking Water,
W82-00223 5B

LECLERC, H.
Automation of Water Bacteriological Analysis: Running Test of an Experimental Prototype,
W82-00225 5A

LEO, J. N.
Fluoridation System,
W82-00061 5F

LESCHINE, T. M.
Does Salt Marsh Fertilization Enhance Shellfish Production. An Application of Flow Analysis,
W82-00259 2L

LESLEY, D. E.
Transformation of the Mouse Clonal Cell Line R846-DP8 by Mississippi River, Raw, and Finished Water Samples from Southeastern Louisiana,
W82-00215 5C

LEY, T. W.
Furrow Irrigation Practices in Northern Colorado,
W82-00139 3F

LI, R-M.
Flow Resistance in Vegetated Waterways,
W82-00152 2E

LIEW, P-F.
Thermostabilization of Enteroviruses by Estuarine Sediment,
W82-00263 2L

LIN, K. C.
Treatment of Potato-Processing Waste Water by an Anaerobic Lagoon-Filter System,
W82-00226 5D

LINDNER, J. B.
A Comparison of Nitrogen in Shallow Ground Water from Sewered and Unsewered Areas, Nassau County, New York, from 1952 Through 1976,
W82-00277 5B

LIPINSKI, P.
A 10-Year Plan to Study the Aquifer System of Indian Wells Valley, California,
W82-00086 6D

LITTLE, W. C.
Erodibility of Streambank Materials of Low Cohesion,
W82-00136 2J

LOCKMAN, H.
Isolation, Enumeration, and Characterization of Aeromonas from Polluted Waters Encountered in Diving Operations,
W82-00224 5C

LOMAX, P.
Comparison of Nine Brands of Membrane Filter and the Most-Probable-Number Methods for Total Coliform Enumeration in Sewage-Contaminated Drinking Water,
W82-00203 5A

LOMBARD, R. E.
Channel Conditions in the Lower Toutle and Cowlitz Rivers Resulting From the Mudflows of May 18, 1980,
W82-00004 5B

LOMEN, D. O.
Two-Dimensional Linearized Moisture Flow with Water Extraction,
W82-00405 2I

LONDQUIST, C. J.
Digital Model of the Unconsolidated Aquifer System in the Modesto Area, Stanislaus and San Joaquin Counties, California,
W82-00415 4B

LONG, J. P.
High-Level Ozone Disinfection of Municipal Wastewater Effluents,
W82-00379 5D

LOOSE, V.
Water Supply and Demand in an Energy Supply Model,
W82-00050 6D

LOW, W. H.
Radionuclide Concentrations in Streams in the Upper Blackfoot River Basin, Southeastern Idaho,
W82-00418 5A

LUBON, P.
Biological Oxidation of Aqueous Thiocyanate,
W82-00442 5D

LUCERO, F.
Water Related Planning and Design at Energy Firms,
W82-00042 6D

LUDWICK, J. C.
Perpetual Shoals at the Entrance to Chesapeake Bay: Flow-Substrate Interactions and Mutually Evasive Net Currents,
W82-00149 2L

LUECKE, R. H.
Assessment of Solvent Extraction for Treatment of Coal Gasifier Wastewater,
W82-00439 5D

LUND, Z. F.
Coastal Bermudagrass Yield and Soil Properties as Affected by Surface-Applied Dairy Manure and Its Residue,
W82-00195 3C

LUTHY, R. C.
Treatment of Coal Gasification Process Wastewaters,
W82-00434 5D

LYNN, S.
Solvent Extraction of Phenols,
W82-00438 5D

LYONS, W. B.
Shallow Core Snow Chemistry of Athabasca Glacier, Alberta,
W82-00320 2C

MACCONNELL, W. P.
A Model of Natural and Man-Induced Changes in Open Freshwater Wetlands on the Massachusetts Coastal Plain,
W82-00397 2I

MACDONALD, R. M.
Determination of Aminocarb in Water by High Performance Liquid Chromatography,
W82-00232 5A

MAGDOFF, F. R.
Nitrogen Availability from Sewage Sludge,
W82-00158 5E

MAGNUSON, M. L.
Upflow Water Filtration Unit, Test Results,
W82-00407 5F

MAGUIRE, R. J.
Fenitrothion Sprayed on a Pond: Kinetics of Its Distribution and Transformation in Water and Sediment,
W82-00159 5B

MAHAN, M. O.
Performance of Bearing Cherry and Prune Trees Under Very Low Irrigation Rates,
W82-00119 3F

MAHLER, A.
Ames' Mutagenic Activity in Recycled Water from an Israeli Water Reclamation Project,
W82-00234 5D

MAIER, W. J.
Characterization of Soluble and Colloidal-Phase Metal Complexes in River Water by Ultrafiltration. A Mass-Balance Approach,
W82-00480 5A

Determination of Organically Combined Chlorine in High Molecular Weight Aquatic Organics,
W82-00258 5A

MAINI, T.
Strategy for Radioactive Waste Disposal in Crystalline Rocks,
W82-00299 5E

MAKI, J. S.
Comparison of Two Direct-Count Methods for Determining Metabolizing Bacteria in Freshwater,
W82-00495 5A

MALOY, B. F.
The Consultant's Viewpoint on Alternative Disinfectants,
W82-00286 6A

MANKA, J.
Organic Micropollution Indices of Effluents and Renovated Waters,
W82-00123 5A

MANN, D. C.
Alkylpyridines in Surface Waters, Groundwaters, and Subsoils of a Drainage Located Adjacent to an Oil Shale Facility,
W82-00481 5B

MARKEE, T. P.
Development of Bioassay Procedures for Defining Pollution of Harbor Sediments,
W82-00387 5C

MARSH, P. B.
Dispersal of Aspergillus Fumigatus from Sewage Sludge Compost Piles Subjected to Mechanical Agitation in Open Air,
W82-00273 5E

MARTI, O. G.
Survival of Eggs and Larvae of Swine Nematode Parasites in Aerobic and Anaerobic Waste Treatment Systems,
W82-00161 5D

MARTI, V. C.
Comparison of Automated Segmented-Flow and Discrete Analyzers for the Determination of Nutrients in Water,
W82-00483 5A

MARTIN, D. K.
Planning Study to Model and Monitor Coal Pile Run-Off,
W82-00091 6A

MARTIN, Q. W.
Optimal Design of Water Conveyance Systems,
W82-00160 6B

MATSUDA, Y.
Effect of Mulch Rate on Soil Loss by Raindrop Splash,
W82-00468 2J

MATSUMOTO, G.
Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aquatic Environments - I. Features of Hydrocarbons for Polluted and Unpolluted Waters,
W82-00453 5B

Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aquatic Environments. II. Features of Fatty Acids for Polluted and Unpolluted Waters,
W82-00454 5A

MATTHEWS, J. E.
Evaluation of the Effectiveness of Granular Activated Carbon Adsorption and Aquaculture for Removing Toxic Compounds From Treated Petroleum Refinery Effluents,
W82-00098 5D

MATTSON, L.
Biological Oxidation of Aqueous Thiocyanate,
W82-00442 5D

MATVEEVA, O. S.
Basin Landscape-Halogeochemical Method of Evaluating the Natural and Reclamation Conditions of Irrigated Territories,
W82-00303 2K

MAYER, F. L.
Clinical Tests in Aquatic Toxicology: State of the Art,
W82-00464 5A

MAYEWSKI, P. A.
Shallow Core Snow Chemistry of Athabasca Glacier, Alberta,
W82-00320 2C

MAYFIELD, C. I.
Nitrogen Fixation and Methane Metabolism in a Stream Sediment-Water System Amended with Leaf Material,
W82-00486 2K

MAYS, E. L.
Specific Inhibition of Nitrite Oxidation by Chlorate and Its Use in Assessing Nitrification in Soils and Sediments,
W82-00242 2L

MCBEAN, E. A.
Mathematical Efficiency Concerns in Water Distribution Network Considerations,
W82-00339 5F

MCBRIDE, M. S.
Predicted Effects on Ground Water of Construction of Divide Cut Section, Tennessee-Tombigbee Waterway, Northeastern Mississippi Using a Digital Model,
W82-00428 2F

MCCAHILL, M. P.
Determination of Organically Combined Chlorine in High Molecular Weight Aquatic Organics,
W82-00258 5A

MCCAMBRIDGE, J.
Effect of Solar Radiation and Predacious Microorganisms on Survival of Fecal and Other Bacteria,
W82-00491 2L

MCCARTHY, J. A.
Electroplating Wastewater Sludge Characterization,
W82-00095 5E

MCDONALD, A.
Enteric Bacterial Concentrations in Reservoir Feeder Streams: Baseflow Characteristics and Response to Hydrograph Events,
W82-00462 5B

MCDONALD, D. G.
Limestone-Lime Treatment of Acid Mine Drainage - Full Scale,
W82-00377 5D

MCDUFFIE, B.
Sorption of Trace Cadmium on Clay Minerals and River Sediments: Effects of pH AND CD(II) Concentrations in a Synthetic River Water Medium,
W82-00174 2K

MCFARLAND, V. A.
Lethality of a Suspended Clay to a Diverse Selection of Marine and Estuarine Macrofauna,
W82-00268 5C

MCGRIFF, E. C.
Facultative Lagoon Effluent Polishing Using Phase Isolation Ponds,
W82-00092 5D

MCINTOSH, G. E.
Premining Hydrologic Conditions of Five Southeastern Ohio Watersheds,
W82-00054 4C

MCKIM, T. W.
High pH Treatment of Combined Water Softening and Wastewater Sludges,
W82-00403 5D

MCKNIGHT, D. M.
Toxicity of Mount St. Helens Ash Leachate to a Blue-Green Alga,
W82-00001 5C

MCMEEKIN, T. A.
Effect of Solar Radiation and Predacious Microorganisms on Survival of Fecal and Other Bacteria,
W82-00491 2L

MEHRLE, P. M.
Clinical Tests in Aquatic Toxicology: State of the Art,
W82-00464 5A

MELTON, R. G.
Identification of Organic Compounds in a Mutagenic Extract of a Surface Drinking Water by a Computerized Gas Chromatography/Mass Spectrometry System (GC/MS/COM),
W82-00256 5A

MERCER, B. W.
Environmental Control Technology for Shale Oil Wastewaters,
W82-00444 5D

MERCER, J. W.
Ground-Water Modeling: Recent Developments,
W82-00281 2F

MEREDITH, J. W.
Electroplating Wastewater Sludge Characterization,
W82-00095 5E

MEREDITH, T. S.
Water-Level Records for the Northern High Plains of Colorado, 1977-81,
W82-00422 7C

MERRILL, S. D.
Effects of Topsoil and Subsoil Thickness on Soil Water Content and Crop Production on a Disturbed Soil,
W82-00465 2G

METCALF, T. G.
Improved Method and Test Strategy for Recovery of Enteric Viruses from Shellfish,
W82-00219 5A

MEYER, W. S.
Field Test of an Irrigation Scheduling Computer Model,
W82-00184 3F

MIDDLESWORTH, B. C.
Planning Study to Model and Monitor Coal Pile Run-Off,
W82-00091 6A

MIDDLETON, J. E.
Performance of Bearing Cherry and Prune Trees Under Very Low Irrigation Rates,
W82-00119 3F

MILES, M. B.
Channel Conditions in the Lower Toutle and Cowlitz Rivers Resulting From the Mudflows of May 18, 1980,
W82-00004 5B

MILLER, B. A.
An Empirical Equation for Predicting Soluble Phosphorus Loads from Agricultural Watersheds,
W82-00134 5B

MILLER, D. E.
Effects of Small Amounts of Residue on Furrow Erosion,
W82-00470 2J

MILLER, G. G.
Selective Overburden Placement,
W82-00053 5G

MILLER, R. J.
Irrigation Tailwater Management,
W82-00392 3C

MILLETTE, J. R.
Concentration and Size of Asbestos in Water Supplies,
W82-00262 5B

MILLNER, P. D.
Dispersal of Aspergillus Fumigatus from Sewage Sludge Compost Piles Subjected to Mechanical Agitation in Open Air,
W82-00273 5E

MILNER, R. S.
Potentiometric Surface of the Floridan Aquifer in the Northwest Florida Water Management District, May 1980,
W82-00025 7C

Potentiometric Surface of the Floridan Aquifer in the Suwannee River Water Management District, Florida, May 1980,
W82-00024 7C

MINAEVA, E. N.
Use of River Waters That Did Not Reach the Aral Sea as a Consequence of Economic Activity During 1961-1975,
W82-00190 4A

MITCHELL, R. N.
Hydrologic Data for Urban Studies in the Austin, Texas Metropolitan Area, 1979,
W82-00083 7C

MITSCH, W. J.
Effects of Sewage Effluent Application on Litter Fall and Litter Decomposition in Cypress Swamps,
W82-00499 5E

MIZRAHI, A.
Silicates as Nonspecific Adsorbents of Bacteriophage: A Model for Purification of Water From Viruses,
W82-00350 5F

MONKE, E. J.
Sediment and Nutrient Movement from the Black Creek Watershed,
W82-00135 5B

MOORE, A. S.
Energy Recovery System,
W82-00059 5D

MOORE, B. E.
Enumeration of Potentially Pathogenic Bacteria from Sewage Sludges,
W82-00221 5A

Recovery of Indigenous Viruses from Wastewater Sludges, Using a Bentonite Concentration Procedure,
W82-00271 5D

Viral Transport Through Soil Columns Under Conditions of Saturated Flow,
W82-00295 5B

MOORE, J. W.
Distribution and Transport of Heavy Metals in the Sediments of a Small Northern Eutrophic Lake,
W82-00235 5B

MOREAUD, H.
Testing the Flocculation/Coagulation of Wastewater by Granulometric Analysis of Suspended Solids in the Water Using a Laser Diffraction Meter,
W82-00463 5D

MORGAN, J. M. III.
Estimating the Physical Carrying Capacity of Recreation Areas: A Rationale for Application of the Universal Soil Loss Equation,
W82-00274 2J

MORIGAKI, T.
Removal and Recovery of Organic Pollutants from the Aquatic Enviroment. 2. Removal and Recovery of Dodecylbenzenesulfonate from Aqueous Solution by Cross-Linked Poly(N-Benzyl-4-Vinylpyridinium Halide),
W82-00217 5D

MORIN, K. A.
Hydraulic Properties of Coal and Related Materials, Northern Great Plains,
W82-00278 2F

MORKOVKINA, I. K.
Possibilities of Using Helium and Tritium Surveys for Studying Recharge Conditions of Subsurface Waters,
W82-00302 7B

MORROW, C. T.
Transient Soil Moisture Movement Through Layered Soils Using a Finite Element Approach,
W82-00133 2G

MOSIER, J. W.
Photolysis of N-Nitrosodi-n-Propylamine in Water,
W82-00164 5B

MOSS, D.
An Appraisal of Pond-Net Samples for Biological Monitoring of Lotic Macroinvertebrates,
W82-00308 7B

MOTT, J. B.
A 13-Month Survey of Nematodes at Three Water Treatment Plants in Southern Ontario, Canada,
W82-00294 5F

MOULTON, E.
Improved Method and Test Strategy for Recovery of Enteric Viruses from Shellfish,
W82-00219 5A

MUELLER, A. J.
A Model of Natural and Man-Induced Changes in Open Freshwater Wetlands on the Massachusetts Coastal Plain,
W82-00397 2I

MUENCH, R. D.
Sediment Transport in Norton Sound, Alaska,
W82-00151 2J

MULAMOOTTIL, G.
A 13-Month Survey of Nematodes at Three Water Treatment Plants in Southern Ontario, Canada,
W82-00294 5F

MULHOLLAND, P. J.
Deposition of Riverborne Organic Carbon in Floodplain Wetlands and Deltas,
W82-00034 2J

MULVIHILL, J.
Water and Wastewater Reclamation: An Economical Answer to Industrial Wastes and Pollution,
W82-00188 3E

MURPHEY, J. B.
Erodibility of Streambank Materials of Low Cohesion,
W82-00136 2J

MURTAGH, G. J.
The Conservative Effect of Rainfall Variation on Fertiliser Response in a Humid Environment,
W82-00316 2A

MUSIK, I.
Analysis of Capacity Requirements for Storage Reservoirs: A Case Study,
W82-00341 6A

NAKAJIMA, R.
Underwater Aerator,
W82-00065 5D

NAMBIAR, K. R.
Luxury Uptake of Nitrogen in Flocculating Algal-Bacterial System,
W82-00307 5D

NARDA, N. K.
SOYROOT - A Dynamic Model of Soybean Root Growth and Water Uptake,
W82-00114 2I

NAVARRE, J-L.
Deposition of Heavy Elements on Belgian Agricultural Soils,
W82-00306 5B

NEBEL, C.
Ozone Treatment of Potable Water - Part I,
W82-00451 5F

Ozone Treatment of Potable Water--Part 2,
W82-00452 5F

NEEMAN, I.
Ames' Mutagenic Activity in Recycled Water from an Israeli Water Reclamation Project,
W82-00234 5D

NELSON, C. H.
Sediment Transport in Norton Sound, Alaska,
W82-00151 2J

NELSON, D. W.
Sediment and Nutrient Movement from the Black Creek Watershed,
W82-00135 5B

NELSON, L. M.
Channel Conditions in the Lower Toutle and Cowlitz Rivers Resulting From the Mudflows of May 18, 1980,
W82-00004 5B

NELSON, W. H.
A Resonance Raman Method for the Rapid Detection and Identification of Bacteria in Water,
W82-00404 5A

NESHYBA, S.
On the Estimation of Antarctic Iceberg Melt Rate,
W82-00166 2C

NEUFELD, R. D.
Biological Oxidation of Aqueous Thiocyanate,
W82-00442 5D

NEWMAN, F. M.
Development of Oil-In-Water Monitor, Phase II,
W82-00100 5A

NEWTON, A. J.
Determination of Marine Consent Conditions,
W82-00323 5G

NOKES, J. M.
Directory of Member Organizations of the National Water Data Exchange (NAWDEX),
W82-00089 10D

NORMAN, D. M.
Analytical Methods Evaluation for Applicability in Leachate Analysis,
W82-00380 5A

NORWOOD, D. L.
Reactions of Chlorine with Selected Aromatic Models of Aquatic Humic Material,
W82-00254 5F

O'DEA, J.
Consecutive Amperometric Titrations for Calcium and Magnesium,
W82-00208 5A

O'DOWD, J.
Northeastern New Jersey Grapples With a Drought,
W82-00289 8A

OCKERSHAUSEN, R. W.
History of a Water Chemical,
W82-00074 5F

OFER, Z.
A Laboratory Model for Under-Water Construction of a Dam,
W82-00347 8D

OLSEN, F. J.
Soil as a Medium for Dairy Liquid Waste Disposal,
W82-00165 5E

ORTIZ, N. V.
Ground-Water Flow and Uranium in Colorado Plateau,
W82-00282 2F

OSANTOWSKI, R.
Physical/Chemical Treatment of Blast Furnace Wastewaters Using Mobile Pilot Units,
W82-00378 5D

OSTERYOUNG, J.
Consecutive Amperometric Titrations for Calcium and Magnesium,
W82-00208 5A

OSTERYOUNG, R. A.
Consecutive Amperometric Titrations for Calcium and Magnesium,
W82-00208 5A

OTOSKI, R. M.
Lime Stabilization and Ultimate Disposal of Municipal Wastewater Sludges,
W82-00386 5E

OVCHINNIKOVA, L. K.
Possibilities of Using Helium and Tritium Surveys for Studying Recharge Conditions of Subsurface Waters,
W82-00302 7B

OVERCASH, M. R.
Carbon Transformations in the Land Areas Receiving Organic Wastes in Relation to Nonpoint Source Pollution: A Conceptual Model,
W82-00179 5B

Predicting Runoff Pollutant Reduction in Buffer Zones Adjacent to Land Treatment Sites,
W82-00141 5B

PABST, M. E.
January 1980 Water Levels, and Data Related to Water-level Changes, Western and South-Central Kansas,
W82-00016 2F

PACHA, R. E.
Human Use in a Dispersed Recreation Area and its Effect on Water Quality,
W82-00393 5B

PAGE, A. L.
Are Sierra Lakes Becoming Acid,
W82-00231 5C

PAL, D.
Leaching of Calcium and Magnesium from Soil Columns as Affected by Form of Nitrogen in Applied Sewage,
W82-00192 5E

PALL, R.
Transient Soil Moisture Movement Through Layered Soils Using a Finite Element Approach,
W82-00133 2G

PALMQUIST, W. N.
Rocky Mountain Pipeline Project: Environmental Impact Statement,
W82-00394 5G

PANSING, M. F.
Concentration and Size of Asbestos in Water Supplies,
W82-00262 5B

PARSONS, W. A.
Improved Water Management of Coal Conversion Processes by Preliminary Absorption of Halides,
W82-00437 5D

PATERSON, J. J.
Soil as a Medium for Dairy Liquid Waste Disposal,
W82-00165 5E

PATRICK, W. H. JR.
Behavior of DDT, Kepone, and Permethrin in Sediment-Water Systems Under Different Oxidation-Reduction and PH Conditions,
W82-00382 5B

Effect of Estuarine Sediment pH and Oxidation-Reduction Potential on Microbial Hydrocarbon Degradation,
W82-00243 2L

PATTON, J. T.
Methane Production from Ozonated Pulp Mill Effluent,
W82-00155 5D

PAVONI, J. L.
The Consultant's Viewpoint on Alternative Disinfectants,
W82-00286 6A

PAYNTER, M. J. B.
Populations of Methane-Producing Bacteria and In Vitro Methanogenesis in Salt Marsh and Estuarine Sediments,
W82-00202 2L

Technique for Determining Total Bacterial Virus Counts in Complex Aqueous Systems,
W82-00222 5A

PEARSON, C. C.
Pressurized Oxygenation System and Method,
W82-00064 5D

PEAVY, H. S.
Water Pollution Potential of Coal-Slurry Pipelines,
W82-00096 6A

PEDDICORD, R. K.
Lethality of a Suspended Clay to a Diverse Selection of Marine and Estuarine Macrofauna,
W82-00268 5C

PELON, W.
Transformation of the Mouse Clonal Cell Line R846-DP8 by Mississippi River, Raw, and Finished Water Samples from Southeastern Louisiana,
W82-00215 5C

PERKINS, S. G.
Preliminary Data From a Series of Artificial Recharge Experiments at Stanton, Texas,
W82-00085 7C

PERRY, R. L.
Use of the Electrolytic Respirometer to Measure Biodegradation in Natural Waters,
W82-00126 5A

PETERS, J. G.
Effects of Surface Mining on Water Quality in a Small Watershed, Sullivan County, Indiana,
W82-00427 5C

PHILLIPS, J. F. V.
Environmental Planning for Coal Strip Mining,
W82-00214 5G

PIEPHO, R. F.
Apparatus for the Purification of Oily Emulsions, Solutions, and Industrial Waste Waters,
W82-00060 5D

PIERCE, J. L.
Comparative Analysis of Sludge and Refuse Leachate: A Preliminary Report,
W82-00287 5E

PILL, W. G.
Effects of Soil Water Regime and Nitrogen Form on Blossom-End Rot, Yield, Water Relations, and Elemental Composition of Tomato,
W82-00162 2I

PIRBAZARI, M.
Effectiveness of Activated Carbon for Removal of Toxic and/or Carcinogenic Compounds From Water Supplies,
W82-00383 5F

POLAND, J.
Ground-Water Information: NWWA Provides the Resources,
W82-00301 2F

PONNAMPERUMA, F. N.
Effects of Water Regime on Growth, Yield, and Nitrogen Uptake of Rice,
W82-00330 2I

POPE, P. R.
Wastewater Treatment by Rooted Aquatic Plants in Sand and Gravel Trenches,
W82-00093 5D

PORTER, K. S.
An Evaluation of Sources of Nitrogen as Causes of Ground-Water Contamination in Nassau County, Long Island,
W82-00279 5B

POST, A.
Effects of Volcanism on the Glaciers of Mount St. Helens,
W82-00007 2C

POWER, J. F.
Effects of Topsoil and Subsoil Thickness on Soil Water Content and Crop Production on a Disturbed Soil,
W82-00465 2G

PRASAD, D.
Anaerobic Treatment of Human Waste in Northern Communities,
W82-00249 5E

PRIEST, P.
Deposition of Heavy Elements on Belgian Agricultural Soils,
W82-00306 5B

PRINCE, K. R.
Use of Flow-Duration Curves to Evaluate Effects of Urbanization on Streamflow Patterns on Long Island, New York,
W82-00416 4C

PROCKO, A.
Electroplating Wastewater Sludge Characterization,
W82-00095 5E

PROEBSTING, E. L. JR.
Performance of Bearing Cherry and Prune Trees Under Very Low Irrigation Rates,
W82-00119 3F

PRUITT, W. O.
Irrigation Tailwater Management,
W82-00392 3C

RAABE, J.
Optimization of Pump Turbines,
W82-00181 8C

RADEMAKER, A. D.
Leachates from Solid Waste Recovery Operations,
W82-00167 5D

RADKE, J. K.
Unsaturated Water Flow Through a Simulated Wheel Track,
W82-00473 2G

RAGONE, S. E.
A Comparison of Nitrogen in Shallow Ground Water from Sewered and Unsewered Areas, Nassau County, New York, from 1952 Through 1976,
W82-00277 5B

RAI, D.
Solution Species of Plutonium in the Environment,
W82-00163 5A

RAMIA, S.
Concentration of Seeded Simian Rotavirus SA-11 from Potable Waters by Using Talc-Celite Layers and Hydroextraction,
W82-00272 5A

RAO, V. C.
Virus Removal in Waste Stabilization Ponds in India,
W82-00121 5D

RATZLAFF, K. W.
Altitude of Water Table, Biscayne Aquifer, Dade County, Florida, March 1979,
W82-00411 7C

Altitude of Water Table, Biscayne Aquifer, Dade County, Florida, May 1980,
W82-00409 7C

Altitude of Water Table, Biscayne Aquifer, Dade County, Florida, October 1979,
W82-00410 7C

RAWLINGS, G. D.
Assessment of Oil Shale Retort Wastewater Treatment and Control Technology - Phases I and II,
W82-00390 5B

UNIV. OF ILL. URBANA-CHAMPAIGN

REALINI, P. A.
Determination of Priority Pollutant Phenols in Water by HPLC,
W82-00110 5A

REBHUN, M.
Organic Micropollution Indices of Effluents and Renovated Waters,
W82-00123 5A

RECHSTEINER, C. E.
Methods for Level 2 Analysis by Organic Compound Category,
W82-00384 5A

REDDY, C. N.
Behavior of DDT, Kepone, and Permethrin in Sediment-Water Systems Under Different Oxidation-Reduction and PH Conditions,
W82-00382 5B

REDDY, J. M.
Optimal Design of Furrow Irrigation Systems,
W82-00138 3F

REDDY, K. R.
Carbon Transformations in the Land Areas Receiving Organic Wastes in Relation to Nonpoint Source Pollution: A Conceptual Model,
W82-00179 5B

REDFIELD, G. W.
The Importance of Regenerated Nitrogen to Phytoplankton Productivity in a Subalpine Lake,
W82-00476 2H

REFLING, D. R.
Advanced Biological Treatment of Tannery Wastewater,
W82-00337 5D

REHM, B. W.
Hydraulic Properties of Coal and Related Materials, Northern Great Plains,
W82-00278 2F

REICOSKY, D. C.
Unsaturated Water Flow Through a Simulated Wheel Track,
W82-00473 2G

REID, J. D.
Sorption of Trace Cadmium on Clay Minerals and River Sediments: Effects of pH AND CD(II) Concentrations in a Synthetic River Water Medium,
W82-00174 2K

REMSEN, C. C.
Comparison of Two Direct-Count Methods for Determining Metabolizing Bacteria in Freshwater,
W82-00495 5A

REPLOGLE, J. A.
Measuring Flumes of Simplified Construction,
W82-00140 7B

RICE, C. E.
Upflow Water Filtration Unit, Test Results,
W82-00407 5F

RICE, I. M.
An Alternative Solution to the THM Problem,
W82-00072 5F

RICE, R. C.
Survival of Enteroviruses in Rapid-Infiltration Basins During the Land Application of Wastewater,
W82-00496 5D

RICHARDSON, C. W.
Modeling Grain Sorghum Ratoon Cropping and Associated Runoff and Sediment Losses,
W82-00113 2G

RIES, R. E.
Effects of Topsoil and Subsoil Thickness on Soil Water Content and Crop Production on a Disturbed Soil,
W82-00465 2G

RILEY, R. G.
Alkylpyridines in Surface Waters, Groundwaters, and Subsoils of a Drainage Located Adjacent to an Oil Shale Facility,
W82-00481 5B

RIPP, J. A.
Planning Study to Model and Monitor Coal Pile Run-Off,
W82-00091 6A

ROACH, F.
Ground Water Alternatives and Solutions,
W82-00029 6D

ROBERTS, P. V.
Total Organic Halogen as a Parameter for the Characterization of Reclaimed Waters: Measurement, Occurrence, Formation, and Removal,
W82-00197 5D

ROCHESTER, E. W.
Water Application Uniformity of Hose Towed Traveler Irrigators,
W82-00296 3F

ROCHOW, J. J.
Power Plant Water Intake Assessment,
W82-00216 6G

ROELFS, V. L.
Joint Dry/Wet Weather Treatment of Municipal Wastewater at Clatskanie, Oregon,
W82-00391 5D

ROESCH, S. E.
Assessment of 1978 Water Quality Conditions in the Upper Potomac Estuary,
W82-00052 5C

ROHR, M-E.
Concentration of Poliovirus in Water by Molecular Filtration,
W82-00246 5A

ROLLINGER, G.
Physical/Chemical Treatment of Blast Furnace Wastewaters Using Mobile Pilot Units,
W82-00378 5D

ROLLINS, H. C.
Summary of U.S. Geological Survey Investigations and Hydrologic Conditions in Southwest Florida for 1979,
W82-00419 10C

ROLOFF, G.
Gully Development in the Deep Loess Hills Region of Central Missouri,
W82-00472 2J

ROMANOV, V. V.
Possibilities of Using Helium and Tritium Surveys for Studying Recharge Conditions of Subsurface Waters,
W82-00302 7B

RONNEAU, C.
Deposition of Heavy Elements on Belgian Agricultural Soils,
W82-00306 5B

ROSENAU, J. C.
Potentiometric Surface of the Floridan Aquifer in the Northwest Florida Water Management District, May 1980,
W82-00025 7C

Potentiometric Surface of the Floridan Aquifer in the Suwannee River Water Management District, Florida, May 1980,
W82-00024 7C

ROSENTHAL, W. D.
SEASAT SAR Response from Water Resources Parameters,
W82-00101 7B

ROULET, N. T.
Illustration of the Roles of Snow in the Evolution of the Winter Cover of a Lake,
W82-00267 2C

ROUSE, M.
Engineering Research and the Water Industry,
W82-00313 8A

ROWE, L. W.
Basin Management in the San Bernardino Basin Area,
W82-00280 6A

Basin Management in the San Bernardino Valley,
W82-00075 4B

RUBIN, R. J.
Ames' Mutagenic Activity in Recycled Water from an Israeli Water Reclamation Project,
W82-00234 5D

RUDD, J. W. M.
Experimental Studies on the Effect of Arsenic on Microbial Degradation of Organic Matter and Algal Growth,
W82-00237 2H

SAFFERMAN, R. S.
Concentration of Poliovirus in Water by Molecular Filtration,
W82-00246 5A

SAGIK, B. P.
Enumeration of Potentially Pathogenic Bacteria from Sewage Sludges,
W82-00221 5A

Recovery of Indigenous Viruses from Wastewater Sludges, Using a Bentonite Concentration Procedure,
W82-00271 5D

Viral Transport Through Soil Columns Under Conditions of Saturated Flow,
W82-00295 5B

SALIM, R.
The Effect of Centrifugation on the Suspended Particles of River Waters,
W82-00124 5A

SALISBURY, H. B.
Absorption of Radium and Thorium From New Mexico Uranium Mill Tailing Solutions,
W82-00040 5D

SAMANI, Z. A.
Soil Hydraulic Stability in a Subsurface Drainage System,
W82-00115 2G

SAMEOTO, D. D.
BIONESS, A New Design in Multiple Net Zooplankton Samplers,
W82-00210 7B

SANDOVAL, F. M.
Effects of Topsoil and Subsoil Thickness on Soil Water Content and Crop Production on a Disturbed Soil,
W82-00465 2G

SARGENT, G. E.
The Significance of the Submarine Geology of Upper Spencer Gulf, South Australia, to Environmental Decision-Making,
W82-00314 2L

SATTAR, S. A.
Concentration of Seeded Simian Rotavirus SA-11 from Potable Waters by Using Talc-Celite Layers and Hydroextraction,
W82-00272 5A

SAUNDERS, D. G.
Photolysis of N-Nitrosodi-n-Propylamine in Water,
W82-00164 5B

SAVITOVA, N. I.
Basin Landscape-Halogeochemical Method of Evaluating the Natural and Reclamation Conditions of Irrigated Territories,
W82-00303 2K

SCHAEFFER, D. J.
Graphical Effluent Quality Control for Compliance Monitoring: What Is a Violation,
W82-00261 5G

SCHAUB, S. A.
Evaluation of the Overland Runoff Mode of Land Wastewater Treatment for Virus Removal,
W82-00220 5B

SCHEINER, B. J.
Dewatering of Industrial Clay Wastes,
W82-00041 5D

Treatment of Florida Surface Waters for Use in Phosphate Beneficiation,
W82-00048 5D

SCHMIDT, R. D.
Computer Modeling of Fluid Flow During Production and Environmental Restoration Phases of In Situ Uranium Leaching,
W82-00043 6A

SCHNOBRICH, D.
Modeling Ammonium Exchange and Regeneration on Clinoptilolite,
W82-00125 5D

SCHOENBERG, M. E.
Preliminary Evaluation of Ground-Water Contamination by Coal-Tar Derivatives, St. Louis Park Area, Minnesota,
W82-00430 5B

SCHWARZ, F. P.
Measurement of the Solubilities of Slightly Soluble Organic Liquids in Water by Elution Chromatography,
W82-00207 5A

SCHWINTZER, C. R.
Vegetation and Nutrient Status of Northern Michigan Bogs and Conifer Swamps with a Comparison to Fens,
W82-00484 2I

SCOTT, K. M.
Erosion and Sedimentation in the Kenai River, Alaska,
W82-00015 2J

SCRIVNER, C. L.
Gully Development in the Deep Loess Hills Region of Central Missouri,
W82-00472 2J

SEIDER, R. J.
Bacterial Contamination of Drinking Water Supplies in a Modern Rural Neighborhood,
W82-00198 5A

SEIDLER, R. J.
Impact of Verification Media and Resuscitation on Accuracy of the Membrane Filter Total Coliform Enumeration Technique,
W82-00494 5A

Isolation, Enumeration, and Characterization of Aeromonas from Polluted Waters Encountered in Diving Operations,
W82-00224 5C

Staphylococcus Aureus in Rural Drinking Water,
W82-00223 5B

SEMMENS, M.
Modeling Ammonium Exchange and Regeneration on Clinoptilolite,
W82-00125 5D

SERNE, R. J.
Solution Species of Plutonium in the Environment,
W82-00163 5A

SETHUNATHAN, N.
Sorption-Desorption of Lindane by Anaerobic and Aerobic Soils,
W82-00189 5A

SHAHAR, A.
Silicates as Nonspecific Adsorbents of Bacteriophage: A Model for Purification of Water From Viruses,
W82-00350 5F

SHAIKH, A. U.
Redox Stability of Inorganic Arsenic(III) and Arsenic(V) in Aqueous Solution,
W82-00206 5A

SHARPE, W. E.
Water Conservation Devices for New or Existing Dwellings,
W82-00401 3D

SHARPLEY, A. N.
Amounts and Relative Significance of Runoff Types in the Transport of Nitrogen into a Stream Draining an Agricultural Watershed,
W82-00173 5B

SHEETS, T. J.
Effect of Agricultural Land Development on Drainage Waters in the North Carolina Tidewater Region,
W82-00094 5B

SHEKAR, M. S.
Graphical Effluent Quality Control for Compliance Monitoring: What Is a Violation,
W82-00261 5G

SHELLEY, G. J.
Field Evaluation of a Swirl Degritter at Tamworth, New South Wales, Australia,
W82-00376 5F

SHIBAHARA, K.
Distribution of Obligately Oligotrophic Bacteria in Lake Biwa,
W82-00346 5A

SHIMOISHI, Y.
Gas Chromatographic Determination of Selenium (-II, O), -(IV), and -(VI) in Natural Waters,
W82-00257 5A

SHIOSAKI, K.
Alkylpyridines in Surface Waters, Groundwaters, and Subsoils of a Drainage Located Adjacent to an Oil Shale Facility,
W82-00481 5B

SHIRTS, M. B.
Absorption of Radium and Thorium From New Mexico Uranium Mill Tailing Solutions,
W82-00040 5D

SHPIRT, E.
Role of Hydrodynamic Factors in Ammonia Desorption by Diffused Aeration,
W82-00293 5D

SHULTERS, M. V.
Mount St. Helens Volcanic-Ash Fall in the Bull Run Watershed, Oregon, March-June 1980,
W82-00002 5B

SIGNOR, D. C.
Preliminary Data From a Series of Artificial Recharge Experiments at Stanton, Texas,
W82-00085 7C

SILVUS, H. S. JR.
Development of Oil-In-Water Monitor, Phase II,
W82-00100 5A

SIMONS, D. B.
Flow Resistance in Vegetated Waterways,
W82-00152 2E

SIMS, R. A.
Aerial Biomass Distribution in an Undisturbed and Disturbed Subarctic Bog,
W82-00211 2C

SINAI, G.
Domestic Water Supplies for Power Plant Cooling,
W82-00180 6D

SINCHUMPASAK, O-A.
The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 1: Description of the System and the Study of the High Rate Pond,
W82-00455 5D

The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 2: Studies of the Fish Ponds,
W82-00456 3C

The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 3: Maize Cultivation Experiment, Bacteriological Studies, and Economic Assessment,
W82-00457 3C

SINGER, M. J.
Effect of Mulch Rate on Soil Loss by Raindrop Splash,
W82-00468 2J

SKAGGS, R. W.
Effect of Agricultural Land Development on Drainage Waters in the North Carolina Tidewater Region,
W82-00094 5B

SKARBORN, S.
Ice Problems at a Cooling Water Intake in a Tidal Estuary at Lingan, N.S.,
W82-00230 8A

SKOGERBOE, R. K.
A Direct Differential Pulse Anodic Stripping Voltammetric Method for the Determination of Thallium in Natural Waters,
W82-00209 5A

SKOLD, M. D.
Economics of Snow Management for Agriculture in the Great Plains,
W82-00178 3F

SLACK, D. C.
An Infiltration Model: Development and Evaluation of Its Parameters,
W82-00137 2G

SLADE, R. M. JR.
Hydrologic Data for Urban Studies in the Austin, Texas Metropolitan Area, 1979,
W82-00083 7C

SLINN, S. A.
Predictions for Particle Deposition on Natural Waters,
W82-00264 5B

SLINN, W. G. N.
Predictions for Particle Deposition on Natural Waters,
W82-00264 5B

SMELLEY, A. G.
Dewatering of Industrial Clay Wastes,
W82-00041 5D

SMIL, V.
A New Era for China's Hydropower,
W82-00335 8A

SMITH, B.
Cutting the Water Losses,
W82-00310 5F

SMITH, D. W.
Enumeration and Relative Importance of Acetylene-Reducing (Nitrogen-Fixing) Bacteria in a Delaware Salt Marsh,
W82-00248 2L

SMITH, J. E.
Microplate Technique for Determining Accumulation of Metals by Algae,
W82-00492 5A

SMITH, R. C. G.
Environmental Resources and Restraints to Agricultural Production in a Mediterranean-Type Environment,
W82-00329 2I

SMITH, R. L.
Reduction of Sulfur Compounds in the Sediments of a Eutrophic Lake Basin,
W82-00488 2H

SMITH, V. L.
Temporal Variations in Trihalomethane Content of Drinking Water,
W82-00255 5A

SNYDER, J. R.
Economics of Snow Management for Agriculture in the Great Plains,
W82-00178 3F

SONZOGNI, W. C.
Pollution From Land Runoff,
W82-00253 5B

SORBER, C. A.
Recovery of Indigenous Viruses from Wastewater Sludges, Using a Bentonite Concentration Procedure,
W82-00271 5D

Viral Transport Through Soil Columns Under Conditions of Saturated Flow,
W82-00295 5B

SORLIN, D. J.
Methods for Level 2 Analysis by Organic Compound Category,
W82-00384 5A

SPERRY, J. F.
A Resonance Raman Method for the Rapid Detection and Identification of Bacteria in Water,
W82-00404 5A

SPIKER, E. C.
Carbon Isotopes as Indicators of the Source and Fate of Carbon in Rivers and Estuaries,
W82-00033 5B

SPROUL, O. J.
The Effect of Bentonite Clay on Ozone Disinfection of Bacteria and Viruses in Water,
W82-00292 5F

STACHEL, B.
Distribution and Balance of Volatile Halogenated Hydrocarbons in the Water and Air of Covered Swimming Pools Using Chlorine for Water Disinfection,
W82-00128 5F

STAFFORD, D. A.
Apparatuses for the Anaerobic Digestion of Natural Organic Waste,
W82-00069 5D

STANLEY, D. A.
Treatment of Florida Surface Waters for Use in Phosphate Beneficiation,
W82-00048 5D

STAUFFER, J. R. JR.
The Influence of Stream Order and Selected Stream Bed Parameters on Fish Diversity in Raystown Branch, Susquehanna River Drainage, Pennsylvania,
W82-00109 2E

STENSTROM, M. K.
Effects of Alpha, Beta and Theta Factor Upon the Design, Specification and Operation of Aeration Systems,
W82-00291 5D

STEPANOV, I. N.
Basin Landscape-Halogeochemical Method of Evaluating the Natural and Reclamation Conditions of Irrigated Territories,
W82-00303 2K

STEVENS, K. L.
Sodium-Potassium Ratios in Soil Solution and Plant Response Under Saline Conditions,
W82-00469 3C

STEVENSON, B.
Solar Cycles and Erosional Events on the New South Wales Central and South Coasts,
W82-00318 2J

STEWART, C. A. JR.
Chlorinated Drinking Water,
W82-00467 5F

STEWART, J. M.
Aerial Biomass Distribution in an Undisturbed and Disturbed Subarctic Bog,
W82-00211 2C

STEWART, J. W.
Hydrogeologic Data for Rocky Creek Landfill and Adjacent Area, Northwest Hillsborough County, Florida, 1969-73,
W82-00417 5B

STILES, E. A.
Toxicity of Mount St. Helens Ash Leachate to a Blue-Green Alga,
W82-00001 5C

STINSON, D. L.
Modeling Grain Sorghum Ratoon Cropping and Associated Runoff and Sediment Losses,
W82-00113 2G

STOLTE, W. J.
The Limitations and Usefulness of Streamflow Generation Methods: A Case Study,
W82-00229 6A

STOLZY, L. H.
Domestic Water Supplies for Power Plant Cooling,
W82-00180 6D

STONE, P. B.
Field Evaluation of a Swirl Degritter at Tamworth, New South Wales, Australia,
W82-00376 5F

STONES, T.
A Realistic Assessment of the Effect of Settlement on Sewage,
W82-00324 5D

STOVER, E. L.
High-Level Ozone Disinfection of Municipal Wastewater Effluents,
W82-00379 5D

STRAUGHAN, I. R.
Are Sierra Lakes Becoming Acid,
W82-00231 5C

STRAUSSMAN, Y.
Silicates as Nonspecific Adsorbents of Bacteriophage: A Model for Purification of Water From Viruses,
W82-00350 5F

STREBLOW, D. E.
A More Versatile Soil Water Sampler,
W82-00191 7B

STRICKLAND, E. R.
Membrane Filter Method for Enumerating Escherichia Coli,
W82-00487 5A

STRIER, M. P.
Pollutant Treatability: A Molecular Engineering Approach,
W82-00252 6E

SUIDAN, M. T.
Continuous Bioregeneration of Granular Activated Carbon During the Anaerobic Degradation of Catechol,
W82-00408 5D

SUNADA, D. K.
Ground-Water Flow and Uranium in Colorado Plateau,
W82-00282 2F

SUNG, J. F. C.
Analytical Methods Evaluation for Applicability in Leachate Analysis,
W82-00380 5A

SUTCLIFFE, H. JR.
Hydrogeologic Data from Test Drilling near Verna Beach, Florida, 1978,
W82-00424 2F

SWANSON, J. L.
Solution Species of Plutonium in the Environment,
W82-00163 5A

SWEENEY, R. E.
Characterisation of Domestic and Industrial Sewage in Southern California Coastal Sediments Using Nitrogen, Carbon, Sulphur, and Uranium Tracers,
W82-00147 5B

Natural Abundances of 15N as a Source Indicator for Near-Shore Marine Sedimentary and Dissolved Nitrogen,
W82-00283 5B

SWEET, R. G.
Deep Well Injection of Industrial Wastes,
W82-00475 5E

SWENSON, W. A.
Development of Bioassay Procedures for Defining Pollution of Harbor Sediments,
W82-00387 5C

SYERS, J. K.
Amounts and Relative Significance of Runoff Types in the Transport of Nitrogen into a Stream Draining an Agricultural Watershed,
W82-00173 5B

TABUCANON, M.
The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 2: Studies of the Fish Ponds,
W82-00456 3C

The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 3: Maize Cultivation Experiment, Bacteriological Studies, and Economic Assessment,
W82-00457 3C

TAKEI, Y.
Underwater Aerator,
W82-00065 5D

TALLMAN, D. E.
Redox Stability of Inorganic Arsenic(III) and Arsenic(V) in Aqueous Solution,
W82-00206 5A

TAM, T-Y.
Nitrogen Fixation and Methane Metabolism in a Stream Sediment-Water System Amended with Leaf Material,
W82-00486 2K

TAN, C. S.
Effect of Irrigation and Tree Density on Peach Production,
W82-00120 2I

TANJI, K. K.
Irrigation Tailwater Management,
W82-00392 3C

TATE, R. L. III
Variation in Microbial Activity in Histosols and Its Relationship to Soil Moisture,
W82-00244 2G

TAUXE, G. W.
Modeling Ammonium Exchange and Regeneration on Clinoptilolite,
W82-00125 5D

TAYLOR, H. E.
A Direct Differential Pulse Anodic Stripping Voltammetric Method for the Determination of Thallium in Natural Waters,
W82-00209 5A

TERRY, R. E.
Variation in Microbial Activity in Histosols and Its Relationship to Soil Moisture,
W82-00244 2G

TERWINDT, J. H. J.
Neap-Spring Tide Sequences of Intertidal Shoal Deposits in a Mesotidal Estuary,
W82-00112 2L

THAGARD, M. E.
Index to Active Hydrologic Data Collection Sites in Florida, 1980-81,
W82-00425 7C

THEIS, S. W.
SEASAT SAR Response from Water Resources Parameters,
W82-00101 7B

THIRUMURTHI, D.
Design Guidelines for Incompletely Mixed or Aerobic-Anaerobic Aerated Lagoons,
W82-00250 5D

Impact of Construction of a Hydroelectric Project on the Water Quality of Five Lakes in Nova Scotia,
W82-00227 5C

THOMAS, R. E.
Evaluation of the Overland Runoff Mode of Land Wastewater Treatment for Virus Removal,
W82-00220 5B

THORP, J. H.
Field Experiments on Responses of a Freshwater, Benthic Macroinvertebrate Community to Vertebrate Predators,
W82-00477 5C

THRUN, K. E.
Methods for Level 2 Analysis by Organic Compound Category,
W82-00384 5A

TIBBITTS, G. C. JR
A Qualitative Appraisal of the Hydrology of the Yemen Arab Republic from Landsat Images,
W82-00022 7B

TIMMONS, J. F.
Protecting Agriculture's Natural Resource Base,
W82-00176 4D

TITTLEBAUM, M. L.
The Consultant's Viewpoint on Alternative Disinfectants,
W82-00286 6A

TOBIN, R. S.
Comparison of Nine Brands of Membrane Filter and the Most-Probable-Number Methods for Total Coliform Enumeration in Sewage-Contaminated Drinking Water,
W82-00203 5A

TOEI, K.
Gas Chromatographic Determination of Selenium (-II, O), -(IV), and -(VI) in Natural Waters,
W82-00257 5A

TRANUM, W. M.
Water Level Data for Wells in and Near Burial Ground 3, Oak Ridge National Laboratory, Tennessee, 1975-1979,
W82-00423 7C

TREWEEK, G. P.
Refuse-To-Energy Wastewater Treatment,
W82-00168 5D

TRINEL, P. A.
Automation of Water Bacteriological Analysis: Running Test of an Experimental Prototype,
W82-00225 5A

TROUTMAN, D. E.
Polychlorinated Biphenyl Transport in the Hudson River, New York,
W82-00008 5B

Relationship of Water Quality of Hudson River, New York, During Peak Discharges to Geologic Characteristics of Contributing Subbasins,
W82-00009 5B

TURBEVILLE, J. E.
Method and Apparatus for Pollutant Spill Control,
W82-00056 5G

TURK, C. A.
Recovery of Indigenous Viruses from Wastewater Sludges, Using a Bentonite Concentration Procedure,
W82-00271 5D

TURK, J. T.
Polychlorinated Biphenyl Transport in the Hudson River, New York,
W82-00008 5B

Relationship of Water Quality of Hudson River, New York, During Peak Discharges to Geologic Characteristics of Contributing Subbasins,
W82-00009 5B

TURNER, D. R.
Water-Rock Partition Coefficients and the Composition of Natural Waters - A Reassessment,
W82-00284 2K

TWYMAN, J. D.
Concentration and Size of Asbestos in Water Supplies,
W82-00262 5B

UCHIDA, H.
Distribution of Obligately Oligotrophic Bacteria in Lake Biwa,
W82-00346 5A

Gas Chromatographic Determination of Selenium (-II, O), -(IV), and -(VI) in Natural Waters,
W82-00257 5A

UNDERWOOD, J. K.
Impact of Construction of a Hydroelectric Project on the Water Quality of Five Lakes in Nova Scotia,
W82-00227 5C

VAN DER VEEN, C.
Hygiene of Drinking Water in Developing Countries,
W82-00269 5F

VANDERPLOEG, H. A.
Seasonal Particle-Size Selection by Diaptomus Sicilis in Offshore Lake Michigan,
W82-00485 2H

VARNESS, K. J.
Human Use in a Dispersed Recreation Area and its Effect on Water Quality,
W82-00393 5B

VAUCLIN, M.
A Comparative Study of Three Forms of the Richard Equation Used for Predicting One-Dimensional Infiltration in Unsaturated Soil,
W82-00328 2G

VEENSTRA, J. N.
High pH Treatment of Combined Water Softening and Wastewater Sludges,
W82-00403 5D

VENN, A. C.
Environmental Planning for Coal Strip Mining,
W82-00214 5G

VERHOFF, F. H.
Energy Recovery System,
W82-00059 5D

VESTAL, J. R.
Lignocellulose Mineralization by Arctic Lake Sediments in Response to Nutrient Manipulation,
W82-00270 2H

VILLERIUS, L. A.
Interference of Sulphide in Inorganic Phosphate Determination in Natural Waters,
W82-00154 5A

VOORHEES, W. B.
Unsaturated Water Flow Through a Simulated Wheel Track,
W82-00473 2G

WAGHMARE, S. V.
Virus Removal in Waste Stabilization Ponds in India,
W82-00121 5D

WAGNER, P.
Control Technology Strategies for Coal Preparation Waste Drainages,
W82-00440 5D

WAHID, P. A.
Sorption-Desorption of Lindane by Anaerobic and Aerobic Soils,
W82-00189 5A

WALKER, E. A.
Behavior of Trifluralin in Aquatic Model Ecosystems,
W82-00233 5C

WALLACE, J. R.
The Analysis of Oil Shale Wastes: A Review,
W82-00388 5A

WALLACE, R. E.
A 201 Pollution Control Planning Tragedy,
W82-00285 6E

WALSH, J. J.
An Analysis of Factors Affecting Oxygen Depletion in the New York Bight,
W82-00106 5C

WANEK, P. L.
Control Technology Strategies for Coal Preparation Waste Drainages,
W82-00440 5D

WANGEN, L. E.
Control Technology Strategies for Coal Preparation Waste Drainages,
W82-00440 5D

WARD, R. L.
Effects of Moisture Content on Long-Term Survival and Regrowth of Bacteria in Wastewater Sludge,
W82-00493 5E

Response of Bacteria in Wastewater Sludge to Moisture Loss by Evaporation and Effect of Moisture Content on Bacterial Inactivation by Ionizing Radiation,
W82-00489 5D

WARRICK, A. W.
Areal Predictions of Water and Solute Flux in the Unsaturated Zone,
W82-00381 6A

Two-Dimensional Linearized Moisture Flow with Water Extraction,
W82-00405 2I

WARSKOW, W. L.
Picloram Dissipation in a Small Southwestern Stream,
W82-00212 5B

UNIV. OF ILL. URBANA-CHAMPAIGN

WATSON, S.
The Prediction of Lacustrine Phytoplankton Diversity,
W82-00319 2H

WEBB, R. M.
Physical Effects of Vehicular Disturbances on Arid Landscapes,
W82-00111 4C

WEBER, W. J. JR.
Effectiveness of Activated Carbon for Removal of Toxic and/or Carcinogenic Compounds From Water Supplies,
W82-00383 5F

WEBSTER, D. A.
Water Level Data for Wells in and Near Burial Ground 3, Oak Ridge National Laboratory, Tennessee, 1975-1979,
W82-00423 7C

WEEKS, E. P.
Preliminary Data From a Series of Artificial Recharge Experiments at Stanton, Texas,
W82-00085 7C

WEIGONG, C.
China's Potential for Hydro Development,
W82-00336 8A

WEINBERGER, P.
Hydrolysis of Fenitrothion in Model and Natural Aquatic Systems,
W82-00157 5B

WELCH, J. F.
A/C Pipe - Assessment or Advocacy,
W82-00070 5F

WESTERMAN, P. W.
Predicting Runoff Pollutant Reduction in Buffer Zones Adjacent to Land Treatment Sites,
W82-00141 5B

WHEATLEY, A. D.
Pilot Scales Tests on the Flotation of Abattoir Wastes by Deep U Tubes,
W82-00322 5D

WHEATON, F. W.
Design, Evaluation and Effluent Water Quality Analysis of Three Oyster Shellstock Washers,
W82-00406 5D

WHITE, M. J. D.
Small is Environmentally Acceptable . . .,
W82-00311 5D

WHITEHALL, K. V.
Management and Design Implications of a Mathematical Model of a Rapid Gravity Sand Filter Backwash,
W82-00460 5D

WHITFIELD, M.
Water-Rock Partition Coefficients and the Composition of Natural Waters - A Reassessment,
W82-00284 2K

WIEGERT, R. E.
Process for Removing Alkalinity and Hardness From Waters,
W82-00063 5F

WILCOX, R. P.
The Operation of a Waste Treatment Plant. Process Dynamic Considerations,
W82-00298 5D

WILDUNG, R. E.
Alkylpyridines in Surface Waters, Groundwaters, and Subsoils of a Drainage Located Adjacent to an Oil Shale Facility,
W82-00481 5B

WILLARDSON, L. S.
Soil Hydraulic Stability in a Subsurface Drainage System,
W82-00115 2G

WILLEY, J. D.
Trace Metal Geochemistry in Sediments from the Miramichi Estuary, New Brunswick,
W82-00236 5A

WILLIAMS, J. M.
Control Technology Strategies for Coal Preparation Waste Drainages,
W82-00440 5D

WILLIAMS, J. R.
Modeling Grain Sorghum Ratoon Cropping and Associated Runoff and Sediment Losses,
W82-00113 2G

WILLIAMS, O. O.
National Water Data Exchange (NAWDEX) System 2000 Data Retrieval Manual,
W82-00420 10B

WILLIAMS, R. D.
The Influence of Stream Order and Selected Stream Bed Parameters on Fish Diversity in Raystown Branch, Susquehanna River Drainage, Pennsylvania,
W82-00109 2E

WILLIAMSON, K. J.
A Bacterial Bioassay for Assessment of Wastewater Toxicity,
W82-00398 5A

WILLIS, W. O.
Economics of Snow Management for Agriculture in the Great Plains,
W82-00178 3F

WILLSON, W. G.
Slagging Fixed-Bed Gasifier (SFBG) Wastewater Pretreatment,
W82-00433 5D

WILSON, B. N.
An Infiltration Model: Development and Evaluation of Its Parameters,
W82-00137 2G

WILSON, J. T.
Effect of Microcrustaceans on Blue-Green Algae in Flooded Soil,
W82-00146 6G

WIMMER, E.
Process for Removal of Mercury and Mercury Compounds From Aqueous Solutions and Industrial Waste Liquors,
W82-00058 5D

WINNER, M. D. JR.
An Observation-Well Network Concept as Applied to North Carolina,
W82-00414 4B

Proposed Observation-Well Networks and Ground-Water Level Program for North Carolina,
W82-00426 4B

WRENCH, J. J.
Reduction, Methylation, and Incorporation of Arsenic into Lipids by the Marine Phytoplankton Dunaliella Tertiolecta,
W82-00239 5B

WRIGHT, J. F.
An Appraisal of Pond-Net Samples for Biological Monitoring of Lotic Macroinvertebrates,
W82-00308 7B

YANG, S-Y.
Soil as a Medium for Dairy Liquid Waste Disposal,
W82-00165 5E

YEAGER, J. G.
Effects of Moisture Content on Long-Term Survival and Regrowth of Bacteria in Wastewater Sludge,
W82-00493 5E

Response of Bacteria in Wastewater Sludge to Moisture Loss by Evaporation and Effect of Moisture Content on Bacterial Inactivation by Ionizing Radiation,
W82-00489 5D

YEH, W. W-G.
Aquifer Parameter Identification with Optimum Dimension in Parameterization,
W82-00131 2F

YIQIU, C.
Environmental Impact Assessment of China's Water Transfer Project,
W82-00129 6D

YOCKIM, R. S.
Behavior of Trifluralin in Aquatic Model Ecosystems,
W82-00233 5C

YOON, Y. S.
Aquifer Parameter Identification with Optimum Dimension in Parameterization,
W82-00131 2F

YOST, E. C.
Characterization of Soluble and Colloidal-Phase Metal Complexes in River Water by Ultrafiltration. A Mass-Balance Approach,
W82-00480 5A

YOUNG, J. C.
Leachates from Solid Waste Recovery Operations,
W82-00167 5D

Water-Related Environmental Control Requirements at Municipal Solid Waste-to-Energy Conversion Facilities,
W82-00037 5D

Water-Related Environmental Control Requirements of Waste-to-Energy Conversion,
W82-00443 5D

YOUNG, L. Y.
Enrichment and Association of Bacteria and Particulates in Salt Marsh Surface Water,
W82-00201 2L

ZANELLA, E. F.
Evaluation of Methodologies for the Determination of Acute Toxicity in Pulp and Paper Effluents,
W82-00297 5A

ZATKO, J. R.
Dewatering of Industrial Clay Wastes,
W82-00041 5D

ZEHNDER, A. J. B.
Anaerobic Methane Oxidation: Occurrence and Ecology,
W82-00218 2H

ZEISIG, T.
Analytical Methods Evaluation for Applicability in Leachate Analysis,
W82-00380 5A

ZEITOUN, I. H.
Power Plant Water Intake Assessment,
W82-00216 6G

ZERDA, K. S.
Concentration of Coliphages from Large Volumes of Water and Wastewater,
W82-00247 5A

ZILLMAN, J. W.
The World Climate Programme,
W82-00317 6A

ZLOBINA, V. L.
Possibilities of Using Helium and Tritium Surveys for Studying Recharge Conditions of Subsurface Waters,
W82-00302 7B

ZOLTEK, J. JR.
Phosphorus Dynamics of a Florida Freshwater Marsh Receiving Treated Wastewater, W82-00108 5E

UNIV. OF ILL. URBANA-CHAMPAIGN

ORGANIZATIONAL INDEX

A/C PIPE PRODUCERS ASSOCIATION, ARLINGTON, VA.
A/C Pipe - Assessment or Advocacy,
W82-00070 5F

ADELAIDE UNIV. (AUSTRALIA). DEPT. OF GEOGRAPHY.
Recent Variations in Winter Extratropical Cyclone Activity for the Australian Region,
W82-00315 2B

ADELAIDE UNIV. (AUSTRALIA). DEPT. OF GEOLOGY.
The Significance of the Submarine Geology of Upper Spencer Gulf, South Australia, to Environmental Decision-Making,
W82-00314 2L

AGRICULTURAL RESEARCH AND EDUCATION CENTER, BELLE GLADE, FL.
Variation in Microbial Activity in Histosols and Its Relationship to Soil Moisture,
W82-00244 2G

AKADEMIYA NAUK SSSR, MOSCOW. INST. GEOGRAFII.
Use of River Waters That Did Not Reach the Aral Sea as a Consequence of Economic Activity During 1961-1975,
W82-00190 4A

AKADEMIYA NAUK SSSR, MOSCOW. INST. OF SOIL CHEMISTRY AND SOIL SCIENCE.
Basin Landscape-Halogeochemical Method of Evaluating the Natural and Reclamation Conditions of Irrigated Territories,
W82-00303 2K

AKADEMIYA NAUK SSSR, MOSCOW. INST. VODNYKH PROBLEM.
Possibilities of Using Helium and Tritium Surveys for Studying Recharge Conditions of Subsurface Waters,
W82-00302 7B

ALABAMA AGRICULTURE EXPERIMENTAL STATION, AUBURN.
Coastal Bermudagrass Yield and Soil Properties as Affected by Surface-Applied Dairy Manure and Its Residue,
W82-00195 3C

ALBERTA ENVIRONMENTAL CENTER, VEGREVILLE.
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W82-00235 5B

ALBERY, PULLERITS, DICKENSON AND ASSOCIATES LTD., DON MILLS (ONTARIO).
Ice Problems at a Cooling Water Intake in a Tidal Estuary at Lingan, N.S.,
W82-00230 8A

ALLIED CHEMICAL CORP., IDAHO FALLS, ID.
Consecutive Amperometric Titrations for Calcium and Magnesium,
W82-00208 5A

ALTEX SCIENTIFIC, BERKELEY, CA.
Determination of Priority Pollutant Phenols in Water by HPLC,
W82-00110 5A

AMSTERDAM WATER WORKS (NETHERLANDS).
Hygiene of Drinking Water in Developing Countries,
W82-00269 5F

ARGONNE NATIONAL LAB., ARGONNE, IL.
Water Quality Issues and Energy Assessments,
W82-00036 6B

Conceptual Design of a Regional Water Quality Screening Model,
W82-00038 6A

ARGONNE NATIONAL LAB., IL.
Longitudinal Succession in Impact Assessment of River System Fish Communities,
W82-00399 5C

ARIZONA UNIV., TUCSON. DEPT. OF SOILS, WATER, AND ENGINEERING.
Areal Predictions of Water and Solute Flux in the Unsaturated Zone,
W82-00381 6A

Two-Dimensional Linearized Moisture Flow with Water Extraction,
W82-00405 2I

ARIZONA UNIV., TUCSON. LAW SCHOOL.
Ground Water Conflicts and Barriers,
W82-00028 6E

ARMY ENGINEER DISTRICT, NEW YORK.
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W82-00103 4A

ARMY ENGINEER WATERWAYS EXPERIMENT STATION, VICKSBURG, MS.
Lethality of a Suspended Clay to a Diverse Selection of Marine and Estuarine Macrofauna,
W82-00268 5C

ARMY MEDICAL BIOENGINEERING RESEARCH AND DEVELOPMENT LAB., FORT DETRICK, MD.
Evaluation of the Overland Runoff Mode of Land Wastewater Treatment for Virus Removal,
W82-00220 5B

ASIAN INST. OF TECH., BANGKOK (THAILAND). DIV. OF AGRICULTURAL AND FOOD ENGINEERING.
The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 1: Description of the System and the Study of the High Rate Pond,
W82-00455 5D

The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 2: Studies of the Fish Ponds,
W82-00456 3C

The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 3: Maize Cultivation Experiment, Bacteriological Studies, and Economic Assessment,
W82-00457 3C

AUBURN UNIV., AL. AGRICULTURAL EXPERIMENT STATION.
Water Application Uniformity of Hose Towed Traveler Irrigators,
W82-00296 3F

BATTELLE PACIFIC NORTHWEST LAB., RICHLAND, WA.
Solution Species of Plutonium in the Environment,
W82-00163 5A

Environmental Control Technology for Shale Oil Wastewaters,
W82-00444 5D

Alkylpyridines in Surface Waters, Groundwaters, and Subsoils of a Drainage Located Adjacent to an Oil Shale Facility,
W82-00481 5B

BATTELLE PACIFIC NORTHWEST LABS., RICHLAND, WA.
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W82-00264 5B

State-of-the-Art of Liquid Waste Disposal for Geothermal Energy Systems: 1979,
W82-00375 5E

BAUER BROS. CO., SPRINGFIELD, OH. (ASSIGNEE).
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W82-00066 5D

BAYLOR COLL. OF MEDICINE, HOUSTON, TX. DEPT. OF VIROLOGY AND EPIDEMIOLOGY.
Concentration of Coliphages from Large Volumes of Water and Wastewater,
W82-00247 5A

Thermostabilization of Enteroviruses by Estuarine Sediment,
W82-00263 2L

Survival of Enteroviruses in Rapid-Infiltration Basins During the Land Application of Wastewater,
W82-00496 5D

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W82-00199 5A

BDM CORP., ALBUQUERQUE, NM.
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W82-00493 5E

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W82-00210 7B

Reduction, Methylation, and Incorporation of Arsenic into Lipids by the Marine Phytoplankton Dunaliella Tertiolecta,
W82-00239 5B

BIRZEIT UNIV., WEST BANK (ISRAEL). DEPT. OF CHEMISTRY.
The Effect of Centrifugation on the Suspended Particles of River Waters,
W82-00124 5A

BREMEN UNIV. (GERMANY, F.R.).
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W82-00128 5F

BRICE, PETRIDES, AND ASSOCIATES, INC., WATERLOO, IA.
Leachates from Solid Waste Recovery Operations,
W82-00167 5D

BROOKHAVEN NATIONAL LAB., UPTON, NY.
An Analysis of Factors Affecting Oxygen Depletion in the New York Bight,
W82-00106 5C

BROOKHAVEN NATIONAL LAB., UPTON, NY. PROCESS SCIENCES DIV.
Environmental Control Technology for the Flash Hydropyrolysis of Coal,
W82-00435 5D

BUREAU OF LAND MANAGEMENT, WASHINGTON, DC.
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W82-00394 5G

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The World Climate Programme,
W82-00317 6A

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W82-00054 4C

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Absorption of Radium and Thorium From New Mexico Uranium Mill Tailing Solutions,
W82-00040 5D

BUREAU OF MINES, SPOKANE, WA. SPOKANE RESEARCH CENTER.
Selective Overburden Placement,
W82-00053 5G

BUREAU OF MINES, TWIN CITIES, MN. TWIN CITIES RESEARCH CENTER.
Computer Modeling of Fluid Flow During Production and Environmental Restoration Phases of In Situ Uranium Leaching,
W82-00043 6A

BUREAU OF MINES, UNIVERSITY, AL. TUSCALOOSA RESEARCH CENTER.
Dewatering of Industrial Clay Wastes,
W82-00041 5D

Treatment of Florida Surface Waters for Use in Phosphate Beneficiation,
W82-00048 5D

Dewatering Florida Phosphatic Clay Wastes With Moving Screens,
W82-00049 5D

BUREAU OF RECLAMATION, DENVER, CO. ENGINEERING AND RESEARCH CENTER.
Performance of Granular Soil Covers on Canals,
W82-00047 8D

Hydraulic Sediment Model Study for Proposed Blanco Diversion Dam Modification,
W82-00446 8A

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W82-00341 6A

CALIFORNIA DEPT. OF WATER RESOURCES, SACRAMENTO.
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W82-00170 6E

CALIFORNIA UNIV., BERKELEY.
Reclaiming and Reusing Wastewater,
W82-00402 5D

Solvent Extraction of Phenols,
W82-00438 5D

CALIFORNIA UNIV., BERKELEY. DEPT. OF CHEMICAL ENGINEERING.
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W82-00431 5D

CALIFORNIA UNIV., BERKELEY. LAWRENCE BERKELEY LAB.
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W82-00445 5D

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W82-00192 5E

Irrigation Tailwater Management,
W82-00392 3C

Effect of Mulch Rate on Soil Loss by Raindrop Splash,
W82-00468 2J

CALIFORNIA UNIV., DAVIS. DIV. OF ENVIRONMENTAL STUDIES.
The Importance of Regenerated Nitrogen to Phytoplankton Productivity in a Subalpine Lake,
W82-00476 2H

CALIFORNIA UNIV., LOS ANGELES. INST. OF GEOPHYSICS AND PLANETARY PHYSICS.
Characterisation of Domestic and Industrial Sewage in Southern California Coastal Sediments Using Nitrogen, Carbon, Sulphur, and Uranium Tracers,
W82-00147 5B

Natural Abundances of 15N as a Source Indicator for Near-Shore Marine Sedimentary and Dissolved Nitrogen,
W82-00283 5B

CALIFORNIA UNIV., LOS ANGELES. SCHOOL OF ENGINEERING AND APPLIED SCIENCE.
Aquifer Parameter Identification with Optimum Dimension in Parameterization,
W82-00131 2F

Effects of Alpha, Beta and Theta Factor Upon the Design, Specification and Operation of Aeration Systems,
W82-00291 5D

CALIFORNIA UNIV., RIVERSIDE. DEPT. OF SOIL AND ENVIRONMENTAL SCIENCES.
Are Sierra Lakes Becoming Acid,
W82-00231 5C

Sodium-Potassium Ratios in Soil Solution and Plant Response Under Saline Conditions,
W82-00469 3C

CAMP, DRESSER AND MCKEE, INC., BOSTON, MA.
Engineering Assessment of Vermicomposting Municipal Wastewater Sludges,
W82-00385 5E

Lime Stabilization and Ultimate Disposal of Municipal Wastewater Sludges,
W82-00386 5E

CARNEGIE - MELLON UNIV., PITTSBURGH, PA. DEPT. OF CIVIL ENGINEERING.
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W82-00434 5D

CAWTHRON INST., NELSON (NEW ZEALAND).
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W82-00242 2L

CENTEC CORP., RESTON, VA.
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W82-00095 5E

CENTRAL RICE RESEARCH INST., CUTTACK (INDIA).
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W82-00189 5A

CENTRE DE RECHERCHE DE L'OMNIUM D'ASSAINISSEMENT, COLOMBES (FRANCE).
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W82-00463 5D

CHENGDU AGRICULTURAL MACHINERY COLL. (CHINA).
Cavitation and Wear on Hydraulic Machines,
W82-00331 8C

CINCINNATI UNIV., OH. DEPT. OF BIOLOGICAL SCIENCES.
Lignocellulose Mineralization by Arctic Lake Sediments in Response to Nutrient Manipulation,
W82-00270 2H

CLEMSON UNIV., SC. DEPT. OF MICROBIOLOGY.
Populations of Methane-Producing Bacteria and In Vitro Methanogenesis in Salt Marsh and Estuarine Sediments,
W82-00202 2L

Technique for Determining Total Bacterial Virus Counts in Complex Aqueous Systems,
W82-00222 5A

CLYDE RIVER PURIFICATION BOARD (SCOTLAND).
Determination of Marine Consent Conditions,
W82-00323 5G

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF AGRICULTURAL AND CHEMICAL ENGINEERING.
Optimal Design of Furrow Irrigation Systems,
W82-00138 3F

Furrow Irrigation Practices in Northern Colorado,
W82-00139 3F

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF CIVIL ENGINEERING.
Ground-Water Flow and Uranium in Colorado Plateau,
W82-00282 2F

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF ECONOMICS.
Economics of Snow Management for Agriculture in the Great Plains,
W82-00178 3F

COLUMBIA NATIONAL FISHERIES RESEARCH LAB., MO.
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W82-00464 5A

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CANBERRA (AUSTRALIA). INST. OF EARTH RESOURCES.
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W82-00466 2J

CONCENTRATION SPECIALISTS, INC., ANDOVER, MA.
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W82-00436 5D

CONSUMERS POWER CO., JACKSON, MI.
Power Plant Water Intake Assessment,
W82-00216 6G

CORLEW (M. B.) AND ASSOCIATES, INC., EDWARDSVILLE, IL.
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W82-00288 6A

CORNELL UNIV., ITHACA, NY. CENTER FOR ENVIRONMENTAL RESEARCH.
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W82-00279 5B

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W82-00146 6G

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W82-00188 3E

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W82-00072 5F

DAVIS AND FLOYD ENGINEERS, INC., GREENWOOD, SC.
The Horse Creek Basin Project,
W82-00071 5G

DELAWARE UNIV., NEWARK. COLL. OF MARINE STUDIES.
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W82-00248 2L

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W82-00388 5A

DEPARTMENT OF AGRICULTURE, HARROW (ONTARIO).
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W82-00120 2I

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W82-00333 5C

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W82-00433 5D

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W82-00441 5D

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W82-00059 5D

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Experimental Studies on the Effect of Arsenic on Microbial Degradation of Organic Matter and Algal Growth,
W82-00237 2H

The Valuation of Recreational Fisheries,
W82-00348 6C

DEPARTMENT OF THE ENVIRONMENT, BURLINGTON (ONTARIO). LANDS DIRECTORATE.
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W82-00321 2K

DEPARTMENT OF THE ENVIRONMENT, EDMONTON. DIV. OF DESIGN AND CONSTRUCTION.
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W82-00118 2A

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W82-00227 5C

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W82-00232 5A

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W82-00157 5B

DOW CHEMICAL CO., MIDLAND, MI.
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W82-00300 5C

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W82-00075 4B

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W82-00458 5A

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W82-00200 5A

Concentration of Poliovirus in Water by Molecular Filtration,
W82-00246 5A

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W82-00052 5C

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W82-00500 5F

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W82-00292 5F

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W82-00233 5C

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W82-00356 6G

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W82-00358 5D

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W82-00360 5E

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W82-00366 5D

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W82-00266 5C

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W82-00355 6G

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W82-00371 6B

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W82-00353 6G

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W82-00367 6G

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W82-00372 6B

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W82-00373 6B

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W82-00107 6D

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W82-00108 5E

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W82-00185 2K

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W82-00499 5E

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W82-00179 5B

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W82-00064 5D

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W82-00490 5A

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W82-00308 7B

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W82-00008 5B

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W82-00009 5B

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W82-00026 7C

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W82-00018 5B

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Radionuclide Concentrations in Streams in the Upper Blackfoot River Basin, Southeastern Idaho,
W82-00418 5A

GEOLOGICAL SURVEY, BOSTON, MA. WATER RESOURCES DIV.
Reconnaissance of the Effect of Landfill Leachate on the Water Quality of Marshall Brook, Southwest Harbor, Hancock County, Maine,
W82-00013 5C

Groundwater Availability in Acadia National Park and Vicinity, Hancock and Knox Counties, Maine,
W82-00017 2F

Water Resources Data for New Hampshire and Vermont, Water Year 1980.
W82-00076 7C

GEOLOGICAL SURVEY, CHARLESTON, WV. WATER RESOURCES DIV.
Water Resources Data for West Virginia, Water Year 1980.
W82-00077 7C

GEOLOGICAL SURVEY, CHEYENNE, WY. WATER RESOURCES DIV.
Water-Resources Investigations of the U.S. Geological Survey in Wyoming, Fiscal Year 1980,
W82-00087 7C

GEOLOGICAL SURVEY, DENVER, CO.
A Direct Differential Pulse Anodic Stripping Voltammetric Method for the Determination of Thallium in Natural Waters,
W82-00209 5A

GEOLOGICAL SURVEY, DENVER, CO. WATER RESOURCES DIV.
Ground Water Availability,
W82-00027 6D

Preliminary Data From a Series of Artificial Recharge Experiments at Stanton, Texas,
W82-00085 7C

GEOLOGICAL SURVEY, INDIANAPOLIS, IN. WATER RESOURCES DIV.
Ground-Water Resources of the White River Basin, Madison County, Indiana,
W82-00412 2A

Effects of Surface Mining on Water Quality in a Small Watershed, Sullivan County, Indiana,
W82-00427 5C

GEOLOGICAL SURVEY, JACKSON, MS. WATER RESOURCES DIV.
Quality of Water in Tibbee Creek and Tributaries Near West Point, Mississippi,
W82-00084 5B

Predicted Effects on Ground Water of Construction of Divide Cut Section, Tennessee-Tombigbee Waterway, Northeastern Mississippi Using a Digital Model,
W82-00428 2F

GEOLOGICAL SURVEY, KNOXVILLE, TN. WATER RESOURCES DIV.
Water Level Data for Wells in and Near Burial Ground 3, Oak Ridge National Laboratory, Tennessee, 1975-1979,
W82-00423 7C

GEOLOGICAL SURVEY, LAGUNA NIGUEL, CA. WATER RESOURCES DIV.
Erosion and Sedimentation in the Kenai River, Alaska,
W82-00015 2J

GEOLOGICAL SURVEY, LAKEWOOD, CO. WATER RESOURCES DIV.
Toxicity of Mount St. Helens Ash Leachate to a Blue-Green Alga,
W82-00001 5C

Selected Hydrologic Data, Arkansas River Basin, Pueblo and Southeastern Fremont Counties, Colorado, 1975-80,
W82-00020 7C

Water-Resources Investigations of the U.S. Geological Survey in Colorado--Fiscal Year 1981.
W82-00088 7C

Water-Level Records for the Northern High Plains of Colorado, 1977-81,
W82-00422 7C

GEOLOGICAL SURVEY, LANSING, MI. WATER RESOURCES DIV.
Ground-Water Data for Michigan, 1979,
W82-00014 2F

GEOLOGICAL SURVEY, LAWRENCE, KS. WATER RESOURCES DIV.
January 1980 Water Levels, and Data Related to Water-level Changes, Western and South-Central Kansas,
W82-00016 2F

Water Resources Data for Kansas, Water Year 1980--Volume 1. Missouri River Basin.
W82-00078 7C

Water Resources Data for Kansas, Water Year 1980--Volume 2. Arkansas River Basin.
W82-00079 7C

GEOLOGICAL SURVEY, LITTLE ROCK, AR. WATER RESOURCES DIV.
Report of the Annual Yield of the Arkansas River Basin for the Arkansas River Basin Compact, Arkansas--Oklahoma, 1980 Water Year,
W82-00012 6E

GEOLOGICAL SURVEY, LOUISVILLE, KY. WATER RESOURCES DIV.
Water in the Elizabethtown Area - A Study of Limestone Terrane in North-Central Kentucky,
W82-00413 5B

GEOLOGICAL SURVEY, MENLO PARK, CA.
Sediment Transport in Norton Sound, Alaska,
W82-00151 2J

Strategy for Radioactive Waste Disposal in Crystalline Rocks,
W82-00299 5E

GEOLOGICAL SURVEY, MENLO PARK, CA. WATER RESOURCES DIV.
Flood Data for the Sacramento River and Butte Basin 1875 to 1978, Sacramento Valley, California,
W82-00019 2E

Water Resources of the Santa Ysabel and Mesa Grande Indian Reservations, San Diego County, California,
W82-00021 7C

Evaluation of Ground-Water Monitoring Network, Santa Cruz County, California,
W82-00023 7A

A 10-Year Plan to Study the Aquifer System of Indian Wells Valley, California,
W82-00086 6D

Isolation of Methanobacterium Bryantii from a Deep Aquifer by Using a Novel Broth-Antibiotic Disk Method,
W82-00240 5A

Digital Model of the Unconsolidated Aquifer System in the Modesto Area, Stanislaus and San Joaquin Counties, California,
W82-00415 4B

GEOLOGICAL SURVEY, MIAMI, FL. WATER RESOURCES DIV.
Altitude of Water Table, Biscayne Aquifer, Dade County, Florida, May 1980,
W82-00409 7C

Altitude of Water Table, Biscayne Aquifer, Dade County, Florida, October 1979,
W82-00410 7C

Altitude of Water Table, Biscayne Aquifer, Dade County, Florida, March 1979,
W82-00411 7C

GEOLOGICAL SURVEY, NASHVILLE, TN. WATER RESOURCES DIV.
Geologic, Hydrologic and Chemical Data From Test Wells in the Dickson Area, Tennessee,
W82-00090 7C

GEOLOGICAL SURVEY, NSTL STATION, MS. WATER RESOURCES DIV.
The U.S. Geological Survey Coal Hydrology Program and the Potential of Hydrologic Models for Impact Assessments,
W82-00429 6E

GEOLOGICAL SURVEY, PORTLAND, OR. WATER RESOURCES DIV.
Mount St. Helens Volcanic-Ash Fall in the Bull Run Watershed, Oregon, March-June 1980,
W82-00002 5B

GEOLOGICAL SURVEY, RALEIGH, NC. WATER RESOURCES DIV.
An Observation-Well Network Concept as Applied to North Carolina,
W82-00414 4B

Proposed Observation-Well Networks and Ground-Water Level Program for North Carolina,
W82-00426 4B

GEOLOGICAL SURVEY, RESTON, VA.
Carbon Isotopes as Indicators of the Source and Fate of Carbon in Rivers and Estuaries,
W82-00033 5B

GEOLOGICAL SURVEY, RESTON, VA. WATER RESOURCES DIV.
A Qualitative Appraisal of the Hydrology of the Yemen Arab Republic from Landsat Images,
W82-00022 7B

Directory of Member Organizations of the National Water Data Exchange (NAWDEX),
W82-00089 10D

National Water Data Exchange (NAWDEX) System 2000 Data Retrieval Manual,
W82-00420 10B

GEOLOGICAL SURVEY, ST. PAUL, MN. WATER RESOURCES DIV.
Preliminary Evaluation of Ground-Water Contamination by Coal-Tar Derivatives, St. Louis Park Area, Minnesota,
W82-00430 5B

GEOLOGICAL SURVEY, SYOSSET, NY. WATER RESOURCES DIV.
Use of Flow-Duration Curves to Evaluate Effects of Urbanization on Streamflow Patterns on Long Island, New York,
W82-00416 4C

GEOLOGICAL SURVEY, TACOMA, WA. WATER RESOURCES DIV.
Mudflows Resulting From the May 18, 1980, Eruption of Mount St. Helens, Washington,
W82-00003 5B

Channel Conditions in the Lower Toutle and Cowlitz Rivers Resulting From the Mudflows of May 18, 1980,
W82-00004 5B

Effects of the Mount St. Helens Eruption on the Benthic Fauna of the Toutle River, Muddy River, and Pine Creek Drainage Basins, Washington,
W82-00005 5C

Effects of Mount St. Helens Eruption on Selected Lakes in Washington,
W82-00006 2H

Effects of Volcanism on the Glaciers of Mount St. Helens,
W82-00007 2C

An Analysis of Reservoir Storage Contents for the Proposed Enlargement of Bumping Lake in Washington,
W82-00421 4A

GEOLOGICAL SURVEY, TALLAHASSEE, FL. WATER RESOURCES DIV.
Chemical, Physical, and Radiological Quality of Selected Public Water Supplies in Florida, February-April 1980,
W82-00010 5F

Potentiometric Surface of the Floridan Aquifer in the Suwannee River Water Management District, Florida, May 1980,
W82-00024 7C

Potentiometric Surface of the Floridan Aquifer in the Northwest Florida Water Management District, May 1980,
W82-00025 7C

Hydrogeologic Data for Rocky Creek Landfill and Adjacent Area, Northwest Hillsborough County, Florida, 1969-73,
W82-00417 5B

GEOLOGICAL SURVEY, TALLAHASSEE, FL. WATER RESOURCES DIV.

Summary of U.S. Geological Survey Investigations and Hydrologic Conditions in Southwest Florida for 1979,
W82-00419 10C

Hydrogeologic Data from Test Drilling near Verna Beach, Florida, 1978,
W82-00424 2F

Index to Active Hydrologic Data Collection Sites in Florida, 1980-81,
W82-00425 7C

GEOLOGICAL SURVEY, TOWSON, MD.
A Comparison of Nitrogen in Shallow Ground Water from Sewered and Unsewered Areas, Nassau County, New York, from 1952 Through 1976,
W82-00277 5B

GEOLOGICAL SURVEY, TOWSON, MD. WATER RESOURCES DIV.
Garrett County Water-Well Records, Chemical-Quality Data Ground-Water Use, Coal Test-Hole Data and Surface-Water Data.
W82-00395 2F

GEORGIA INST. OF TECH., ATLANTA. SCHOOL OF CIVIL ENGINEERING.
Continuous Bioregeneration of Granular Activated Carbon During the Anaerobic Degradation of Catechol,
W82-00408 5D

GEOTRANS, INC., RESTON, VA.
Ground-Water Modeling: Recent Developments,
W82-00281 2F

GOVERNMENT ENGINEERING COLL., TRICHUR (INDIA). DEPT. OF CIVIL ENGINEERING.
Luxury Uptake of Nitrogen in Flocculating Algal-Bacterial System,
W82-00307 5D

GREAT LAKES BASIN COMMISSION, ANN ARBOR, MI.
Pollution From Land Runoff,
W82-00253 5B

GREAT LAKES FORESTRY RESEARCH CENTER, SAULT STE. MARIE (ONTARIO).
Aerial Biomass Distribution in an Undisturbed and Disturbed Subarctic Bog,
W82-00211 2C

GUELPH UNIV. (ONTARIO). DEPT. OF ENVIRONMENTAL BIOLOGY.
Reduced Transpiration and Increased Water Efficiency by Diuron in Corn (Zea Mays),
W82-00196 2D

HAMWORTHY ENGINEERING LTD., FLEETS CORNER (ENGLAND). (ASSIGNEE).
Apparatuses for the Anaerobic Digestion of Natural Organic Waste,
W82-00069 5D

HANSHIN ENGINEERING CO. LTD., OSAKA (JAPAN). (ASSIGNEE).
Underwater Aerator,
W82-00065 5D

HARVEY MUDD COLL. CLAREMONT, CA. DEPT. OF CHEMISTRY.
Measurements of Hydrogen Peroxide in Rainwater,
W82-00497 2K

HARZA ENGINEERING CO., CHICAGO, IL.
Terrace Planning Criteria for Runoff Control for Deep Loess Soil,
W82-00144 4D

HEALTH AND WELFARE CANADA, OTTAWA (ONTARIO). HEALTH PROTECTION BRANCH.
Comparison of Nine Brands of Membrane Filter and the Most-Probable-Number Methods for Total Coliform Enumeration in Sewage-Contaminated Drinking Water,
W82-00203 5A

HEALTH EFFECTS RESEARCH LAB., CINCINNATI, OH.
Identification of Organic Compounds in a Mutagenic Extract of a Surface Drinking Water by a Computerized Gas Chromatography/Mass Spectrometry System (GC/MS/COM),
W82-00256 5A

Concentration and Size of Asbestos in Water Supplies,
W82-00262 5B

HEALTH EFFECTS RESEARCH LAB., WEST KINGSTON, RI.
Membrane Filter Method for Enumerating Escherichia Coli,
W82-00487 5A

HILL (G. H.), MANCHESTER (ENGLAND).
Treatment Works--The Designer's Problems,
W82-00312 5F

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY, SPRINGFIELD.
Graphical Effluent Quality Control for Compliance Monitoring: What Is a Violation,
W82-00261 5G

INDUSTRIE PIRELLI, S.P.A., MILAN (ITALY). (ASSIGNEE).
Floating Breakwater,
W82-00067 8A

INSTITUT NATIONAL DE LA RECHERCHE AGRONOMIQUE, THONON-LES-BAINS (FRANCE).
Biological Consequences of Treating a Lake with Hydrogen Peroxide on the Plankton Biocenosis (Biologiques Du Traitement D'Un Lac Avec Du Peroxyde D'Hydrogene Sur La Biocenose Planctonique),
W82-00305 2H

INSTITUTE FOR WATER RESOURCES (ARMY), FORT BELVOIR, VA.
Report of Survey of Corps of Engineers Construction Workforce,
W82-00102 6B

INSTITUTE OF PAPER CHEMISTRY, APPLETON, WI.
Evaluation of Methodologies for the Determination of Acute Toxicity in Pulp and Paper Effluents,
W82-00297 5A

INTERNACIONAL DE ENGENHARIA, RIO DE JANEIRO (BRAZIL).
Hydraulic Gates: The State-of-the-Art,
W82-00332 8C

INTERNATIONAL RICE RESEARCH INST. LOS BANOS (PHILIPPINES).
Effects of Water Regime on Growth, Yield, and Nitrogen Uptake of Rice,
W82-00330 2I

IOWA STATE UNIV., AMES.
Water-Related Environmental Control Requirements at Municipal Solid Waste-to-Energy Conversion Facilities,
W82-00037 5D

Protecting Agriculture's Natural Resource Base,
W82-00176 4D

Water-Related Environmental Control Requirements of Waste-to-Energy Conversion,
W82-00443 5D

IOWA STATE UNIV., AMES. DEPT. OF ANIMAL ECOLOGY.
Prediction of Total Phosphorus Concentrations, Chlorophyll a, and Secchi Depths in Natural and Artificial Lakes,
W82-00400 2H

IOWA UNIV., IOWA CITY.
High pH Treatment of Combined Water Softening and Wastewater Sludges,
W82-00403 5D

ISRAEL INST. FOR BIOLOGICAL RESEARCH, NES ZIYYONA.
Silicates as Nonspecific Adsorbents of Bacteriophage: A Model for Purification of Water From Viruses,
W82-00350 5F

JOHNS HOPKINS UNIV., BALTIMORE, MD. DEPT. OF ENVIRONMENTAL HEALTH SCIENCES.
Ames' Mutagenic Activity in Recycled Water from an Israeli Water Reclamation Project,
W82-00234 5D

KANSAS DEPT. OF HEALTH AND ENVIRONMENT, TOPEKA.
Survival of Eggs and Larvae of Swine Nematode Parasites in Aerobic and Anaerobic Waste Treatment Systems,
W82-00161 5D

KARLSRUHE UNIV. (GERMANY, F.R.). DEPT. OF WATER CHEMISTRY.
Total Organic Halogen as a Parameter for the Characterization of Reclaimed Waters: Measurement, Occurrence, Formation, and Removal,
W82-00197 5D

KENTUCKY UNIV., LEXINGTON. DEPT. OF AGRICULTURAL ENGINEERING.
An Infiltration Model: Development and Evaluation of Its Parameters,
W82-00137 2G

KYOTO INST. OF TECH. (JAPAN). DEPT. OF CHEMISTRY.
Removal and Recovery of Organic Pollutants from the Aquatic Enviroment. 2. Removal and Recovery of Dodecylbenzenesulfonate from Aqueous Solution by Cross-Linked Poly(N-Benzyl-4-Vinylpyridinium Halide),
W82-00217 5D

KYOTO UNIV. (JAPAN). DEPT. OF FISHERIES.
Distribution of Obligately Oligotrophic Bacteria in Lake Biwa,
W82-00346 5A

LABORATOIRE DE CHIMIE INORGANIQUE ET NUCLEAIRE, LOUVAIN (BELGIUM).
Deposition of Heavy Elements on Belgian Agricultural Soils,
W82-00306 5B

LAMONT-DOHERTY GEOLOGICAL OBSERVATORY, PALISADES, NY.
Sediment Trap Dynamics and Calibration: A Laboratory Evaluation,
W82-00104 7B

Field Assessment of Sediment Traps,
W82-00105 7B

LEEDS UNIV. (ENGLAND). SCHOOL OF GEOGRAPHY.
Enteric Bacterial Concentrations in Reservoir Feeder Streams: Baseflow Characteristics and Response to Hydrograph Events,
W82-00462 5B

LILLE-1 UNIV., VILLENEUVE D'ASCQ (FRANCE).
Automation of Water Bacteriological Analysis: Running Test of an Experimental Prototype,
W82-00225 5A

LILLY RESEARCH LAB., GREENFIELD, IN.
Photolysis of N-Nitrosodi-n-Propylamine in Water,
W82-00164 5B

LITTLE (ARTHUR D.), CAMBRIDGE, MA.
Methods for Level 2 Analysis by Organic Compound Category,
W82-00384 5A

LOS ALAMOS SCIENTIFIC LAB., NM.
Ground Water Alternatives and Solutions,
W82-00029 6D

Water Related Planning and Design at Energy Firms,
W82-00042 6D

Water Supply and Demand in an Energy Supply Model,
W82-00050 6D

Control Technology Strategies for Coal Preparation Waste Drainages,
W82-00440 5D

LOS ANGELES COUNTY SANITATION DISTRICTS, WHITTIER, CA.
Foam Control in Aeration Tanks,
W82-00171 5D

LOUISIANA STATE UNIV., BATON ROUGE.
Behavior of DDT, Kepone, and Permethrin in Sediment-Water Systems Under Different Oxidation-Reduction and PH Conditions,
W82-00382 5B

LOUISIANA STATE UNIV., BATON ROUGE. COASTAL ECOLOGY LAB.
Modeling the Relationship Between Development and Storm Water and Nutrient Runoff,
W82-00260 2A

LOUISIANA STATE UNIV., BATON ROUGE. DEPT. OF CIVIL ENGINEERING.
The Consultant's Viewpoint on Alternative Disinfectants,
W82-00286 6A

LOUISIANA STATE UNIV., BATON ROUGE. LAB. FOR WETLAND SOILS AND SEDIMENTS.
Effect of Estuarine Sediment pH and Oxidation-Reduction Potential on Microbial Hydrocarbon Degradation,
W82-00243 2L

LOUISIANA STATE UNIV. MEDICAL CENTER, NEW ORLEANS. DEPT. OF MICROBIOLOGY.
Transformation of the Mouse Clonal Cell Line R846-DP8 by Mississippi River, Raw, and Finished Water Samples from Southeastern Louisiana,
W82-00215 5C

LOXTON, HUNTING AND ASSOCIATES, GABERONE (BOTSWANA).
Environmental Planning for Coal Strip Mining,
W82-00214 5G

MANCHESTER INST. OF SCIENCE AND TECHNOLOGY (ENGLAND).
Pilot Scales Tests on the Flotation of Abattoir Wastes by Deep U Tubes,
W82-00322 5D

MANITOBA UNIV., WINNIPEG. DEPT. OF GEOGRAPHY.
A New Era for China's Hydropower,
W82-00335 8A

MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM, PLYMOUTH (ENGLAND).
Water-Rock Partition Coefficients and the Composition of Natural Waters - A Reassessment,
W82-00284 2K

MARYLAND UNIV., COLLEGE PARK. DEPT. OF MICROBIOLOGY.
Isolation, Enumeration, and Characterization of Aeromonas from Polluted Waters Encountered in Diving Operations,
W82-00224 5C

MARYLAND UNIV., COLLEGE PARK. DEPT. OF RECREATION.
Estimating the Physical Carrying Capacity of Recreation Areas: A Rationale for Application of the Universal Soil Loss Equation,
W82-00274 2J

MARYLAND UNIV. EASTERN SHORE, PRINCESS ANNE. DEPT. OF NATURAL SCIENCES.
Effect of Kaolin Concentration on Distribution Coefficient of Copper,
W82-00153 5B

Effect of Cations on Copper Adsorption by Kaolin,
W82-00172 2K

MARYLAND UNIV., FROSTBURG. APPALACHIAN ENVIRONMENTAL LAB.
The Influence of Stream Order and Selected Stream Bed Parameters on Fish Diversity in Raystown Branch, Susquehanna River Drainage, Pennsylvania,
W82-00109 2E

MASSACHUSETTS INST. OF TECH., CAMBRIDGE.
Some Limiting Forms of the Poisson Distribution of Annual Station Precipitation,
W82-00132 2B

MASSACHUSETTS UNIV., AMHERST. DEPT. OF FORESTRY AND WILDLIFE MANAGEMENT.
Does Salt Marsh Fertilization Enhance Shellfish Production. An Application of Flow Analysis,
W82-00259 2L

A Model of Natural and Man-Induced Changes in Open Freshwater Wetlands on the Massachusetts Coastal Plain,
W82-00397 2I

MASSEY UNIV., PALMERSTON NORTH (NEW ZEALAND). DEPT. OF SOIL SCIENCE.
Amounts and Relative Significance of Runoff Types in the Transport of Nitrogen into a Stream Draining an Agricultural Watershed,
W82-00173 5B

MATRECON, INC., OAKLAND, CA.
Lining of Waste Impoundment and Disposal Facilities.
W82-00099 5E

MCGILL UNIV., MONTREAL (QUEBEC). DEPT. OF BIOLOGY.
The Prediction of Lacustrine Phytoplankton Diversity,
W82-00319 2H

MCGILL UNIVERSITY, MONTREAL (QUEBEC). DEPT. OF BIOLOGY.
Postdepositional Mobility of Phosphorus in Lake Sediments,
W82-00474 2H

MCKEE (ARTHUR G.) AND CO., CLEVELAND, OH.
Improved Water Management of Coal Conversion Processes by Preliminary Absorption of Halides,
W82-00437 5D

MCMASTER UNIV., HAMILTON (ONTARIO). DEPT. OF CIVIL ENGINEERING AND ENGINEERING MECHANICS.
Resonator Studies for Kincardine Harbour, Lake Huron,
W82-00228 8B

MEDICAL COLL. OF WISCONSIN, MILWAUKEE. DEPT. OF PHARMACOLOGY AND TOXICOLOGY.
Relationship Between Biotransformation and the Toxicity and Fate of Xenobiotic Chemicals in Fish,
W82-00186 5C

METCALF AND EDDY, INC., BOSTON, MA.
High-Level Ozone Disinfection of Municipal Wastewater Effluents,
W82-00379 5D

MICHIGAN STATE UNIV., EAST LANSING. DEPT. OF CROP AND SOIL SCIENCES.
Cropping Systems for Treatment and Utilization of Municipal Wastewater and Sludge,
W82-00097 5E

MICHIGAN STATE UNIV., HICKORY CORNERS. W. K. KELLOGG BIOLOGICAL STATION.
Sulfhydrolase Activity in Sediments of Wintergreen Lake, Kalamazoo County, Michigan,
W82-00241 2H

Reduction of Sulfur Compounds in the Sediments of a Eutrophic Lake Basin,
W82-00488 2H

MICHIGAN UNIV., ANN ARBOR.
Effectiveness of Activated Carbon for Removal of Toxic and/or Carcinogenic Compounds From Water Supplies,
W82-00383 5F

MICHIGAN UNIV., ANN ARBOR. DEPT. OF ENVIRONMENTAL AND INDUSTRIAL HEALTH.
Comparison of In Situ and In Vitro Rates of Methane Release in Freshwater Sediments,
W82-00245 2H

MICHIGAN UNIV., PELLSTON. BIOLOGICAL STATION.
Vegetation and Nutrient Status of Northern Michigan Bogs and Conifer Swamps with a Comparison to Fens,
W82-00484 2I

MINNESOTA UNIV., MINNEAPOLIS. DEPT. OF CHEMISTRY.
Determination of Organically Combined Chlorine in High Molecular Weight Aquatic Organics,
W82-00258 5A

MINNESOTA UNIV., MINNEAPOLIS. DEPT. OF CIVIL AND MINERAL ENGINEERING.
Modeling Ammonium Exchange and Regeneration on Clinoptilolite,
W82-00125 5D

Characterization of Soluble and Colloidal-Phase Metal Complexes in River Water by Ultrafiltration. A Mass-Balance Approach,
W82-00480 5A

MISSOURI UNIV., COLUMBIA.
Effects of Soil Water Regime and Nitrogen Form on Blossom-End Rot, Yield, Water Relations, and Elemental Composition of Tomato,
W82-00162 2I

Assessment of Solvent Extraction for Treatment of Coal Gasifier Wastewater,
W82-00439 5D

Gully Development in the Deep Loess Hills Region of Central Missouri,
W82-00472 2J

MITRE CORP., MCLEAN, VA.
Design, Evaluation and Effluent Water Quality Analysis of Three Oyster Shellstock Washers,
W82-00406 5D

MONSANTO RESEARCH CORP., DAYTON, OH.
Assessment of Oil Shale Retort Wastewater Treatment and Control Technology - Phases I and II,
W82-00390 5B

MONTANA STATE UNIV., BOZEMAN, DEPT. OF CIVIL ENGINEERING AND ENGINEERING MECHANICS.
Water Pollution Potential of Coal-Slurry Pipelines,
W82-00096 6A

MONTGOMERY (JAMES M.), INC. PASADENA, CA.
Refuse-To-Energy Wastewater Treatment,
W82-00168 5D

MOULTON NIGUEL WATER DISTRICT, LAGUNA NIGUEL, CA.
Wastewater Treatment by Rooted Aquatic Plants in Sand and Gravel Trenches,
W82-00093 5D

NATIONAL ATMOSPHERIC AND OCEANIC ADMINISTRATION, ANN ARBOR, MICH. GREAT LAKES ENVIRONMENTAL RESEARCH LAB.
Seasonal Particle-Size Selection by Diaptomus Sicilis in Offshore Lake Michigan,
W82-00485 2H

NATIONAL BUREAU OF STANDARDS, WASHINGTON, DC. NATIONAL MEASUREMENT LAB.
Measurement of the Solubilities of Slightly Soluble Organic Liquids in Water by Elution Chromatography,
W82-00207 5A

NATIONAL ENVIRONMENTAL ENGINEERING RESEARCH INST., NAGPUR (INDIA).
Virus Removal in Waste Stabilization Ponds in India,
W82-00121 5D

NATIONAL INST. FOR WATER RESEARCH, PRETORIA (SOUTH AFRICA).
Nitrogen Fixation and the Nitrogen Budget of a Eutrophic Impoundment,
W82-00127 2H

NATIONAL SCIENCE FOUNDATION, WASHINGTON, DC.
Report on the Summer MONEX Field Phase,
W82-00265 2B

NATIONAL WATER QUALITY LAB., ARVADA, CO.
Comparison of Automated Segmented-Flow and Discrete Analyzers for the Determination of Nutrients in Water,
W82-00483 5A

NATIONAL WATER RESEARCH INST., BURLINGTON (ONTARIO).
Fenitrothion Sprayed on a Pond: Kinetics of Its Distribution and Transformation in Water and Sediment,
W82-00159 5B

NATIONAL WATER RESEARCH INST., BURLINGTON (ONTARIO). PROCESS RESEARCH DIV.
Geochemistry of a Subarctic Salt Marsh Environment,
W82-00148 2L

NATIONAL WATER WELL ASSOCIATION, WORTHINGTON, OH.
Ground-Water Information: NWWA Provides the Resources,
W82-00301 2F

NATURE CONSERVANCY, ABBOTTS RIPTON (ENGLAND). MONKS WOOD EXPERIMENTAL STATION.
Tadpoles as Indicators of Harmful Levels of Pollution in the Field,
W82-00478 5A

NEDERLANDS INST. VOOR ONDERZOEK DER ZEE, TEXEL.
Interference of Sulphide in Inorganic Phosphate Determination in Natural Waters,
W82-00154 5A

NEW BRUNSWICK UNIV., FREDERICTON. DEPT. OF CIVIL ENGINEERING.
Treatment of Potato-Processing Waste Water by an Anaerobic Lagoon-Filter System,
W82-00226 5D

NEW ENGLAND RIVER BASINS COMMISSION, BOSTON, MA.
Before the Well Runs Dry: A Handbook for Designing a Local Water Conservation Plan.
W82-00396 3D

NEW HAMPSHIRE UNIV., DURHAM. DEPT. OF EARTH SCIENCES.
Shallow Core Snow Chemistry of Athabasca Glacier, Alberta,
W82-00320 2C

NEW HAMPSHIRE UNIV., DURHAM. DEPT. OF MICROBIOLOGY.
Improved Method and Test Strategy for Recovery of Enteric Viruses from Shellfish,
W82-00219 5A

NEW JERSEY DEPT. OF ENVIRONMENTAL PROTECTION, TRENTON.
Northeastern New Jersey Grapples With a Drought,
W82-00289 8A

NEW SOUTH WALES DEPT. OF AGRICULTURE, WOLLONGBAR (AUSTRALIA).
The Conservative Effect of Rainfall Variation on Fertiliser Response in a Humid Environment,
W82-00316 2A

NEW YORK STATE AGRICULTURAL EXPERIMENT STATION, GENEVA. DEPT. OF FOOD SCIENCE AND TECHNOLOGY.
Assimilation of Lemonade-Processing Wastewater by Yeasts,
W82-00204 5D

NEW YORK STATE DEPT. OF HEALTH, ALBANY. DIV. OF LAB. AND RESEARCH.
Role of Hydrodynamic Factors in Ammonia Desorption by Diffused Aeration,
W82-00293 5D

NORTH CAROLINA STATE UNIV. AT RALEIGH.
Effect of Agricultural Land Development on Drainage Waters in the North Carolina Tidewater Region,
W82-00094 5B

NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF BIOLOGICAL AND AGRICULTURAL ENGINEERING.
Predicting Runoff Pollutant Reduction in Buffer Zones Adjacent to Land Treatment Sites,
W82-00141 5B

NORTH CAROLINA UNIV. AT CHAPEL HILL. DEPT. OF ENVIRONMENTAL SCIENCES AND ENGINEERING.
Reactions of Chlorine with Selected Aromatic Models of Aquatic Humic Material,
W82-00254 5F

NORTH CAROLINA UNIV. AT WILMINGTON. DEPARTMENT OF CHEMISTRY.
Trace Metal Geochemistry in Sediments from the Miramichi Estuary, New Brunswick,
W82-00236 5A

NORTH CENTRAL FOREST EXPERIMENTAL STATION, GRAND RAPIDS, MN.
A More Versatile Soil Water Sampler,
W82-00191 7B

NORTH DAKOTA STATE UNIV., FARGO. DEPT. OF CHEMISTRY.
Redox Stability of Inorganic Arsenic(III) and Arsenic(V) in Aqueous Solution,
W82-00206 5A

NORTH DAKOTA UNIV., GRAND FORKS. ENGINEERING EXPERIMENT STATION.
Hydraulic Properties of Coal and Related Materials, Northern Great Plains,
W82-00278 2F

NORTHUMBRIAN WATER AUTHORITY, GOSFORTH (ENGLAND).
Cutting the Water Losses,
W82-00310 5F

NOVA SCOTIA TECHNICAL COLL., HALIFAX. DEPT. OF CIVIL ENGINEERING.
Design Guidelines for Incompletely Mixed or Aerobic-Anaerobic Aerated Lagoons,
W82-00250 5D

OAK RIDGE NATIONAL LAB., TN.
Assessment of Environmental Control Technology for Coal Conversion Processes,
W82-00432 5D

OAK RIDGE NATIONAL LAB., TN. ENVIRONMENTAL SCIENCES DIV.
Deposition of Riverborne Organic Carbon in Floodplain Wetlands and Deltas,
W82-00034 2J

OCEAN ECOLOGY LTD., EDMONTON (ALBERTA). (ASSIGNEE).
Means and Method for Sweeping Material Floating on Water Using Vibrational Energy,
W82-00062 5G

OKAYAMA UNIV. (JAPAN). DEPT. OF CHEMISTRY.
Gas Chromatographic Determination of Selenium (-II, O), -(IV), and -(VI) in Natural Waters,
W82-00257 5A

OKLAHOMA STATE UNIV., STILLWATER. DEPT. OF AGRICULTURAL ENGINEERING.
Upflow Water Filtration Unit, Test Results,
W82-00407 5F

ORANGE FREE STATE UNIV., BLOEMFONTEIN (SOUTH AFRICA). DEPT. OF AGROMETEOROLOGY.
A Proposed Technique to Measure Evapotranspiration Using Micrometeorological Methods,
W82-00183 2D

OREGON STATE UNIV., CORVALLIS. DEPT. OF AGRICULTURAL ENGINEERING.
Water, Energy and Labor Requirements for Future Pacific Northwest Irrigation,
W82-00143 6A

OREGON STATE UNIV., CORVALLIS. DEPT. OF CIVIL ENGINEERING.
A Bacterial Bioassay for Assessment of Wastewater Toxicity,
W82-00398 5A

OREGON STATE UNIV., CORVALLIS. DEPT. OF FISHERIES AND WILDLIFE.
Natural Variation in Abundance of Salmonid Populations in Streams and its Implications for Design of Impact Studies,
W82-00389 5C

OREGON STATE UNIV., CORVALLIS. DEPT. OF MICROBIOLOGY.
Bacterial Contamination of Drinking Water Supplies in a Modern Rural Neighborhood,
W82-00198 5A

Staphylococcus Aureus in Rural Drinking Water,
W82-00223 5B

Impact of Verification Media and Resuscitation on Accuracy of the Membrane Filter Total Coliform Enumeration Technique,
W82-00494 5A

OREGON STATE UNIV., CORVALLIS. SCHOOL OF OCEANOGRAPHY.
On the Estimation of Antarctic Iceberg Melt Rate,
W82-00166 2C

OTAGO UNIV., DUNEDIN (NEW ZEALAND). DEPT. OF ZOOLOGY.
Occurrence of Aphanomyces Ovidestruens, a Fungus Parasitic on Copepods, in Two Eutrophic Lakes,
W82-00304 2H

OTTAWA UNIV. (ONTARIO). DEPT. OF MICROBIOLOGY AND IMMUNOLOGY.
Concentration of Seeded Simian Rotavirus SA-11 from Potable Waters by Using Talc-Celite Layers and Hydroextraction,
W82-00272 5A

PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION, SEATTLE, WA.
Human Use in a Dispersed Recreation Area and its Effect on Water Quality,
W82-00393 5B

PEABODY COAL CO., ST. LOUIS, MO.
Limestone-Lime Treatment of Acid Mine Drainage - Full Scale,
W82-00377 5D

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK. DEPT. OF AGRICULTURAL ENGINEERING.
Transient Soil Moisture Movement Through Layered Soils Using a Finite Element Approach,
W82-00133 2G

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK. INST. FOR RESEARCH ON LAND AND WATER RESOURCES.
Water Conservation Devices for New or Existing Dwellings,
W82-00401 3D

PITTSBURGH UNIV., PA. DEPT. OF CIVIL ENGINEERING.
Secondary Flow, Shear Stress and Sediment Transport,
W82-00117 2J

Biological Oxidation of Aqueous Thiocyanate,
W82-00442 5D

PRETORIA UNIV. (SOUTH AFRICA).
Estimating End-Of-Construction Pore-Pressures in Unsaturated Earth Embankments,
W82-00194 8D

PROCTER AND GAMBLE CO., CINCINNATI, OH.
Use of the Electrolytic Respirometer to Measure Biodegradation in Natural Waters,
W82-00126 5A

PUNJAB AGRICULTURAL UNIV., LUDIANA (INDIA). DEPT. OF SOIL AND WATER ENGINEERING.
SOYROOT - A Dynamic Model of Soybean Root Growth and Water Uptake,
W82-00114 2I

PURDUE UNIV., LAFAYETTE, IN. DEPT. OF AGRICULTURAL ENGINEERING.
Sediment and Nutrient Movement from the Black Creek Watershed,
W82-00135 5B

PURDUE UNIV., LAFAYETTE, IN. LAB. OF RENEWABLE RESOURCES ENGINEERING.
Methane Production from Ozonated Pulp Mill Effluent,
W82-00155 5D

QUEEN'S UNIV., KINGSTON (ONTARIO). DEPT. OF GEOGRAPHY.
Geographic Information Systems and Environmental Impact Assessment,
W82-00338 7C

RESEARCH INST. ON ENVIRONMENTAL SCIENCE, BEIJING (CHINA).
Environmental Impact Assessment of China's Water Transfer Project,
W82-00129 6D

REXNORD, INC., MILWAUKEE, WI.
Physical/Chemical Treatment of Blast Furnace Wastewaters Using Mobile Pilot Units,
W82-00378 5D

RHODE ISLAND UNIV., KINGSTON. DEPT. OF CHEMISTRY.
A Resonance Raman Method for the Rapid Detection and Identification of Bacteria in Water,
W82-00404 5A

ROBERT S. KERR ENVIRONMENTAL RESEARCH LAB., ADA, OK.
Evaluation of the Effectiveness of Granular Activated Carbon Adsorption and Aquaculture for Removing Toxic Compounds From Treated Petroleum Refinery Effluents,
W82-00098 5D

RODBOURNE WATER POLLUTION CONTROL PLANT, SWINDON (ENGLAND).
Management and Design Implications of a Mathematical Model of a Rapid Gravity Sand Filter Backwash,
W82-00460 5D

S & E IRRIGATED AGRICULTURE RESEARCH AND EXTENSION CENTER, PROSSER, WA.
Performance of Bearing Cherry and Prune Trees Under Very Low Irrigation Rates,
W82-00119 3F

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT, CA.
Basin Management in the San Bernardino Basin Area,
W82-00280 6A

SANDIA NATIONAL LAB., ALBUQUERQUE, NM.
Response of Bacteria in Wastewater Sludge to Moisture Loss by Evaporation and Effect of Moisture Content on Bacterial Inactivation by Ionizing Radiation,
W82-00489 5D

SASKATCHEWAN UNIV., SASKATOON. DEPT. OF CIVIL ENGINEERING.
The Limitations and Usefulness of Streamflow Generation Methods: A Case Study,
W82-00229 6A

SAVANNAH RIVER ECOLOGY LAB., AIKEN, SC.
Field Experiments on Responses of a Freshwater, Benthic Macroinvertebrate Community to Vertebrate Predators,
W82-00477 5C

SCHNEIDER ENGINEERS, BRIDGEVILLE, PA.
Comparative Analysis of Sludge and Refuse Leachate: A Preliminary Report,
W82-00287 5E

SCIENCE AND EDUCATION ADMINISTRATION, AMES, IA. AGRICULTURE AND HOME ECONOMICS EXPERIMENTAL STATION.
Effect of Crop Residue on Soil Loss from Continuous Row Cropping,
W82-00145 2J

SCIENCE AND EDUCATION ADMINISTRATION, BELTSVILLE, MD.
Dispersal of Aspergillus Fumigatus from Sewage Sludge Compost Piles Subjected to Mechanical Agitation in Open Air,
W82-00273 5E

SCIENCE AND EDUCATION ADMINISTRATION, BELTSVILLE, MD. HYDROLOGY LAB.
Characterizing Short Duration Rainfall Intensities for Runoff Calculation,
W82-00142 2A

SCIENCE AND EDUCATION ADMINISTRATION, BERKELEY, CA. WESTERN REGIONAL RESEARCH LAB.
Odorous Compounds from Potato Processing Waste Effluent Irrigation Fields: Volatile Acids,
W82-00156 5E

SCIENCE AND EDUCATION ADMINISTRATION, MANDAN, ND. NORTHERN GREAT PLAINS RESEARCH CENTER.
Effects of Topsoil and Subsoil Thickness on Soil Water Content and Crop Production on a Disturbed Soil,
W82-00465 2G

SCIENCE AND EDUCATION ADMINISTRATION, MORRIS, MN.
Unsaturated Water Flow Through a Simulated Wheel Track,
W82-00473 2G

SCIENCE AND EDUCATION ADMINISTRATION, OXFORD, MS. SEDIMENTATION LAB.
Erodibility of Streambank Materials of Low Cohesion,
W82-00136 2J

SCIENCE AND EDUCATION ADMINISTRATION, PHILADELPHIA, PA. EASTERN REGIONAL RESEARCH CENTER.
Nitrosamines in Tap Water After Concentration by a Carbonaceous Adsorbent,
W82-00459 5A

SCIENCE AND EDUCATION ADMINISTRATION, PHOENIX, AZ. WATER CONSERVATION LAB.
Measuring Flumes of Simplified Construction,
W82-00140 7B

SCIENCE AND EDUCATION ADMINISTRATION, PROSSER, WA.
Effects of Small Amounts of Residue on Furrow Erosion,
W82-00470 2J

SCIENCE AND EDUCATION ADMINISTRATION, STILLWATER, OK. CONSERVATION STRUCTURES LAB.
Model Study of a Box-Inlet Chute Spillway and SAF Stilling Basin,
W82-00046 8A

SCIENCE AND EDUCATION ADMINISTRATION, TEMPLE, TX. BLACKLAND CONSERVATION RESEARCH CENTER.
Modeling Grain Sorghum Ratoon Cropping and Associated Runoff and Sediment Losses,
W82-00113 2G

SCIENCE AND EDUCATION ADMINISTRATION, TUCSON, AZ.
Picloram Dissipation in a Small Southwestern Stream,
W82-00212 5B

SEA RESEARCH FOUNDATION, WEST HARTFORD, CT. INST. FOR AQUARIUM STUDIES.
A Salicylate-Hypochlorite Method for Determining Ammonia in Seawater,
W82-00238 5A

SEDWAY/COOKE, SAN FRANCISCO, CA.
Final Environmental Impact Statement; South Tahoe Public Utility District and Douglas County Sewer Improvement District No. 1, Appendix B: Mitigation Program.
W82-00369 6G

SEVERN-TRENT WATER AUTHORITY, BIRMINGHAM (ENGLAND).
Chemistry of Septicity,
W82-00325 5D

SOIL AND IRRIGATION RESEARCH INST., PRETORIA (SOUTH AFRICA). DEPT. OF AGRICULTURE AND FISHERIES.
Field Test of an Irrigation Scheduling Computer Model,
W82-00184 3F

SOUTH CAROLINA UNIV., COLUMBIA. BELLE W. BARUCH INST. FOR MARINE BIOLOGY AND COASTAL RESEARCH.
The Abundance of Estuarine Larval and Juvenile Fish in a South Carolina Intertidal Creek,
W82-00276 2L

SOUTH CAROLINA UNIV., COLUMBIA. DEPT. OF GEOLOGY.
Geomorphic and Hydraulic Evolution of Tidal Creeks on a Subsiding Beach Ridge Plain, North Inlet, S.C.,
W82-00150 2L

Element Mass Balances for South Carolina Coastal Plain Watersheds,
W82-00175 5B

SOUTHERN ILLINOIS UNIV. AT CARBONDALE. DEPT. OF PLANT AND SOIL SCIENCE.
Soil as a Medium for Dairy Liquid Waste Disposal,
W82-00165 5E

SOUTHERN PIEDMONT CONSERVATION RESEARCH CENTER, WATKINSVILLE, GA.
The Effects of Surface Slaty Fragments on Soil Erosion by Water,
W82-00471 2J

SOUTHWEST RESEARCH INST., SAN ANTONIO, TX.
Development of Oil-In-Water Monitor, Phase II,
W82-00100 5A

STANDARD OIL CO., CHICAGO, IL.
The Alpha-Beta-Gamma's of Wastewater Treatment,
W82-00275 5D

STANFORD UNIV., CA. DEPT. OF APPLIED EARTH SCIENCES.
Physical Effects of Vehicular Disturbances on Arid Landscapes,
W82-00111 4C

STANFORD UNIV., CA. DEPT. OF CIVIL ENGINEERING.
Enrichment and Association of Bacteria and Particulates in Salt Marsh Surface Water,
W82-00201 2L

STATE UNIV. OF NEW YORK AT BINGHAMTON. DEPT. OF CHEMISTRY.
Sorption of Trace Cadmium on Clay Minerals and River Sediments: Effects of pH AND CD(II) Concentrations in a Synthetic River Water Medium,
W82-00174 2K

SUSQUEHANNA RIVER BASIN COMMISSION, HARRISBURG, PA.
Flood Forecast and Warning System Evaluation, Susquehanna River Basin, New York, Pennsylvania and Maryland.
W82-00351 6F

SYDNEY UNIV. (AUSTRALIA).
Solar Cycles and Erosional Events on the New South Wales Central and South Coasts,
W82-00318 2J

SYRACUSE UNIV., NY. DEPT. OF CIVIL ENGINEERING.
Microplate Technique for Determining Accumulation of Metals by Algae,
W82-00492 5A

TASMANIA UNIV., HOBART (AUSTRALIA). DEPT. OF AGRICULTURAL SCIENCE.
Effect of Solar Radiation and Predacious Microorganisms on Survival of Fecal and Other Bacteria,
W82-00491 2L

TECHNICAL UNIV. OF DENMARK, LYNGBY. TECHNICAL LAB.
Distribution of Clostridium Botulinum,
W82-00349 5A

TECHNION-ISRAEL INST. OF TECH., HAIFA.
Domestic Water Supplies for Power Plant Cooling,
W82-00180 6D

TECHNION-ISRAEL INST. OF TECH., HAIFA. ENVIRONMENTAL AND WATER RESOURCES ENGINEERING.
Organic Micropollution Indices of Effluents and Renovated Waters,
W82-00123 5A

TECHNISCHE UNIV., MUNICH (GERMANY, F.R.).
Optimization of Pump Turbines,
W82-00181 8C

TENNESSEE UNIV., KNOXVILLE.
Toxicity and Ecological Significance of Trace Elements in Aquatic Environments,
W82-00498 5B

TERRA TEK, SALT LAKE CITY, UT.
Shear Strength of Rockfill,
W82-00116 8D

TEXAS A AND M UNIV., COLLEGE STATION. REMOTE SENSING CENTER.
SEASAT SAR Response from Water Resources Parameters,
W82-00101 7B

TEXAS DEPT. OF WATER RESOURCES, AUSTIN.
Optimal Design of Water Conveyance Systems,
W82-00160 6B

TEXAS UNIV. CENTER FOR APPLIED RESEARCH AND TECHNOLOGY AT SAN ANTONIO.
Enumeration of Potentially Pathogenic Bacteria from Sewage Sludges,
W82-00221 5A

Recovery of Indigenous Viruses from Wastewater Sludges, Using a Bentonite Concentration Procedure,
W82-00271 5D

Viral Transport Through Soil Columns Under Conditions of Saturated Flow,
W82-00295 5B

TEXAS UNIV. HEALTH SCIENCE CENTER, HOUSTON. DEPT. OF ENVIRONMENTAL SCIENCES.
Temporal Variations in Trihalomethane Content of Drinking Water,
W82-00255 5A

TOKYO METROPOLITAN UNIV. (JAPAN). DEPT. OF CHEMISTRY.
Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aquatic Environments - I. Features of Hydrocarbons for Polluted and Unpolluted Waters,
W82-00453 5B

Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aquatic Environments. II. Features of Fatty Acids for Polluted and Unpolluted Waters,
W82-00454 5A

TORONTO UNIV. (ONTARIO). DEPT. OF CIVIL ENGINEERING.
Anaerobic Treatment of Human Waste in Northern Communities,
W82-00249 5E

Recent Developments in Water Pollution Control,
W82-00340 5D

TRC ENVIRONMENTAL CONSULTANTS, INC., WETHERSFIELD, CT.
Planning Study to Model and Monitor Coal Pile Run-Off,
W82-00091 6A

TRENT UNIV., PETERBOROUGH (ONTARIO). DEPT. OF GEOGRAPHY.
Illustration of the Roles of Snow in the Evolution of the Winter Cover of a Lake,
W82-00267 2C

TRONDHEIM UNIV. (NORWAY).
Low Temperature Removal of Nitrate by Bacterial Denitrification,
W82-00461 5D

UNIVERSITE SCIENTIFIQUE ET MEDICALE DE GRENOBLE (FRANCE). INST. DE MECANIQUE.
A Comparative Study of Three Forms of the Richard Equation Used for Predicting One-Dimensional Infiltration in Unsaturated Soil,
W82-00328 2G

UNIVERSITY OF NEW ENGLAND, ARMIDALE (AUSTRALIA). DEPT. OF AGRONOMY AND SOIL SCIENCE.
Environmental Resources and Restraints to Agricultural Production in a Mediterranean-Type Environment,
W82-00329 2I

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG (SOUTH AFRICA).
A Laboratory Model for Under-Water Construction of a Dam,
W82-00347 8D

UTAH STATE UNIV., LOGAN. DEPT. OF AGRICULTURAL AND IRRIGATION ENGINEERING.
Soil Hydraulic Stability in a Subsurface Drainage System,
W82-00115 2G

UTAH STATE UNIV., LOGAN. DEPT. OF FORESTRY AND OUTDOOR RECREATION.
Slash Treatment After Clearcutting Lodgepole Pine Affects Nutrients in Soil Water,
W82-00130 4C

UTRECHT RIJKSUNIVERSITEIT (NETHERLANDS). DEPT. OF SEDIMENTOLOGY.
Neap-Spring Tide Sequences of Intertidal Shoal Deposits in a Mesotidal Estuary,
W82-00112 2L

VERMONT UNIV., BURLINGTON.
Worthless, Valuable, or What. An Appraisal of Wetlands,
W82-00177 6B

VERMONT UNIV., BURLINGTON. DEPT. OF PLANT AND SOIL SCIENCE.
Nitrogen Availability from Sewage Sludge,
W82-00158 5E

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF CIVIL ENGINEERING.
Small-Scale Hydro in New England: 1960-1976,
W82-00169 6D

VOLCANI INST. OF AGRICULTURAL RESEARCH, BET-DAGAN (ISRAEL). INST. OF SOIL AND WATER.
Effects of Tillage and Gypsum Incorporation on Rain Runoff and Crust Strength in Field Soils Irrigated With Saline-Sodic Water,
W82-00327 2A

WACKER-CHEMIE G.M.B.H., MUNICH (GERMANY, F. R.). (ASSIGNEE).
Process for Removal of Mercury and Mercury Compounds From Aqueous Solutions and Industrial Waste Liquors,
W82-00058 5D

WASHINGTON STATE UNIV., PULLMAN. DEPT. OF ANTHROPOLOGY.
Historical Nile Floods and Their Implications for Climatic Change,
W82-00326 2E

WASHINGTON UNIV., SEATTLE.
Analytical Methods Evaluation for Applicability in Leachate Analysis,
W82-00380 5A

WASHINGTON UNIV., SEATTLE. DEPT. OF OCEANOGRAPHY.
Chemical Indicators of Organic River Sources in Rivers and Estuaries,
W82-00035 5B

WATER POLLUTION RESEARCH LAB., STEVENAGE (ENGLAND).
Small is Environmentally Acceptable . . .,
W82-00311 5D

WATER REFINING CO., INC., MIDDLETOWN, OH. (ASSIGNEE).
Process for Removing Alkalinity and Hardness From Waters,
W82-00063 5F

WATER RESEARCH CENTRE, MARLOW (ENGLAND).
Engineering Research and the Water Industry,
W82-00313 8A

WATER TREATMENT PLANT, LONGVIEW, WA.
The Aftermath at Longview,
W82-00073 5C

WATERLOO UNIV. (ONTARIO). DEPT. OF BIOLOGY.
A 13-Month Survey of Nematodes at Three Water Treatment Plants in Southern Ontario, Canada,
W82-00294 5F

Nitrogen Fixation and Methane Metabolism in a Stream Sediment-Water System Amended with Leaf Material,
W82-00486 2K

WATERLOO UNIV. (ONTARIO). DEPT. OF CIVIL ENGINEERING.
Flow Resistance in Vegetated Waterways,
W82-00152 2E

Mathematical Efficiency Concerns in Water Distribution Network Considerations,
W82-00339 5F

WATERWAYS EXPERIMENTAL STATION, STEVENVILLE, MD.
Perpetual Shoals at the Entrance to Chesapeake Bay: Flow-Substrate Interactions and Mutually Evasive Net Currents,
W82-00149 2L

WELSH WATER AUTHORITY (WALES).
A Successful Transfer,
W82-00309 4A

WESTVACO CORP., LAUREL, MD.
The Operation of a Waste Treatment Plant. Process Dynamic Considerations,
W82-00298 5D

WHITELEY-JACOBSEN AND ASSOCIATES, PORTLAND, OR.
Joint Dry/Wet Weather Treatment of Municipal Wastewater at Clatskanie, Oregon,
W82-00391 5D

WILLIAMSPORT SANITARY AUTHORITY, PA.
Sludge Settling Hampered by Industrial Discharge,
W82-00290 5D

WISCONSIN-MILWAUKEE UNIV. CENTER FOR GREAT LAKES STUDIES.
Comparison of Two Direct-Count Methods for Determining Metabolizing Bacteria in Freshwater,
W82-00495 5A

WISCONSIN UNIV.-MADISON.
Modeling the Flux of Atmospheric Polychlorinated Biphenyls Across the Air/Water Interface,
W82-00193 5B

WISCONSIN UNIV.-MADISON. DEPT. OF BACTERIOLOGY.
Anaerobic Methane Oxidation: Occurrence and Ecology,
W82-00218 2H

WISCONSIN UNIV.-MADISON. WATER CHEMISTRY LAB.
Factors Affecting Phosphorus Release from Intact Lake Sediment Cores,
W82-00251 2H

WISCONSIN UNIV.-MADISON. WATER RESOURCES CENTER.
An Empirical Equation for Predicting Soluble Phosphorus Loads from Agricultural Watersheds,
W82-00134 5B

WISCONSIN UNIV.-SUPERIOR.
Development of Bioassay Procedures for Defining Pollution of Harbor Sediments,
W82-00387 5C

WOODWARD-CLYDE CONSULTANTS, SAN FRANCISCO, CA.
Quarterly Progress Report, Nationwide Urban Runoff Program.
W82-00044 5G

ACCESSION NUMBER INDEX

W82-00001 5C
W82-00002 5B
W82-00003 5B
W82-00004 5B
W82-00005 5C
W82-00006 2H
W82-00007 2C
W82-00008 5B
W82-00009 5B
W82-00010 5F
W82-00011 7C
W82-00012 6E
W82-00013 5C
W82-00014 2F
W82-00015 2J
W82-00016 2F
W82-00017 2F
W82-00018 5B
W82-00019 2E
W82-00020 7C
W82-00021 7C
W82-00022 7B
W82-00023 7A
W82-00024 7C
W82-00025 7C
W82-00026 7C
W82-00027 6D
W82-00028 6E
W82-00029 6D
W82-00030 6D
W82-00031 6E
W82-00032 6B
W82-00033 5B
W82-00034 2J
W82-00035 5B
W82-00036 6B
W82-00037 5D
W82-00038 6A
W82-00039 5B
W82-00040 5D
W82-00041 5D
W82-00042 6D
W82-00043 6A
W82-00044 5G
W82-00045 5G
W82-00046 8A
W82-00047 8D
W82-00048 5D
W82-00049 5D
W82-00050 6D
W82-00051 6G
W82-00052 5C
W82-00053 5G
W82-00054 4C
W82-00055 5F
W82-00056 5G
W82-00057 5D
W82-00058 5D
W82-00059 5D
W82-00060 5D
W82-00061 5F
W82-00062 5G
W82-00063 5F
W82-00064 5D
W82-00065 5D
W82-00066 5D
W82-00067 8A
W82-00068 2B
W82-00069 5D
W82-00070 5F
W82-00071 5G
W82-00072 5F
W82-00073 5C
W82-00074 5F
W82-00075 4B
W82-00076 7C
W82-00077 7C
W82-00078 7C
W82-00079 7C
W82-00080 7C
W82-00081 7C
W82-00082 7C
W82-00083 7C
W82-00084 5B
W82-00085 7C
W82-00086 6D
W82-00087 7C
W82-00088 7C
W82-00089 10D
W82-00090 7C
W82-00091 6A
W82-00092 5D
W82-00093 5D
W82-00094 5B
W82-00095 5E
W82-00096 6A
W82-00097 5E
W82-00098 5D
W82-00099 5E
W82-00100 5A
W82-00101 7B
W82-00102 6B
W82-00103 4A
W82-00104 7B
W82-00105 7B
W82-00106 5C
W82-00107 6D
W82-00108 5E
W82-00109 2E
W82-00110 5A
W82-00111 4C
W82-00112 2L
W82-00113 2G
W82-00114 2I
W82-00115 2G
W82-00116 8D
W82-00117 2J
W82-00118 2A
W82-00119 3F
W82-00120 2I
W82-00121 5D
W82-00122 5C
W82-00123 5A
W82-00124 5A
W82-00125 5D
W82-00126 5A
W82-00127 2H
W82-00128 5F
W82-00129 6D
W82-00130 4C
W82-00131 2F
W82-00132 2B
W82-00133 2G
W82-00134 5B
W82-00135 5B
W82-00136 2J
W82-00137 2G
W82-00138 3F
W82-00139 3F
W82-00140 7B
W82-00141 5B
W82-00142 2A
W82-00143 6A
W82-00144 4D
W82-00145 2J
W82-00146 6G
W82-00147 5B
W82-00148 2L
W82-00149 2L
W82-00150 2L
W82-00151 2J
W82-00152 2E
W82-00153 5B
W82-00154 5A
W82-00155 5D
W82-00156 5E
W82-00157 5B
W82-00158 5E
W82-00159 5B
W82-00160 6B
W82-00161 5D
W82-00162 2I
W82-00163 5A
W82-00164 5B
W82-00165 5E
W82-00166 2C
W82-00167 5D
W82-00168 5D
W82-00169 6D
W82-00170 6E
W82-00171 5D
W82-00172 2K
W82-00173 5B
W82-00174 2K
W82-00175 5B
W82-00176 4D
W82-00177 6B
W82-00178 3F
W82-00179 5B
W82-00180 6D
W82-00181 8C
W82-00182 5D
W82-00183 2D
W82-00184 3F
W82-00185 2K
W82-00186 5C
W82-00187 3E
W82-00188 3E
W82-00189 5A
W82-00190 4A
W82-00191 7B
W82-00192 5E
W82-00193 5B
W82-00194 8D
W82-00195 3C
W82-00196 2D
W82-00197 5D
W82-00198 5A
W82-00199 5A
W82-00200 5A
W82-00201 2L
W82-00202 2L
W82-00203 5A
W82-00204 5D
W82-00205 5A
W82-00206 5A
W82-00207 5A
W82-00208 5A
W82-00209 5A
W82-00210 7B
W82-00211 2C
W82-00212 5B
W82-00213 8C
W82-00214 5G
W82-00215 5C
W82-00216 6G
W82-00217 5D
W82-00218 2H
W82-00219 5A
W82-00220 5B
W82-00221 5A
W82-00222 5A
W82-00223 5B
W82-00224 5C
W82-00225 5A
W82-00226 5D
W82-00227 5C
W82-00228 8B
W82-00229 6A
W82-00230 8A
W82-00231 5C
W82-00232 5A
W82-00233 5C
W82-00234 5D
W82-00235 5B
W82-00236 5A
W82-00237 2H
W82-00238 5A
W82-00239 5B
W82-00240 5A
W82-00241 2H
W82-00242 2L
W82-00243 2L
W82-00244 2G
W82-00245 2H
W82-00246 5A
W82-00247 5A
W82-00248 2L
W82-00249 5E
W82-00250 5D
W82-00251 2H
W82-00252 6E
W82-00253 5B
W82-00254 5F
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W82-00256 5A
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W82-00261 5G
W82-00262 5B
W82-00263 2L
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W82-00266 5C
W82-00267 2C
W82-00268 5C
W82-00269 5F
W82-00270 2H
W82-00271 5D
W82-00272 5A
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W82-00274 2J
W82-00275 5D
W82-00276 2L
W82-00277 5B
W82-00278 2F
W82-00279 5B
W82-00280 6A
W82-00281 2F
W82-00282 2F
W82-00283 5B
W82-00284 2K
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W82-00287 5E
W82-00288 6A
W82-00289 8A
W82-00290 5D
W82-00291 5D
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W82-00293 5D
W82-00294 5F
W82-00295 5B
W82-00296 3F
W82-00297 5A
W82-00298 5D
W82-00299 5E
W82-00300 5C
W82-00301 2F
W82-00302 7B
W82-00303 2K
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W82-00305 2H
W82-00306 5B
W82-00307 5D
W82-00308 7B
W82-00309 4A
W82-00310 5F
W82-00311 5D
W82-00312 5F
W82-00313 8A
W82-00314 2L
W82-00315 2B
W82-00316 2A
W82-00317 6A
W82-00318 2J
W82-00319 2H
W82-00320 2C
W82-00321 2K
W82-00322 5D
W82-00323 5G
W82-00324 5D
W82-00325 5D
W82-00326 2E
W82-00327 2A
W82-00328 2G
W82-00329 2I
W82-00330 2I
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W82-00343 5D
W82-00344 5D
W82-00345 5D
W82-00346 5A
W82-00347 8D
W82-00348 6C
W82-00349 5A
W82-00350 5F
W82-00351 6F
W82-00352 6G
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W82-00354 6G
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W82-00356 6G
W82-00357 5D
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W82-00361 5D
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W82-00365 5D
W82-00366 5D
W82-00367 6G
W82-00368 6D
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W82-00392 3C
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W82-00398 5A
W82-00399 5C
W82-00400 2H
W82-00401 3D
W82-00402 5D
W82-00403 5D
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W82-00405 2I
W82-00406 5D
W82-00407 5F
W82-00408 5D
W82-00409 7C
W82-00410 7C
W82-00411 7C
W82-00412 2A
W82-00413 5B
W82-00414 4B
W82-00415 4B
W82-00416 4C
W82-00417 5B
W82-00418 5A
W82-00419 10C
W82-00420 10B
W82-00421 4A
W82-00422 7C
W82-00423 7C
W82-00424 2F
W82-00425 7C
W82-00426 4B
W82-00427 5C
W82-00428 2F
W82-00429 6E
W82-00430 5B
W82-00431 5D
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W82-00447 6E
W82-00448 6E
W82-00449 6E
W82-00450 6E
W82-00451 5F
W82-00452 5F
W82-00453 5B
W82-00454 5A
W82-00455 5D
W82-00456 3C
W82-00457 3C
W82-00458 5A
W82-00459 5A
W82-00460 5D
W82-00461 5D
W82-00462 5B
W82-00463 5D
W82-00464 5A
W82-00465 2G
W82-00466 2J
W82-00467 5F
W82-00468 2J
W82-00469 3C
W82-00470 2J
W82-00471 2J
W82-00472 2J
W82-00473 2G
W82-00474 2H
W82-00475 5E
W82-00476 2H
W82-00477 5C
W82-00478 5A
W82-00479 5B
W82-00480 5A
W82-00481 5B
W82-00482 6E
W82-00483 5A
W82-00484 2I
W82-00485 2H
W82-00486 2K
W82-00487 5A
W82-00488 2H
W82-00489 5D
W82-00490 5A
W82-00491 2L
W82-00492 5A
W82-00493 5E
W82-00494 5A
W82-00495 5A
W82-00496 5D
W82-00497 2K
W82-00498 5B
W82-00499 5E
W82-00500 5F

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- WATER QUALITY MANAGEMENT AND PROTECTION
- WATER RESOURCES PLANNING
- RESOURCES DATA
- ENGINEERING WORKS
- MANPOWER, GRANTS, AND FACILITIES
- SCIENTIFIC AND TECHNICAL INFORMATION

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- SUBJECT INDEX
- AUTHOR INDEX
- ORGANIZATIONAL INDEX
- ACCESSSION NUMBER INDEX

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VOLUME 15, NUMBER 2
FEBRUARY 1, 1982

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Office of Water Research and Technology,
U.S. Department of the Interior

VOLUME 15, NUMBER 2
FEBRUARY 1, 1982

W82-00501 -- W82-01100

The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through August 31, 1983.

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Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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THE OFFICE OF WATER RESEARCH AND TECHNOLOGY DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

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CONTENTS

SUBJECT FIELDS AND GROUPS

Please use the edge index on the back cover to locate Subject Fields and Indexes.

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

A MATHEMATICAL MODEL FOR CONSOLIDATION IN A THERMOELASTIC AQUIFER DUE TO HOT WATER INJECTION OR PUMPING,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W82-00602

GRAVITATIONAL STABILITY OF WATER OVER STEAM IN VAPOR-DOMINATED GEOTHERMAL SYSTEMS,
Aerospace Corp., Los Angeles, CA. Space Science Lab.
G. Schubert, and J. M. Straus.
Journal of Geophysical Research, Vol 85, No B11, p 6505-6512, November, 1980. 7 Fig, 13 Ref.

Descriptors: *Geothermal studies, *Water vapor, *Stability analysis, Geothermal resources, Mathematical studies, Condensates, Permeability.

The gravitational stability of a condensate or water layer overlying steam in a vapor-dominated geothermal system was investigated. Linear stability analysis was carried out on superposed layers of immiscible fluids in a porous medium and demonstrated that the heavy over light configuration is always unstable. A similar stability analysis was carried out for the case in which the interface separating the fluid layers is a phase change. The phase change was found to stabilize the heavy over light configuration. The conditions under which this stabilization occurs are quantified and applied to the water over steam situation characteristic of vapor-dominated geothermal systems. The condensate layer can be stabilized if the permeability near its base is no larger than about 40 sq nm (0.04 millidarcy). The special behavior of the phase change interface between water and steam permits the stabilization of the system with a nonzero permeability. (Small-FRC)
W82-00963

BUOYANCY FORCE REVERSALS IN VERTICAL NATURAL CONVECTION FLOWS IN COLD WATER,
State Univ. of New York at Buffalo. Dept. of Mechanical Engineering.
V. P. Carey, B. Gebhart, and J. C. Mollendorf.
Journal of Fluid Mechanics, Vol 97, No 2, p 279-297, March, 1980. 9 Fig, 11 Ref.

Descriptors: *Temperature effects, *Natural flow, *Buoyancy, Mathematical studies, Hydrodynamics, Saline water, Ice, Freezing, Melting.

Calculated transport is compared to experimental transport for laminar buoyancy-induced flows driven by thermal transport to or from a vertical isothermal surface in cold pure and saline water. Specifically, the consequences of temperature conditions wherein the buoyance force reverses across the thermal region owing to the presence of a density extremum are explored. This is a common condition in terrestrial waters and in technological processes utilizing cold water. A nonlinear density equation of state for both pure and saline water is presented which permits an accurate treatment of flows for bounding temperatures up to 20 deg C at salinity levels from 0 to 40 ppt and pressure levels from 1 to 1000 bars. Applications include the melting or slow freezing of a vertical ice surface in pure water as well as a heated or cooled vertical isothermal surface in pure or saline water. Calculated transport agreed well with experimental results. The results indicate that such flows are relatively weak but can lead to early laminar instability. (Small-FRC)
W82-00981

FLOW ANALYSIS OF MODELS OF THE HUBBARD BROOK ECOSYSTEM,
Massachusetts Univ., Amherst. Dept. of Forestry and Wildlife Management.
J. T. Finn.
Ecology, Vol 61, No 3, p 562-571, 1980. 7 Fig, 7 Tab, 19 Ref.

Descriptors: *Flow characteristics, *Ecosystems, Model studies, Flow measurement, Flow profiles, Flow rates, Flow system, Cycling nutrients, Nutrients, Energy.

Flow analysis, a method of tracing flows of materials through a system, was applied to some of the Hubbard Brook data to determine the amount cycled per year of several elements and energy at Hubbard Brook compared to the total amount of each flowing per year in the system and also determine the pattern of nutrient and energy flow in the ecosystem. Three different models of calcium flow were compared to judge the effect of small differences in model structure on cycling and flow pattern. When all three models were analyzed using the same nutrient flux data, flow measures became very close, in spite of structural differences in the models. For these models, flow values were more important than the architecture of the models in determining cycling and flow characteristics. Flow analysis offers a new set of tools to investigators of biogeochemical cycling, which enabls comparisons between elements and across systems, and which also may serve as an aid in evaluating models of cycling. (Baker-FRC)
W82-01038

1B. Aqueous Solutions and Suspensions

AQUASOLS: THE BEHAVIOR OF SMALL PARTICLES IN AQUATIC SYSTEMS,
Johns Hopkins Univ., Baltimore, MD.
C. R. O'Melia.
Environmental Science and Technology, Vol 14, No 9, p 1052-1060, September, 1980. 11 Fig, 3 Tab, 13 Ref.

Descriptors: *Physical properties, *Water pollution, Reviews, Water resources management, Water demand, Water quality, *Particulate matter, Water treatment facilities, Wastewater treatment, Water transport, Conveyance structures, Aqueducts, Aquifers, Natural waters, Lakes, Temperature effects.

This article describes the physical processes that affect transport and fate of solid particles in aquatic systems and illustrates, using case studies, the present understanding of these processes and the extent of their effects. Three physical processes are considered: Brownian or molecular diffusion, in which random motion of small particles is brought about by thermal effects; fluid shear (either turbulent or laminar): and gravity, which produces vertical transport of particles and depends on the buoyant weight of the particles. Four case studies are summarized. Two are examinations of particle deposition at water-solid interfaces; filtration by packed beds in laminar flow, and deposition on pipe walls in turbulent flow. The other two examples consider particle transport within aquatic systems: a water treatment plant and a lake. Current available evidence suggests that most pollutants in water are particles or are associated with particles. These particles are governed by physical processes. Knowledge permits these processes to be described and controlled in treatment and transport systems for water supply and wastewater disposal. By extending these concepts to natural aquatic systems, new insights will be found into the functioning of the natural systems and the flow of materials through them. This knowledge will improve man's management of these systems and enable him to more successfully control his impact on them. (Baker-FRC)
W82-00540

ADSORPTION ON CARBON: SOLVENT EFFECTS ON ADSORPTION,
For primary bibliographic entry see Field 5F.
W82-00619

ELECTRICAL ASPECTS OF ADSORBING COLLOID FLOTATION. XI. SURFACTANT ADSORPTION ISOTHERMS, PARTICLE DISPLACEMENT, AND DIFFERENTIAL CAPACITANCE,
Vanderbilt Univ., Nashville, TN. Dept. of Chemistry.
J. E. Kiefer, and D. Wilson.
Separation Science and Technology, Vol 15, No 1, p 57-74, 1980. 14 Fig, 25 Ref.

Descriptors: *Bubbles, Statistical methods, *Adsorption, Isotherms, Temperature gradient, *Surfactants, Sediment-water interfaces, Electrical properties, *Air-water interfaces.

The theory of surfactant adsorption of floc particles at the air-water interface was explored. First the adsorption of surfactant onto floc particles to form a hemimicelle was examined; this renders the particles hydrophobic and permits bubble attachment to occur. Statistical mechanics were used to calculate adsorption isotherms of ionic surfactants on charged solid-water interfaces. The effects of coulombic repulsions between the ionic heads of the surfactant species are taken into account, as are the van der Waals attractions of their hydrocarbon tails. A 'squeeze-out' mechanism by means of which viscous drag forces acting tangentially to the surface of a rising bubble may detach floc particles from it is examined. A nonideal Poisson-Boltzmann equation is used to calculate the differential capcitance of the electric double layer at an interface. (Baker-FRC)
W82-00788

2. WATER CYCLE

2A. General

IDENTIFICATION OF STREAMFLOW STOCHASTIC MODELS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
J. D. Salas, J. T. B. Obeysekera, and R. A. Smith.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY7, p 853-866, July, 1981. 2 Fig, 5 Tab, 35 Ref.

Descriptors: *Stochastic processes, *Streamflow forecasting, *Model studies, Niger River, Rivers, Hydrologic models, Watersheds, Rainfall-runoff relationships, Groundwater, Autoregressive Moving Average Model.

This paper presents a method for choosing an appropriate stochastic model for annual streamflows. The type of model is chosen on the basis of a conceptual physical representation of a natural watershed, and the form, on the basis of recently developed R-functions and S-functions. Under certain assumptions, for an ARMA (p,q) (Autoregressive Moving Average Model) precipitation input the groundwater storage is an ARMA (p + 1, q) process and the streamflow is an ARMA (p + 1, q + 1) process. In general, such groundwater and streamflow processes belong to the class of restricted ARMA processes in the sense that their parameter space is a subspace of that corresponding to the general ARMA models. An example shows how the annual flows of the Niger River at Koulicoro, Africa, can be modeled by ARMA. (Cassar-FRC)
W82-00555

A GEOMORPHOLOGIC SYNTHESIS OF NONLINEARITY IN SURFACE RUNOFF,
Mississippi Univ., University. Dept. of Civil Engineering.
C. T. Wang, V. K. Gupta, and E. Waymire.
Water Resources Research, Vol 17, No 3, p 545-554, June, 1981. 7 Fig, 1 Tab, 24 Ref.

Descriptors: *Surface runoff, *Geomorphology, Rainfall-runoff relationships, Hydrographs, Runoff, Rainfall intensity, Predictions, Basins, River basins, Illinois, *Nonlinear programming.

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A nonlinear (quasi-linear) geomorphic approach for modeling the rainfall-runoff process for a basin was developed by generalizing a recently developed linear geomorphic approach (Gupta et al., 1980). The nonlinearity in the transformation enters in partly through the dependence of the mean holding time on the rainfall intensity. Under an assumed first approximation that this dependence is the sole source of nonlinearity, an explicit quasi-linear representation results for the rainfall-runoff transformation. The kernel function of this transformation can be termed the instantaneous response function, whereas the linear rainfall-runoff transformation is termed the instantaneous unit hydrograph. Analysis of a small basin showed agreement between the quasi-linear theory results and the prediction from the kinematic wave approach. For two large (1100 sq miles) basins in Illinois, predictions from the quasi-linear approach compared well with observed flows. Computations of the measure of nonlinearity for four basins showed that it approaches 2/3 with decreasing basin size and zero with increasing basin size. A straight line was formed with a semilog plot of nonlinearity vs. square root of basins area. (Cassar-FRC)
W82-00604

MULTIVARIATE HYDROLOGIC TIME SERIES ANALYSIS,
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
C. T. Hsu, and K. Adamowski.
Advances in Water Resources, Vol 4, No 2, p 83-95, June, 1981. 11 Fig, 2 Tab, 16 Ref.

Descriptors: *Runoff, *Mathematical models, *Watershed management, Model studies, Statistical analysis, Rainfall, Hydrology, Meteorological data collection, *Streamflow forecasting.

A multivariate watershed hydrologic system model was developed which involves meteorological data as the input and river flow as the output. Monthly hydrological time series of runoff, temperature, and precipitation were analyzed. This autoregressive-moving average transfer function model was adequate to model the monthly watershed system. The accuracy of estimation of runoff characteristics was enhanced with the use of the meteorological and hydrometric data. For watersheds with large storage, the improvement was not pronounced. The large storage effect plays a dominant role in the generating process of system response, and the contribution from external disturbances will be damped out before it becomes significant. To model a multivariate watershed hydrologic system, a combined deterministic-statistical approach could be used. For example, net precipitation rather than gross precipitation could be used as input. (Small-FRC)
W82-00647

STUDY OF THE FACTORS AND REGULARITIES OF RIVER RUNOFF ON THE BASIS OF DATA OF OBSERVATIONS ON REPRESENTATIVE BASINS,
Hydrometeorological Service of the USSR, Moscow.
V. D. Komarov.
Water Resources (English Translation), Vol 7, No 4, p 293-303, July-August, 1980. 8 Fig, 8 Ref. Translated from Vodnye Resursy, No 4, p 5-18, July-August, 1980.

Descriptors: *Runoff forecasting, *Representative basins, *Snowmelt, Basins, Hydrologic models, Russia, Spatial distribution, Forest watersheds, Watersheds, Small watersheds, Rivers, Snow cover, Soil moisture, Freezing, Vegetation.

River runoff observations were started in representative basins in Russia in 1924. There are 10 water balance stations in European Russia, and others in Central Asia, the Far East, and Maritime Territory. The major concern in the European sector is the spring runoff. The observation program includes runoff measurements, snow surveys, depth of freezing, soil moisture content, groundwater level, and meteorological data. By considering two types of spatial inhomogeneity, methods of calculation for runoff can be improved. The first is the variation in physiographic conditions, for example, treeless and forested zones. The second is the variation within each part of the water basin equivalent of snow cover, soil moisture content, depth of freezing, storage capacity of closed depressions, etc. The Moscow water balance station is used as an illustration in choosing representative basins. It is not necessary to choose a totally treeless basin and a totally forested basin. Instead, the Medvenka River basin (area 21.5 sq km, forest 0.26) and the Zakza River basin (area 17.0 sq km, forest 0.73) were chosen. These basins are similar in physiographic conditions, with the exception of forest cover, and are representative of larger basins. Relationships derived from these two representative basins are applied to the 18,000 sq km Cheptsa River basin, forest coverage 0.26, similar to the two representative basins in soils, relief, and vegetation. The calculated runoff agreed well with that observed in the Cheptsa basin--1974, 172 and 162 mm; 1975, 79 and 77 mm; and 1976, 59 and 56 mm. (Cassar-FRC)
W82-00652

EFFECTS OF RECENT INCREASES IN RAINFALL ON FLOODS AND RUNOFF IN THE UPPER HUNTER VALLEY,
New South Wales Univ., Kensington (Australia). School of Geography.
For primary bibliographic entry see Field 2E.
W82-00668

EFFECTS OF TROPICAL CYCLONE WALLY IN SOUTHEAST VITI LEVU, FIJI, EASTER 1980,
Victoria Univ., Wellington (New Zealand).
R. Howorth, M. J. Crozier, and I. J. Grant.
Search, Vol 12, No 1/2, p 41-43, January/February, 1981. 1 Fig, 1 Tab, 3 Ref.

Descriptors: *Landslides, *Tropical cyclones, *Excess rainfall, Rainfall, Cyclones, Storms, Rainstorms, Flooding, Floods, Viti Levu, *Fiji Islands.

As part of a slope-stability study being carried out in the Fiji Islands, landslides which occurred on Viti Levu during the time the tropical cyclone Wally passed through the area were investigated. Massive and extensive landslides occurred in the area after a rainfall exceeding 500 mm over a two-day period. The average monthly rainfall for this area is 263 mm. Severe flooding caused flood water depths of 1.0-1.5 m on the Navua River delta. Fifteen people were killed and 113 villages were affected. Times of peak discharge of the coastal rivers were coincident with the landslides. Most of the landslides occurred on the evening of April 4th. Total rainfall for April 4 was 261.8 mm, for April 3, 307.8 mm, and for April 2, 111.4 mm. Most of the slides affected only regolith, and in only one case was in situ bedrock involved. Most of the slides occurred just after nightfall, between 1800 and 2200 hr. The rain stopped at about the same time, which may have permitted the ground to regain stability. (Small-FRC)
W82-00670

POSSIBILITY OF USING TRITIUM FOR STUDYING GLOBAL CIRCULATION OF ATMOSPHERIC MOISTURE,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
V. I. Ferronskii, L. Yu. Ivanova, Kh. A. Kikichev, L. P. Kuznetsova, and V. V. Romanov.
Water Resources (English Translation), Vol. 7, No. 5, p 478-482, September/October, 1980. 3 Fig, 12 Ref. Translated from Vodnye Resursy, No. 5, p 171-177, Setember/October, 1980.

Descriptors: *Atmospheric moisture, *Tritium, Measurement techniques, Air circulation, Isotopic tracers, Tracers, Water vapor, Atmospheric, Global circulation.

The suitability of the isotopic tracer method for use in studying global circulation of atmospheric moisture was investigated, using as a lable the tritium (T) produced during the low-power atmospheric nuclear in China on March 14, 1978. Tritium which enters the atmosphere as a result of nuclear explosions quickly reacts with atmospheric oxygen to form the water molecular HTO. This tritium water vapor participates in the circulation of air masses and moisture in the atmosphere, permitting tracking of the movement of the incorporating air mass until the tritium label is removed by dispersion of air particles and moisture. The sampling method used is based on adsorption of water vapor during pumping of air through a drying agent, followed by electrolysis and measurement of the tritium concentration by a liquid scintillation spectrometer. The higher level of radioactivity in the atmosphere and precipitation permitted tracking of the radioactive cloud for two weeks after the explosion. Analysis of the movement of the labelled air mass demonstrated that the time of circulation of water vapor around the earth is a natural phenomenon as well as a theoretical concept. Under certain conditions of atmospheric circulation, packets of moisture may exist and be moved over long periods of time without substantial dispersion, at least in the substratosphere. The isotopic tracer method permits tracking of the movement of air masses and atmospheric moisture both in cloudy and rainy and in clear and dry weather. These results indicate that tritium, which can be injected at the required height by ordinary technical means, can be used as a tracer in experimental studies of global circulation of air masses and atmospheric water vapor. (Carroll-FRC)
W82-00863

A COMPARISON OF RAINFALL-RUNOFF MODELS,
Western Australia Univ., Nedlands.
W. D. Weeks, and R. H. B. Hebbert.
Nordic Hydrology, Vol 11, No 1, p 7-24, 1980. 10 Fig, 4 Tab, 16 Ref.

Descriptors: *Rivers, *Model studies, *Rainfall-runoff relationships, Australia, Time series analysis, Mathematical studies, Sacramento model, Monash model, Stanford model, Boughton model, *Comparison studies.

Five rainfall-runoff models were tested on 3 catchments in southwest Western Australia by calibration with 6 years of data followed by testing on a further 6-7 years of extra data. The Boughton Model, a simple conceptual model, was unacceptable because it was developed for catchments vastly different from the rivers studied. The Sacramento, Stanford, and Monash models, sophisticated conceptual models, and a black box or purely mathematical method involving a recursive time series algorithm all performed in a satisfactory manner. The straightforward Sacramento and the simple time series analysis are recommended for the larger rivers; the Monash and Stanford models, for the smaller catchments, Monash being marginally better. The Sacramento, with finite storages, and the time series analysis, with no provision for baseflow, performed poorly on the very small river. (Cassar-FRC)
W82-00911

SIMULATION OF LAKE-WATERSHED SYSTEMS, I. DESCRIPTION AND SENSITIVITY ANALYSIS OF THE MODEL,
Alberta Univ., Edmonton. Dept. of Geology.
A. S. Crowe, and F. W. Schwartz.
Journal of Hydrology, Vol 52, No 1/2, p 71-105, June, 1981. 15 Fig, 1 Tab, 19 Ref.

Descriptors: *Watersheds, *Model studies, Lakes, Groundwater, Hydrology, Water quality, Salinity, Lake morphology, Precipitation, Evaporation, Surface runoff, Flow discharge, *Lake-watershed systems.

A hydrologic transport model has been developed which is oriented primarily toward lakes and is used to examine the role that various climatic and watershed variables play in controlling the physical and chemical hydrology. The hypothetical lake-watershed system defined for the sensitivity analysis has characteristics similar to lakes in the prairie parkland of Canada. The lumped response model presented is able to simulate the hydrologic responses of a lake-watershed system to variations

in precipitation, potential evaporation and air temperatures. It operates by routing water through an idealized system. From the use of this model several conclusions were drawn. The water level and salinities of the lake depended on the general lake morphometry. Variations in groundwater chemistry over a part of the watershed do not significantly alter the salinity of the hypothetical prairie lake. Large decreases or increases in the quality of groundwater over the entire watershed will alter the salinity of the lake. The unsaturated zone primarily controls the amount of water percolating to the groundwater zone and thus indirectly influences the amount of groundwater discharged to the lake. As the amount of a watershed covered by an unsaturated zone decreases, the amount of groundwater recharge increases. Increasing the proportion of this hypothetical watershed that is impervious causes precipitation to flow directly to the lake, decreasing salinity, increasing fluctuations of lake levels and generally increasing the lake stage. Variations in precipitation and potential evaporation do not cause large fluctuations in lake levels and salinity in the large watershed used in this analysis, but would in a small lake-watershed system. (Baker-FRC)
W82-00926

SIMULATION OF LAKE-WATERSHED SYSTEMS, II. APPLICATION TO BAPTISTE LAKE, ALBERTA, CANADA,
Alberta Univ., Edmonton. Dept. of Geology.
A. S. Crowe, and F. W. Schwartz.
Journal of Hydrology, Vol 52, No 1/2, p 107-125, June, 1981. 8 Fig, 6 Tab, 21 Ref.

Descriptors: *Watersheds, *Model studies, Lakes, Groundwater, Groundwater movement, Surface-groundwater relations, Lake morphology, *Lake-watershed systems.

The applicability of a hydrologic simulation model for evaluating an actual lake-watershed system was investigated at the Baptiste Lake system in east-central Alberta, Canada. This is an important potential recreational development area, and a large data base for the area already exists. The watershed covers an area of 318 square kilometers, of which 58% is forest, 25% is standing water consisting of the subject lake, swamps and rivers, 16% is agricultural land, and less than 1% is cottage development along the lake shore. Land to the north and east of the lake is farm land, while that to the south and west is mostly swamp and forest. With the model it was possible to recapitulate a 6-year history of lake level fluctuations. The predicted and measured lake levels have a mean absolute difference of less than 0.1 meter. The cyclical character of water level fluctuations on an annual basis was also preserved in the simulation results. Although only a relatively short record of lake chemistry was available, the model was able to simulate with a reasonable degree of accuracy the total dissolved solids content of the lake. The study suggests that groundwater inflow to the lake comprises about 13% of the annual inflow from all sources and is not unreasonable for lakes in this kind of hydrological setting. (Baker-FRC)
W82-00927

ADAPTIVE HYDROLOGICAL FORECASTING - A REVIEW,
Institute of Hydrology, Wallingford (England).
P. E. O'Connell, and R. T. Clarke.
Hydrological Sciences Bulletin, Vol 26, No 2, p 179-205, June, 1981. 3 Fig, 2 Tab, 40 Ref.

Descriptors: *Runoff forecasting, *Rainfall, *Mathematical models, Forecasting, Hydrology, River basins, Reviews.

A variety of models and parameter estimation algorithms for hydrological forecasting are reviewed, including a discussion of the assumptions underlying them and some problems encountered in their application. Four models were applied to 2 months of half-hourly rainfall and runoff data for the Hirnant sub-basin of the River Dee. The four models were: Model A, a version of the River Dee sub-basin model; Model B, the simple nonlinear conceptual model used by Moore and Weiss (1980); Model C, a linear transfer function model with time variant parameters; and Model D, a selftuning predicator with PERLOG input. Models A and B had the smallest error variances, but D performed best in terms of standardized Q and S statistics. The standard assumptions of independence and identical distribution for system noise are not justified for hydrological systems. There are considerable unsolved estimation problems in real time forecasting, but it may be most beneficial to find a better representation of the spatial variation in rainfall and its effects of streamflow. (Small-FRC)
W82-00984

OVERLAND FLOW ON A DIVERGING SURFACE,
Mississippi State Univ., Mississippi State. Dept. of Civil Engineering.
N. Agiralioglu, and V. P. Singh.
Hydrological Sciences Bulletin, Vol 26, No 2, p 137-147, June, 1981. 7 Fig, 2 Tab, 15 Ref.

Descriptors: *Overland flow, *Mathematical models, *Groundwater basins, Kinetics, Hydrographs, Mathematical studies, Topography.

A basin diverging flow model is presented which utilizes kinetic wave theory. A first order explicit finite difference scheme is used to solve the kinematic equations. The model is compared with the plane model. The two models yield different concentration times and hydrographs that differ in shape, depending upon the degree of divergence. The rising hydrograph rises faster for the diverging model than for the plane model. The reverse is true for the recession hydrograph. Also, the diverging model gave longer times of concentration than the plane model. In natural basins that have divergence in their geometric configurations, the divergence model may predict hydrographs reasonably well. Suitable basins are both rural and urban with upland portions which diverge and lower portions which converge. A diverging basin's response is similar to that of a cascade of planes of decreasing size, and its descrete analog is a system composed of unequal nonlinear reservoirs used in parametric hydrology. (Small-FRC)
W82-00986

2B. Precipitation

TRACE CONSTITUENTS IN CLOUD WATER, RAINWATER AND AEROSOL SAMPLES COLLECTED NEAR THE WEST COAST OF INDIA DURING THE SOUTHWEST MONSOON,
Bhabha Atomic Research Centre, Bombay (India). Air Monitoring Section.
S. Sadasivan.
Atmospheric Environment, Vol 14, No 1, p 33-38, January, 1980. 3 Fig, 3 Tab, 27 Ref.

Descriptors: *Clouds, *Aerosols, *Rain, Precipitation, Seawater *India, *Trace levels, Halogens, Sulfates, Iodine, Bromine, Chlorides, Salts, Monsoons, Fallout, Chemical reactions.

Trace constituents were determined in cloud water, rain water, and impactor aerosol samples collected at a mountain top near the west coast of India during the summer monsoon in order to study the evolution of clouds and raindrops. Concentrations of trace constituents in cloud water were within the ranges previously reported for oceanic cloud water. Ratios of Cl, Br, and I to Na were close to those of seawater, indicating no incorporation of halogens in the cloud water. In cloud water there were excesses of Ca (probably from soil particles), K (from enrichment during transfer from seawater to air), and sulfates. Rainwater samples were difficult to analyze because the concentrations of trace constituents were near the detection limit. Average ammonium/sulfate ratio was 0.2; Cl and Na correlated well; and Br/Na and I/Na values were higher than samples from the coast taken previously. Aerosol particles collected under rainy conditions and clear weather conditions showed enrichment of Br and I at higher altitudes. These findings indicate that cloud droplets form on large and giant aerosol particles. There is no significant gaseous I absorption in raindrops. The aerosol composition explains the observed I enrichment in rainwater. (Cassar-FRC)
W82-00676

ON AUGUST MEAN TEMPERATURE AND THE SUCCEEDING SEASON'S RAINFALL OVER SOUTH AFRICA,
University of the Witwatersrand, Johannesburg (South Africa).
T. G. J. Dyer.
South African Journal of Science, Vol 76, No 2, p 85-87, February, 1980. 7 Fig, 1 Ref.

Descriptors: *Rainfall distribution, *Temperature control, *South Africa, Temperature, *Seasonal distribution, Precipitation, Model studies.

The relationship between August mean temperature and the total rainfall received during the following season was investigated in light of the commonly assumed interrelationship between the two factors. The study reveals that there may be some truth in the claim of an association between August mean temperature and rainfall over part of the rainy season. The correlation fields for November and December, and also for the whole season, have areas of significant coefficients. The whole-season correlation arises, however, by virtue of the form of the fields in the former two months and to a lesser extent of that which exists during January. This is based on the fact that the fields tend to weaken in an organized fashion as the season progresses. If there is a true relationship, it is highly spatially dependent, as no correlation exists to the north of a line through Bloemfontein and Durban. Even in the strongest fields the relationship accounts for only a relatively small proportion of the total relative variance in rainfall. However, these fields lend themselves to being considered as possible inputs to any model designed to forecast seasonal rainfall. (Baker-FRC)
W82-00692

A NUMERICAL COMPARISON BETWEEN LAGRANGIAN AND EULERIAN RAINFALL STATISTICS,
Stockholm Univ. (Sweden). Arrhenius Lab.
M. Hamrud, H. Rodhe, and J. Grandell.
Tellus, Vol 33, No 3, p 235-241, June, 1981. 2 Fig, 2 Tab, 10 Ref.

Descriptors: *Numerical analysis, *Precipitation, *Comparison studies, Mathematical studies, Rainfall, Precipitation scavenging, Statistical methods.

The problem of estimating statistical parameters characterizing the precipitation experienced by a parcel of air as it is carried along by the winds is of considerable interest in connection with studies of the transport and dispersion of air pollutants subject to precipitation scavenging. Lagrangian data are data relating to the 'weather' experienced by the air parcel as it is carried along by the wind. Eulerian data are meteorological observations obtained at fixed locations. This study investigated the relationship between Lagrangian and Eulerian rainfall statistics. Parameters characterizing Lagrangian precipitation statistics were derived using 850-mbar air trajectories over nothern Europe in conjunction with precipitation data. Comparisons with similar Eulerian statistics which had been spatially averaged over the area indicated that the magnitudes of these parameters differed only moderately between the two frames of reference. It therefore seems reasonable to assume as a first approximation an equality between the Lagrangian and the Eulerian estimates of the parameters studied. (Carroll-FRC)
W82-00803

RELATION OF SATELLITE-BASED THUNDERSTORM INTENSITY TO RADAR-ESTIMATED RAINFALL,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
A. J. Negri, and R. F. Adler.
Journal of Applied Meteorology, Vol 20, No 3, p 388-300, March, 1981. 9 Fig, 16 Ref.

Descriptors: *Thunderstorms, *Satellite technology, *Radar, *Weather forecasting, Correlation analysis, Storms, Remote sensing.

Measurements of thunderstorm intensity determined from short-interval geosynchronous digital satellite data were compared to precipitation measurements from radar data. In the satellite infrared data, the thunderstorms were defined by the location of the relative minima in the equivalent blackbody temperature field. When the evolution of a number of storms was examined, the first low level radar echo (18dBZ) appeared when the satellite observed cloud-top minimum blackbody temperature had a mean of 245 K (7.4 km). Larger reflectivities appeared as the cloud tops penetrated upward to colder temperatures. As the storms approached and penetrated the tropopause, reflectivity values greater than 50 dBZ began. A correlation was found between satellite-based estimates of thunderstorms and maximum radar reflectivity. Thunderstorm top ascent rates in the 235-240 K region indicated the intensity of the initial storm updraft and were correlated with the maximum storm reflectivity, with weak cells having minimum reflectivity and strong cells having echos equal to or greater than 50 dBZ. (Small-FRC)
W82-00806

APPARATUS FOR THE SIMULATION OF RAIN IN THE LABORATORY,
State Univ. of New York at Albany.
D. R. Derenzo, and B. Vonnegut.
Journal of Applied Meteorology, Vol 20, No 1, p 36-41, January, 1981. 7 Fig, 1 Tab, 15 Ref.

Descriptors: *Rainfall simulators, *Simulated rainfall, *Calibrations, Rainfall, Laboratory equipment.

A method is described to produce simulated rain which does not require several meters of fall. The short fall distance means that the simulated rain can be produced without the aid of a rainshaft and within the convenience of normal ceiling height. A jet of water is directed toward the periphery of an automobile tire that rotates opposite to the flow of water. The rotating tire creates air and mechanical turbulence that break the jet up into a spray of water. Three rains having rainfall rates of 14, 48, and 2100 mm/hr were investigated using the simulator. The rains had drop-size distributions that exhibited characteristics of those found in natural rains. Also, drops fell at approximately terminal velocity. The apparatus can be used to calibrate meteorological instruments that measure some aspect of rainfall either in the field or laboratory. Examples of instruments would be those dealing with water drop-soil interactions. (Small-FRC)
W82-00807

SATELLITE RAIN ESTIMATION IN THE U.S. HIGH PLAINS,
National Oceanic and Atmospheric Administration, Boulder, CO.
C. G. Griffith, J. A. Augustine, and W. L. Woodley.
Journal of Applied Meteorology, Vol 20, No 1, p 53-66, January, 1981, 10 Fig, 10 Ref.

Descriptors: *Computer models, *Satellite technology, *Rainfall, Arid climates, Clouds, Error analysis, Weather forecasting, High plains, Remote sensing.

A computer-automated technique to estimate rainfall using visible or infrared geosynchronous satellite imagery was used to estimate rainfall on 15 selected days in the High Plains. Each site was instrumented with a small, dense raingage network to provide a ground measure of rainfall for verification. Model results exceeded the corresponding gage estimates by a factor of 3-5 because the model treated convective clouds in arid regions as tropical clouds. The technique was adjusted to apply to the High Plains. Gage and satellite comparisons were made for a small area, and this comparison was extrapolated to satellite rain estimates for large areas. A second adjustment technique involved calculation of an adjustment factor using the output of a one-dimensional cumulus cloud model. Preliminary results indicated that these adjusted techniques have considerable utility. The accuracy of the model is discussed in terms of bias, mean error factor, root mean square error, and linear regression analysis. (Small-FRC)
W82-00808

EVALUATION OF AREAL VERSUS POINT RAINFALL WITH SPARSE DATA,
Ecole Polytechnique, Montreal (Quebec). Dept. of Civil Engineering.
V-T-V. Nguyen, J. Rousselle, and M. B. McPherson.
Canadian Journal of Civil Engineering, Vol 8, No 2, p 173-178, June, 1981. 10 Fig, 1 Tab, 11 Ref.

Descriptors: *Areal precipitation, *Rainfall distribution, *Mathematical studies, Mathematical models, Precipitation, Hydrology, Geography, Probabilistic process, Mathematical equations, *Urban hydrology, *Rainfall-runoff relationships, *Runoff forecasting.

Urban hydrologic studies designed to determine runoff peaks and volumes depend on both temporal and spatial information on rainfall distribution. Since rainfall data used as input to rainfall-runoff models are measured at a point, it is necessary to establish some relationships for the transformation of point rainfall data to areal rainfall. Mean rainfalls for a fixed area and the associated rainfall for a fixed point in that area were analyzed from a probabilistic perspective, and a theoretical methodology for establishing a relationship between these values is proposed. An exponential distribution function for hourly point rainfall was used to derive the distribution relation for mean rainfall over a fixed geographic area. Values of the areal correction factor were estimated at equal levels of exceedance probability for point and areal mean rainfalls. These estimations showed that the areal correction factor is not constant for all return periods and that its value may not always be less than or equal to 1. The point-areal rainfall relationship developed by this study may be more realistic and more useful for many engineering applications because in nature the occurrence of storm centers in a given region is thought to be purely random and in engineering practice attention is often focussed on a fixed area. (Carroll-FRC)
W82-00835

ASSOCIATIONS AND MESOSCALE SPATIAL RELATIONSHIPS AMONG RAINWATER CONSTITUENTS,
Illinois State Water Survey, Urbana.
D. F. Gatz.
Journal of Geophysical Research, Vol. 85, No C10, p 5588-5598, October, 1980. 3 Fig, 13 Tab, 12 Ref.

Descriptors: *Chemistry of precipitation, *Deposition, *Factor analysis, Rainwater, Mathematical studies, Precipitation, Scavenging, Metals, Heavy metals, Sulfates, Air pollution effects.

Information about how rainwater constituents are scavenged from the atmosphere and precipitated was collected in a study of 10 rain events near St. Louis during the summers of 1972-1975. Factor analysis was used to identify groups of constituents having similar deposition patterns. Rainwater samples were collected in networks of 80 or 85 open polyethylene containers and were analyzed for Li, Na, Mg, K, Ca, Fe, Zn, Cd, In, Pb, and sulfate. Four main groupings of depositional patterns occurred: soluble soil-derived elements, insoluble soil-derived elements, soluble pollutants, and insoluble pollutants. Differences between the depositional patterns of pollutants and soil elements are probably due to the distribution of sources. The differences between soluble and insoluble portions of the same element may indicate important differences in scavenging and/or precipitation formation processes. These processes need further investigation. (Small-FRC)
W82-00964

SULFUR AND ASSOCIATED ELEMENTS AND ACIDITY IN CONTINENTAL AND MARINE RAIN FROM NORTH FLORIDA,
Florida State Univ., Tallahassee. Dept. of Oceanography.
S. Tanaka, M. Darzi, and J. W. Winchester.
Journal of Geophysical Research, Vol 85, No C8, p 4519-4526, August, 1980. 5 Fig, 4 tab, 15 Ref.

Descriptors: *Acid rain, *Sulfur, *Rainfall, *Chemical composition, Water analysis, Metals, Air pollution effects, North Florida, Baseline studies, Environmental surveys, *Florida.

The composition characteristics of north Florida rain were investivated to establish some nonurban baselines of elemental concentrations and to estimate the extent of transport of air pollutants. A new measuring technique was used, the proton-induced X-ray emission (Pixe), which could analyze a wide range of elements from S to Pb simultaneously. Elemental composition was determined for: S, K, Ca, V, Mn, Fe, Ni, Cu, Zn, Br, Sr, and Pb, from 4 ml aliquots of 38 different rain samples. Northerly air flow rain exhibited polluted and continental characteristics. Concentrations of Pb, S, and Fe were higher, and strong correlations of Br, Ca, and Fe with Pb were found. In general, southerly air flow rain had lower elemental concentrations, and element concentrations were not correlated with Pb. The average pH of northern rain was 4.4, while southern rain had an average pH of 5.3. The region of influence for atmospheric pollution industrial regions seemed larger than is usually thought. (Small-FRC)
W82-00965

THE MAGNITUDE OF THE HYDROLOGICAL FREQUENCY FACTOR IN MAXIMUM RAINFALL ESTIMATION,
Science and Education, Beltsville, MD. Hydrology.
D. M. Hershfield.
Hydrological Sciences Bulletin, Vol 26, No 2, p 171-177, June, 1981. 5 Fig, 1 Tab, 7 Ref.

Descriptors: *Rainfall, *Probable maximum precipitation, *Frequency analysis, Precipitation, Probability distribution, Mathematical studies, *Eastern United States.

Results from several sets of maximum rainfall data are compared and related in terms of a frequency factor. Chow's hydrological frequency factor is used, which is primarily a function of the recurrence interval for a particular probability distribution. This frequency factor is displayed as a function of the mean of the annual maxima for both official and unofficial rainfall observations and the probable maximum precipitation. The frequency factor is shown to be a function of the magnitude of the unofficial rainfall observations and probable maximum precipitation for areas in the eastern U.S. This suggests that the magnitude of probable maximum precipitation is largely influenced by the magnitude of the frequency factor. The geographical distribution of the probable maximum distribution factor was displayed on maps for the eastern United States, and ranged from about 20 in the south to more than 35 in the north. (Small-FRC)
W82-00983

NUMERICAL SIMULATION OF THE EFFECTS OF COOLING TOWER COMPLEXES ON CLOUDS AND SEVERE STORMS,
South Dakota School of Mines and Technology, Rapid City.
H. D. Orville, P. A. Eckhoff, J. E. Peak, J. H. Hirsch, and F. J. Kopp.
Atmospheric Environment, Vol 15, No 5, p 823-836, 1981. 12 Fig, 1 Tab, 24 Ref.

Descriptors: *Cooling towers, *Storms, Rainstorms, Hail, Rain, *Temperature effects, Simulation analysis, Mathematical studies, Model studies, *Powerplants, Heat, Clouds, Latent heat, Sensible heat.

Attempts were made to determine the effects of excess heat and vapor from large power parks on heavy rain and hailstorms through the use of numerical simulation studies. A two-dimensional, time-dependent model was used which gave realistic simulations of many severe storm processes

including heavy rains, hail and strong winds. The model is a set of partial differential equations which describe time changes of momentum, energy, and mass. Appropriate boundary and initial conditions are imposed on a domain about 20 km high by 20 km wide and 200 meter grid intervals to complete the model. Modifications were made to allow additional water vapor and heat to be added at several lower grid points to simulate effluents from a power peak. Realistic storm situations were recreated. One atmospheric sounding has a strong middle-level inversion which tends to inhibit the first convective clouds but later gives rise to a severe storm with hail and heavy rains. One other sounding is taken from a day in which a severe storm occurred in the Miami area. A third sounding depicts atmospheric conditions in which severe storms formed in the vicinity of Huron, South Dakota. Results of the study indicate that a power park emitting 80% latent heat and 20% sensible heat has little effect on the simulated storm. A case with 100% sensible heat emission leads to a much different solution, with the simulated storm reduced in severity and the rain and hail redistributed. A case in which water vapor is accumulated in a region and released over a broad depth results in slightly more rain from a severe storm. (Baker-FRC)
W82-00995

ATMOSPHERIC WATER CONTENT OVER THE TROPICAL PACIFIC DERIVED FROM THE NIMBUS-6 SCANNING MICROWAVE SPECTROMETER,
National Environmental Satellite Service, Washington, DC.
For primary bibliographic entry see Field 7B.
W82-01004

VARIATIONS IN PRECIPITATION PARAMETERS BETWEEN DROUGHT AND NON-DROUGHT PERIODS IN TEXAS AND SOME IMPLICATIONS FOR CLOUD SEEDING,
National Weather Service Stoneville, MS.
M. S. Flynn, and J. F. Griffiths.
Journal of Applied Meteorology, Vol 19, No 12, p 1363-1370, December, 1980. 1 Fig, 6 Tab, 3 Ref.

Descriptors: *Drought, *Cloud seeding, Weather modification, Moisture deficiency, Water shortage, Water deficit, Artificial precipitation, Rainfall, Irrigation practices, *Texas.

Information concerning rainfall patterns over Texas was extracted from the Texas Section of Hourly Precipitation Data of the US Weather Bureau, 1950-1973. The data involved a study of hourly rainfall for the period of time used for the current study, 1950-1969. Twelve key sites were selected for the evaluation. No easily identifiable patterns for regions emerged from the analysis of the data, which may indicate that many more than 12 sites should be included in future studies. Based on these stations, however, severe droughts in Texas appeared to be characterized by a reduction in both the number of individual rainfalls experienced and a reduction in the intensity of the falls. This indicates that days of cloud seeding opportunity as well as natural precipitation efficiency are diminished, and attempts to start rainfall by artificial methods may have limited success. Length of rainfall during severe droughts is also diminished significantly, and therefore there would be little opportunity for seeding clouds already producing rain. It is also suggested that there is a little benefit to be gained by shutting down irrigation equipment once a rain has started during a severe drought. (Baker-FRC)
W82-01006

2C. Snow, Ice, and Frost

PHYSICAL MECHANICS OF AUFEIS GROWTH,
Alaska Univ., Fairbanks. Inst. of Water Resources.
D. L. Kane.
Canadian Journal of Civil Engineering, Vol 8, No 2, p 186-195, June, 1981. 9 Fig, 21 Ref.

Descriptors: *Aufeis, *Freezing, *Arctic, Polar regions, *Ice formation, Physical properties, River mechanics, Pore pressure, Water pressure, Groundwater, Permafrost, Frozen ground, Piezometers, Time series analysis, Mathematical studies, Alaska.

Although subsurface physical systems in arctic and subarctic regions are frequently considered to be dormant during the winter months, several heat and mass transfer processes near the surface are quite active. These include aufeis growth, which occurs when water under pressure in a stream channel flows onto the existing ice cover and freezes. Data relating to the process of aufeis growth were collected on two small watersheds near Fairbanks, Alaska, over several winters. The pressure variations of the fluid in the porous streambank were measured using piezometers installed at several sites. Time series analyses were used to correlate the variations in the observed pore pressures with climatic variables. The piezometer measurements of pore water pressure indicated that subpermafrost groundwater or groundwater from nonpermafrost regions was the source of water for these ice deposits. Groundwater pore pressures were found to be sufficient to vertically lift the soil overburden and ice in the vicinity of the stream if an impermeable barrier existed. Ice lenses, formed when the seasonal frost penetrated to a zone high in soil moisture, provided this barrier. Ice wedges were found to develop in the seasonal frost zone near the water table, and the thickness of this ice wedge decreased with increasing distance from the stream. Time series analysis of air temperature and groundwater pore pressure indicated that periods of aufeis growth would be associated with or follow periods of moderately warm weather. Although the raw data for the later winter months supported this conclusion, it was less evident in the early winter months. A time lag was also found to exist between the start of a warming trend and the corresponding increase in pore water pressure, and this time lag increased with increasing ice thickness. (Carroll-FRC)
W82-00836

OCCURRENCE OF ICE LAYERS AT THE BASE OF HIGH ARCTIC SNOWPACKS,
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
M-K. Woo, and R. Heron.
Arctic and Alpine Research, Vol. 13, No. 2, p 225-230, May 1981. 3 Fig, 1 Tab, 6 Ref.

Descriptors: *Snowpack, *Ice formation, Cold regions, *Arctic zone, Snowmelt, Melting, Interfaces, *Canada, Cornvallis Island.

Field observations were carried out near Resolute, Cornwallis Island, North West Territory, during the snowmelt periods of 1979 and 1980 at sites underlain by gravel, bog, and lake ice wich was frozen to the lake bottom. At each site, snow temperatures and temperatures at various depths in the ground or in the lake ice were measured using thermistors. The measurements suggest two stages in the formation of a basal ice layer in most High Arctic snowpacks, including seepage of the meltwater into the frozen substrate before the ice is formed and initiation and sustained growth of a basal ice layer. Each stage of development seems to be affected by a set of conditions which can terminate further ice growth. At the seepage stage, the amount of meltwater lost to the substrate depends on the nature of the frozen material and the amount of ice already frozen in its pores. Seepage loss to lake ice is negligible because of its low permeability, but the ample pore space in coarse gravel will permit substantial seepage, and basal ice layer formation may be retarded. When most pores in the frozen substrate are sealed, further supplies from the pack will freeze as a basal ice layer if the substrate is sufficiently cold to dissipate the latent heat. With warming, however, additional meltwater will slush the snow above the ice layer, or will move downslope along the ice surface. A collection of lateral drainage sometimes produces thick ice layers in topographic depressions, as long as the ground temperature remains below zero degrees centigrade for an extended time. (Baker-FRC)
W82-00844

THE EFFECTS OF SURFACE DUST ON SNOWMELT RATES,
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
J. J. Drake.
Arctic and Alpine Research, Vol. 13, No 2, p 219-223, May, 1981. 1 Fig, 14 Ref.

Descriptors: *Snowmelt, *Dusts, Wind velocity, solar radiation, Mathematical studies, Mathematical models, Temperature effects, Snowpack.

A basic assessment is presented of both the albedo and other effects of surface dust on snowmelt rates. These effects are illustrated with a particular numerical example from Schefferville. A model is presented which demonstrates the changes in albedo and surface temperature in relation to dust cover. This model leads to realistic order-of-magnitude estimates of the conditions under which snowmelt will be advanced or retarded. Thick dust covers, low solar radiation and high windspeeds retard snowmelt, while thin dust covers, intense solar radiation and low windspeeds increase snowmelt rates. The results agree with an earlier observation that dust covered snow near active mine sites is completely melted some four days before the general snowpack in the area. Other experiments have demonstrated that Mount St. Helens ash retards melt at thickness greater than 10 to 20 mm. (Baker-FRC)
W82-00845

THE DISTRIBUTION OF SEA ICE MELTWATER IN THE EASTERN CANADIAN ARCTIC,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Oceanographic Lab.
F. C. Tan, and P. M. Strain.
Journal of Geophysical Research, Vol 85, No C4, p 1925-1932, April, 1980. 11 Fig, 3 Tab, 24 Ref.

Descriptors: *Isotopic tracers, *Sea ice, Snowmelt, *Arctic zone, Isotope studies, Salinity, *Baffin Bay, *Canada, Melt water.

The feasibility of using oxygen isotope techniques to study the formation of Baffin Bay (eastern Canadian Arctic) bottom water was investigated. Water samples and sea ice cores were collected and analyzed to determine the oxygen isotopic composition. The nature of freezing seawater is such that sea ice contains much less salt than the water from which it was formed but does not have a very different isotopic composition. The distribution of sea ice melt water in the area was determined. Results indicated that the proposal by Sverdrup et al. which suggests that this water mass is a mixture of Labrador Sea deep water and Baffin Bay surface waters may be true. The analysis also gave support to the formation mechanism proposed by Collin and Bailey. Greater than 250-m water in Nares Strait (Smith Sound) had the same isotopic composition as both Baffin Bay deep water and bottom water. The difference in salinity between the Nares Strait water and the bottom water could be due to the addition of brines during ice formation. (Small-FRC)
W82-00966

2D. Evaporation and Transpiration

TRANSPIRATION, STOMATAL CONDUCTANCE, AND PHOTOSYNTHESIS OF TOMATO PLANTS WITH VARIOUS PROPORTIONS OF ROOT SYSTEM SUPPLIED WITH WATER,
Department of Agriculture, Harrow (Ontario).
For primary bibliographic entry see Field 2I.
W82-00504

SEASONAL CHANGES IN LEAF AREA, STOMATAL AND CANOPY CONDUCTANCES AND TRANSPIRATION FROM BRACKEN BELOW A FOREST CANOPY,
Institute of Hydrology, Wallingford (England).
J. Roberts, C. F. Pymar, J. S. Wallace, and R. M. Pitman.
Journal of Applied Ecology, Vol 17, No 2, p 409-422, August, 1980. 5 Fig, 5 Tab, 22 Ref.

Group 2D—Evaporation and Transpiration

Descriptors: *Stomatal transpiration, *Forests, *Canopy, Leaves, Conductance, Pine trees, Trees, Evapotranspiration, Seasonal variation, Water consumption.

The use of water by forests depends both on the major tree species present and on the amount and type of undercover. Therefore, in studying the factors controlling evaporation from a Scots pine forest at Thetford Chase, East Anglia, it was necessary to estimate the contribution from the bracken undergrowth. The development of the bracken canopy beneath the forest was investigated and the values of stomatal and canopy conductances were obtained for use in calculating bracken transpiration. Transpiration from the bracken was calculated using leaf area index and stomatal conductance values and appropriate environmental variables in the Penman-Monteith Equation. Calculated transpiration agreed well with independent values derived by weighing transplanted bracken. The contribution of bracken to the total forest transpiration was over 50% when the soil was driest and the atmospheric humidity deficits were also high. Under normal summer conditions, the bracken underbrush contributed between 20 and 25% of the total forest transpiration. Bracken stomatal conductance appears to be largely insensitive to atmospheric humidity deficits or to soil moisture conditions in forest environments. (Carroll-FRC)
W82-00655

CONSUMPTIVE USE AND DAILY EVAPOTRANSPIRATION OF CORN UNDER DIFFERENT LEVELS OF NITROGEN AND MOISTURE REGIMES,
Andhra Pradesh Agricultural Univ., Hyderabad (India). Dept. of Agronomy.
M. Devender Reddy, I. Krishna Murthy, K. Anand Reddy, and A. Venkatachari.
Plant and Soil, Vol 56, No 1, p 143-147, 1980. 3 Fig, 6 Ref.

Descriptors: *Corn, *Evapotranspiration, *Consumptive use, Water use, Nitrogen, Crop yield, Semiarid lands, Fertilization, Soil water, *India, Soil-water-plant relationships.

Cropping of corn in the semi-arid regions of Andhra Pradesh, India, was investigated by determining corn's seasonal consumptive use, daily evapotranspiration, and water use under different levels of nitrogen and moitsure regimes. Consumptive use difference was less among different nitrogen levels, but was marked between different moisture regimes. Evapotranspiration was less in the initial stages of the growing season, attained a peak at 80% of the growing season, and declined at the end of the season when maturity was reached. As nitrogen levels increased up to 180 kg N/ha, water use efficiency increased. There was a close relationship between the continuous availability of soil moisture and the response of corn to fertilizer application. If soil moisture becomes a limiting factor, the addition of fertilizer at this time might adversely affect the yield. Among moisture regimes, higher water use efficiency was found under 20% available soil moisture depletion. (Small-FRC)
W82-00660

THE INFLUENCE OF PLANT COMMUNITIES UPON THE HYDROLOGY OF CATCHMENTS,
Flinders Univ. of South Australia, Bedford Park. School of Earth Sciences.
J. W. Holmes, and E. B. Wronski.
Agricultural Water Management, Vol 4, No 1-3, p 19-34, 1981. 2 Fig, 8 Tab, 27 Ref.

Descriptors: *Catchment areas, *Vegetation effects, *Evapotranspiration, *Forest watersheds, Evaporation rate, Leaves, Runoff, Groundwater recharge, Hydrology, *Australia.

The effect of land use on the water yield from catchments is reviewed, with emphasis on forested land. In general, less runoff occurs on forested catchments because the evapotranspiration from them is larger than from catchments not in forest. Rainwater held upon wet foliage evaporates faster than the transpiration rate would be if the leaves were dry. Interception loss may account for the observed yields from forested catchments, up to 200 mm/yr less than, for example, grassland. The interception store can be 2 mm. Also, deep-rooted perennial plants created a soil-water deficit that is probably larger than that caused by annual pastures or cereal crops. The data available indicate that it is probable that a soil-water deficit of 250 mm each year could be created by an evergreen forest and 180 mm each year by annuals. This is valid for the climatic regions of southern Australia, where rainfall is 700 mm/year or more. This implies a yield of 70 mm/year less from forested land in runoff or recharge of groundwater. Thus, a forested area will experience enhanced evaporation of rainwater on leaves, and this may eventually cause hydrologic changes. (Small-FRC)
W82-00931

LEAF AND ENVIRONMENTAL PARAMETERS INFLUENCING TRANSPIRATION: THEORY AND FIELD MEASUREMENTS,
Wyoming Univ., Laramie. Dept. of Botany.
W. K. Smith, and G. N. Geller.
Oecologia, Vol 46, No 3, p 308-313, September, 1980. 3 Fig, 1 Tab, 21 Ref.

Descriptors: *Desert plants, *Leaves, *Transpiration, Xerophytes, Stomatal transpiration, Soil-water-plant relationships.

This paper investigated the influence of changes in leaf size or wind on transpiration at a given stomatal resistance for various combinations of air temperature and absorbed solar energy. Predicted transpiration either increased or decreased for increases in leaf size depending on the specific combinations of the above factors. Major reductions in simulated transpiration with increasing leaf size occurred for shaded, highly reflective, or specially oriented leaves (fraction of full sunlight, 0.1) at relatively high air temperatures when stomatal resistance was below 500 s per m. Increases in fraction of sunlight (to 0.7) and decreases in air temperature (to 20 C) lowered this critical resistance to below 50 s per m. When stomatal resistance was above this critical value of 500 s per m, transpiration increased with larger leaves and less wind. The theoretical results were compared to field measurements on some desert plants. (Cassar-FRC)
W82-00979

SOIL MOISTURE RELATIONS IN THE SOUTHERN CALIFORNIA CHAPARRAL,
San Diego State Univ., CA. Dept. of Biology.
E. Ng, and P. C. Miller.
Ecology, Vol 61, No 1, p 98-107, 1980. 6 Fig, 3 Tab, 53 Ref.

Descriptors: *Soil moisture, *Chaparral, *California, Drought, Moisture availability, Transpiration, Vegetation regrowth, *Soil-water-plant relationships.

Soil moisture balance and vegetation studies were conducted on two chaparral-covered slopes in southern California. Vegetation on the north-facing slope was dominated by Ceanothus greggii, and on the south-facing slope by Adenostoma fasciculatum. Vegetation cover on the north-facing slope was greater than on the south-facing slope. Throughout the year, soil moisture at 0.3-1.0 m depths was greater on the south-facing slope than on the north-facing slope. Soil texture on the two slopes did not differ significantly. Precipitation on the two slopes was the same, averaging 30 cm/year, below the usual level for this area. Subsurface drainage was greater on the south-facing slope and peaked in January, close to the time of maximum precipitation. Evaporation was greater on the south-facing slope, but transpiration was greater on the north-facing slope. The greater vegetation cover and drier soils on the north-facing slope are probably related to the drought-resistant nature of vegetation in this mediterranean climate. The greater transpiration on the north-facing slope is probably due to the ability of the plants on this slope to draw water from deeper soil layers and to maintain open stomata at lower water potentials. (Baker-FRC)
W82-01035

RATIO BETWEEN EVAPOTRANSPIRATION OF IRRIGATED CROPS FROM FLOATING LYSIMETERS AND CLASS A PAN EVAPORATION,
Department of Agriculture, Harrow (Ontario). Research Station.
C. S. Tan, and J. M. Fulton.
Canadian Journal of Plant Science, Vol 60, No 1, p 197-201, January, 1980. 3 Fig, 8 Ref.

Descriptors: *Evapotranspiration, *Vegetation effects, Evapotranspiration potential, Lysimeters, Evaporation rate, Evaporation pans, Evaporimeters, Water loss, Potatoes, Corn, Tomatoes, *Irrigation, *Vegetable crops, *Ontario, Canada.

This paper provides the crop coefficient of early potatoes, corn and processing tomatoes using evapotranspiration data on irrigated crops collected from floating lysimeters and potential crop evapotranspiration obtained from Class A pan at Harrow for the growing season of 1963 through 1972. The crop coefficient is the ratio of crop evapotranspiration to potential or maximum evapotranspiration. The value of the crop coefficient depends on the percentage of foliage cover on the soil, increasing from emergence to about 50-80% of foliage cover, remaining at a maximum value for about 2-5 weeks, and thereafter decreasing during the late season stage until the crops approach maturity. The low value of the crop coefficient at the initial stage of crop development may be attributable to the evaporation rate from bare soil. The soil evaporation can be affected by irrigation and rainfall frequency. As the soil surface water dries out, though the root zone water is ample, the value of the crop coefficient will remain at a low value. This is because the capillary flow from the root zone of the soil body to the soil surface limits the rate of evaporation. As the percentage of foliage cover continues to increase, the evaporation from soil becomes less important and remains relatively constant. (Baker-FRC)
W82-01050

2E. Streamflow and Runoff

A LEAKY RESERVOIR MODEL FOR EPHEMERAL FLOW RECESSION,
Office of Surface Mining Reclamation and Enforcement (DI), Washington, DC.
R. W. Peebles, R. E. Smith, and S. J. Yakowitz.
Water Resources Research, Vol 17, No 3, p 628-636, June, 1981. 9 Fig, 1 Tab, 12 Ref.

Descriptors: *Ephemeral streams, *Recession, *Streamflow forecasting, Reservoirs, Storage, Flood flow, Flood peak, *Model studies, Hydrographs, Infiltration, Reservoir leakage, *Streamflow depletion.

A leaky reservoir model is proposed to represent streamflow recession in an ephemeral stream. The model is described by a continuity equation, a discharge-stage relation (stream rating), and a stage-storage relation (reservoir configuration). The infiltration loss in the stream channel is analogous to leaking in the bottom of a reservoir. No input is routed through the reservoir: at the onset of the recession the reservoir has water in storage. By calibrating reservoir leakage rate and initial storage (reservoir shape) a good fit to observed curves is obtained. The most critical parameter is reservoir shape; recession curves do not change much with changing reservoir loss rate. (Cassar-FRC)
W82-00600

MULTIVARIATE HYDROLOGIC TIME SERIES ANALYSIS,
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W82-00647

EFFECTS OF RECENT INCREASES IN RAINFALL ON FLOODS AND RUNOFF IN THE UPPER HUNTER VALLEY,

New South Wales Univ., Kensington (Australia). School of Geography.
F. C. Bell, and W. D. Erskine.
Search, Vol 12, No 3/4, p 82-83, March/April, 1981. 2 Fig, 1 Tab, 8 Ref.

Descriptors: *Runoff, *Flood frequency, Channel improvement, *Rainfall-runoff relationships, *Hunter Valley, *Australia, Streamflow, Water resources development.

Recent large and significant changes in flood frequencies and annual runoff were observed since 1946 in the Hunter Valley, Australia. Results of analysis of rainfall and runoff records since 1898 suggest that the cause is the increased rainfall and lower frequency of dry years after 1946, not catchment modifications or disturbance. Before 1946, channel and catchment modifications probably caused decreases in runoff and runoff variability during dry years and increases during wet years. After 1946 there was no effect from modification activities. (Cassar-FRC)
W82-00668

EFFECTS OF TROPICAL CYCLONE WALLY IN SOUTHEAST VITI LEVU, FIJI, EASTER 1980,
Victoria Univ., Wellington (New Zealand).
For primary bibliographic entry see Field 2A.
W82-00670

FLOODS IN KANSAS CITY, MISSOURI AND KANSAS, SEPTEMBER 12-13,
Geological Survey, Rolla, Mo. Water Resources Div.
L. D. Hauth, W. J. Carswell, Jr., and E. H. Chin.
Branch of Dist., USGS 604 South Pickett St. Alexandria, Va. 22304. Price $3.50. Geological Survey Professional Paper 1169, 1981. 47 p, 39 Fig, 4 Tab, 21 Ref.

Descriptors: *Floods, *Flood data, *Flood damage, *Flood peak, *Flood profiles, Gaging stations, Flood flow, Streamflow, Rainfall-runoff relationships, Flood frequency, Hydrologic data, Flood hydrographs, *Missouri, *Kansas, *Kansas City.

The storms of Sept. 12-13, 1977, delivered as much as 16 in. of rain, with average rainfall exceeding 10 in. in the Kansas City metropolitan area. Twenty-five lives were lost, many were left homeless, and damages exceeded $80 million. Data obtained by the National Weather Service and the U.S. Geological Survey indicate that two record-setting rainstorms occurred within 24 hours. The first storm, in the early morning, thoroughly soaked the local drainage basins. The second storm, centered along the Brush and Round Grove Creek basins, resulted in a devastating flash flood. Peak discharges were determined during and after this major flood at gaging stations and selected miscellaneous locations. Streamflows and flood volumes in many locations far exceeded estimated values for the 100-year flood. (USGS)
W82-00724

TEMPERATURE AND SOLUTE-TRANSPORT SIMULATION IN STREAMFLOW USING A LAGRANGIAN REFERENCE FRAME,
Geological Survey, NSTL Station, MS. Water Resources Div.
H. E. Jobson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-225757, Price codes: A09 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-2, 1980. 165 p, 21 Fig, 2 Tab, 24 Ref.

Descriptors: *Computer models, *Temperature, *Solute transport, *Streamflow, Path of pollutants, Tracking techniques, Traveltime, Rivers, Flow, Unsteady flow, Open channels, Numerical analysis, Mathematical models, Prediction, Computer programs.

A computer program for simulating one-dimensional, unsteady temperature and solute transport in a river has been developed and documented for general use. The solution approach to the convective-diffusion equation uses a moving reference frame (Lagrangian) which greatly simplifies the mathematics of the solution procedure and dramatically reduces errors caused by numerical dispersion. The model documentation is presented as a series of four programs of increasing complexity. The conservative transport model can be used to route a single conservative substance. The simplified temperature model is used to predict water temperature in rivers when only temperature and windspeed data are available. The complete temperature model is highly accurate but requires rather complete meteorological data. Finally, the 10-parameter model can be used to route as many as 10 interacting constituents through a river reach. (USGS)
W82-00726

THE ROLE OF SUBSTRATUM IN BENTHIC MACROINVERTEBRATE MICRODISTRIBUTION AND LITTER DECOMPOSITION IN A WOODLAND STREAM,
North Carolina Univ. at Chapel Hill. Dept. of Zoology.
S. R. Reice.
Ecology, Vol 61, No 3, p 580-590, 1980. 4 Fig, 5 Tab, 38 Ref.

Descriptors: *Ecosystems, *Streams, Litter, Organic matter, *Leaves, *Decomposition, Decomposing organic matter, Detritus, *Macroinvertebrates, Spatial distribution, *Substrates, New Hope Creek, Orange County, *North Carolina, Forest watersheds.

The contribution of substratum per se on decomposition of leaf litter and microdistribution of benthic invertebrates in streams were investigated. The study was conducted in winter 1975-76 in New Hope Creek, Orange County, North Carolina. The site was Duke Forest, which affords a protected habitat. The substratum was relatively uniform, consisting of cobbles with a few boulders, some sand, and gravel. Overall litter decomposition did not vary among substrata. The fraction of animal populations in leaf packs was proportional to the biomass remaining. Animals showed substratum preferences even when velocity differences were eliminated. Preferences of common taxa were unaffected by the presence or absence of leaf packs on the substratum. Common taxa showed strong preferences for either leaves or substrata. Abundance data strongly contradict the density data. The latter measure offers more biological insight. These results emphasize the importance of substratum size as a prime determinant of the structure of lotic macroinvertebrate communities. (Baker-FRC)
W82-01037

FLOW ANALYSIS OF MODELS OF THE HUBBARD BROOK ECOSYSTEM,
Massachusetts Univ., Amherst. Dept. of Forestry and Wildlife Management.
For primary bibliographic entry see Field 1A.
W82-01038

2F. Groundwater

HYDROGEOLOGICAL AND GEOPHYSICAL LOGGING.
Wuidart Engineering Ltd., Shefford Beds (England).
For primary bibliographic entry see Field 7B.
W82-00511

THE USE OF NA/CL RATIOS TO TRACE SOLUTE SOURCES IN A SEMIARID ZONE,
Weizmann Inst. of Science, Rehovot (Israel). Isotope Dept.
For primary bibliographic entry see Field 7B.
W82-00601

A MATHEMATICAL MODEL FOR CONSOLIDATION IN A THERMOELASTIC AQUIFER DUE TO HOT WATER INJECTION OR PUMPING,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
J. Bear, and M. Y. Corapcioglu.
Water Resources Research, Vol 17, No 3, p 723-736, June, 1981. 1 Fig, 30 Ref.

Descriptors: *Subsidence, *Geothermal studies, Aquifer management, *Mathematical models, Model studies, *Thermal water, *Injection wells, Wells, Pore pressure, Energy, Storage.

This paper develops a mathematical model to estimate fluid pressure, temperature, land subsidence and horizontal displacement produced by hot water injection into thermoelastic confined and leaky aquifers (for energy storage), pumping from a geothermal field, or flooding a warm aquifer with cold water. Assuming that the aquifer is thin relative to the horizontal distances involved, the dependent variables are average (over the aquifer thickness) values. The solid matrix is assumed to be thermoelastic. After development of three-dimensional conservation of mass and energy equations and equilibrium equations in terms of horizontal and vertical displacements, the model is derived by averaging the three-dimensional model over the vertical thickness of the aquifer, subject to conditions of plane total stress. The resulting averaged coupled equations are stated in terms of pore water pressure, temperature, and vertical and horizontal displacement. An example of a single pumping/injection well is given as an illustration. (Cassar-FRC)
W82-00602

DETERMINATION OF HYDROGEOLOGICAL PARAMETERS USING SINUSOIDAL PRESSURE TESTS: A THEORETICAL APPRAISAL,
Institute of Geological Sciences, Harwell (England). Environmental Protection Unit.
For primary bibliographic entry see Field 7B.
W82-00603

A NON-EQUILIBRIUM THERMODYNAMICS APPROACH TO TRANSPORT PHENOMENA IN CAPILLARY POROUS MEDIA,
Universidade Federal de Vicosa (Brazil).
M. Fortes, and M. R. Okos.
Transactions of the ASAE, Vol 24, No 3, p 756-760, May/June, 1981. 41 Ref.

Descriptors: Porosity, Thermodynamics, *Model studies, *Groundwater movement, Mathematical studies, Capillary water, *Porous media, Soil water, Capillary coductivity.

The objective of this work is to present a set of transport equations which incorporates most of the existing models by combining the mechanistic and irreversible thermodynamics approaches to heat and mass transfer in porous media. A comparison between the non-equilibrium thermodynamics equations and those obtained from a mechanistic reasoning leads to the evaluation of the phenomenological coefficients. DuFour and Soret's coefficients are obtained from Onsager's relationships. The model describes transport phenomena in capillary-porous media. It is shown based on the local equilibrium principle, that the isothermal driving force for both liquid and vapor transfer in a porous medium is the gradient of equilibrium moisture content. Thus, it is postulated that water, in a capillary-porous medium, can move in opposition to a moisture content gradient, but always in the direction of the equilibrium moisture content gradient. (Baker-FRC)
W82-00697

HYDROGEOCHEMISTRY AND SIMULATED SOLUTE TRANSPORT, PICEANCE BASIN, NORTHWESTERN COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W82-00723

POTENTIOMETRIC-SURFACE MAP FOR THE CRETACEOUS AQUIFER, VIRGINIA COASTAL PLAIN, 1978,

Geological Survey, Richmond, VA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-00727

POTENTIOMETRIC SURFACE OF THE WILCOX-CARRIZO AQUIFER; BIENVILLE, RED RIVER, NORTHERN NATCHITOCHES, AND SOUTHERN WEBSTER PARISHES, LOUISANA,
Geological Survey, Alexandria, LA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-00728

GENERALIZED THICKNESS OF THE FLORIDAN AQUIFER, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-00729

APPROXIMATE GROUND-WATER-LEVEL CONTOURS, APRIL 1981, FOR THE SOQUEL-APTOS AREA, SANTA CRUZ COUNTY, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-00734

RESISTIVITY STUDY OF A COASTAL KARST TERRAIN, FLORIDA,
Geological Survey, Tampa, FL.
J. D. Fretwell, and M. T. Stewart.
Ground Water, Vol 19, No 2, p 156-162, March/April, 1981. 6 Fig, 1 Tab, 24 Ref.

Descriptors: *Resistivity, *Saline-freshwater interfaces, *Coastal aquifers, Aquifer properties, Geohydrology, Electrical properties, *Karst hydrology, *Florida, Saline water intrusion.

Results from the resistivity method for locating a fresh-salt water interface agreed with known hydrologic data. The study site was the west-central Gulf coast area of Florida, where 28 vertical electrical soundings were done. Four geoelectric layers were revealed: surficial sands; a karstic, highly transmissive carbonate; a less porous carbonate; and a saline carbonate layer with resistivity of less than 1 ohm-meter. The depth of the fresh-salt water interface decreased toward the coast. (Cassar-FRC)
W82-00817

NUMERICAL SIMULATION OF POTENTIOMETRIC SURFACE CHANGES CAUSED BY A PROPOSED OPEN-PIT ANTHRACITE MINE,
Stone and Webster Engineering Corp., Cherry Hill, NJ.
For primary bibliographic entry see Field 6A.
W82-00819

THE DEVELOPMENT OF METHODS FOR DETERMINING AQUIFER CHARACTERISTICS,
Ohio State Univ., Columbus.
R. Broadhead.
Ground Water, Vol 19, No 2, p 230-232, March/April, 1981. 1 Fig, 33 Ref.

Descriptors: *Aquifer characteristics, *Mathematical studies, *Storage coefficient, *Transmissivity, Aquifers, Groundwater reservoirs, Groundwater availability.

Recent effects in refining mathematical techniques to describe aquifer characteristics are summarized. Ground water hydrologists are primarily concerned with the storage coefficient (S) and the coefficient of transmissivity (T). The latest advance is the work by Rushton, presented in 1978. A mathematical model was developed to estimate transmissivity and the storage coefficient from pumped well data only. In 1971 Nawrocki experimentally compared four methods of determining T and S. No method was found to yield consistently higher or lower results than the others. The sensitivity of the various equations to the accuracy of the data input had not been determined. The major factor limiting the accuracy of aquifer coefficients is the inhomogeneity of real aquifers. In the future, a good appreciation for the inherent variations in the coefficients should be combined with an awareness of the final use intended for the coefficients. (Small-FRC)
W82-00827

PREDICTIVE DEPOSITIONAL MODEL FOR GLACIAL AQUIFERS,
University of South Florida, Tampa. Dept. of Geology.
M. T. Stewart.
Ground Water, Vol 19, No 2, p 133-137, March/April, 1981. 10 Fig, 1 Tab, 7 Ref.

Descriptors: *Groundwater mining, *Mathematical models, *Glacial aquifers, Aquifers, Glaciers, Bedrock, *Wisconsin, Groundwater potential.

This study defined zones within valley fill in northeastern Wisconsin that have a high probability of containing high-yield drift aquifers. A depositional model was developed to aid in the location of high-yield drift aquifers. The yield and spatial distribution of glacial aquifers were controlled by bedrock topography and glacial geology. Driller's logs were used to obtain lithologic control for identification and classification of aquifer units. This information was combined with seismic refraction and gravity survey data to derive the bedrock elevation map. Bedrock topography strongly influenced the distribution and character of glacial units and clearly delineated two glacial aquifer types: valley and morainal units. Valley aquifers are the most productive. Using statistical analysis, a model was developed which allows the knowledge of bedrock topography to be coupled with glacial geology to predict the spatial distribution of glacial aquifers. (Small-FRC)
W82-00828

THE RELATIONSHIP BETWEEN FRACTURE TRACES AND JOINTS IN A TERTIARY BASIN, SOUTHWEST MONTANA,
Indiana Univ. at Bloomington. Dept. of Geology.
For primary bibliographic entry see Field 7B.
W82-00829

WASTE HEAT BALANCE IN AQUIFERS CALCULATED BY A COMPUTER PROGRAMME,
Geologisches Landesamt Nordrheim-Westfalen, Krefeld (Germany, F.R.).
For primary bibliographic entry see Field 7B.
W82-00830

HYDROGEOLOGY OF THE SIERRA NEVADA FOOTHILL LINEAMENT NEAR OAKHURST, CALIFORNIA,
California State Univ., Fresno. Dept. of Geology.
S. Mack, and K. D. Schmidt.
Ground Water, Vol 19, No 2, p 149-155, March/April, 1981. 5 Fig, 2 Tab, 11 Ref.

Descriptors: *Geologic history, *Groundwater, *Chlorides, Connate water, Granites, *Sierra Nevada, California, *Geohydrology.

The influence of hydrogeologic factors on the distribution of high chloride ground water is discussed for the Sierra Nevada Foothill lineament near Oakhurst, California. This northwest trending lineament extends for 60 miles along the western Sierra Nevada foothills of Fresno and Madera Counties and includes 33 wells and two springs. The high-chloride water was probably influenced by connate waters derived from the compaction of Paleozoic and early Mesozoic marine clastic rocks in the Sierra Nevada. If granitic plutons in the area are presumed to be fairly thin mushroom-like complexes emplaced in the upper crust, hydrologeologic relations are explained. Marine connate water migration upward more or less vertically from a fault zone beneath a capping of granitic rock defined the lineament. Excellent correlation was found in the Oakhurst Basin between air-photo linear features and wells yielding high-chloride water. The persistence of the high-chloride water may be due to the high density of the connate water and the lack of deep circulation of meteoric water beneath topographically low areas. (Small-FRC)
W82-00831

THE DECLINING GROUND-WATER RESOURCES OF ALLUVIAL VALLEYS: A CASE STUDY,
Geological Survey, Lawrence, KS.
For primary bibliographic entry see Field 4B.
W82-00832

A COMBINATION OF ELECTRICAL RESISTIVITY, SEISMIC REFRACTION, AND GRAVITY MEASUREMENTS FOR GROUNDWATER EXPLORATION IN SUDAN,
Groundwater Survey TNO, Delft (Netherlands).
R. A. van Overmeeren.
Geophysics, Vol 46, No 9, p 1304-1313, September, 1981. 10 Fig, 10 Ref.

Descriptors: Water resources development, *Geophysics, *Groundwater potential, Seismology, Gravity studies, Resistivity, Bedrock, Salinity, Exploration, *Geohydrology, *Sudan.

An integrated application of several geophysical exploration methods provided hydrogeologic information during groundwater exploration in the Sudan. Electrical resistivity, seismic refraction, and gravity methods were used to study prospects for additional supply of groundwater. Multilayer electrical sounding curves were already available and an additional 16 vertical electrical soundings were made. Seismic refraction work was carried out at selected locations to yield additional information on depths to bedrock. Using seismic data, a unique solution was found for the electrical souding curves, from which it was concluded that groundwater in the area was saline. Drilling tests confirmed these findings. A regional relative Bouguer anomaly map gave a picture of the general geologic structures and estimated depths to bedrock. In areas such as this where the basement rocks are close to the surface, gravity anomalies cannot be corrected with bedrock relief because of the strong influence of lateral density variations within the bedrock. Reliable data on depth to bedrock and formation resistivities could not have been obtained using only one of the techniques. (Small-FRC)
W82-00852

A METHOD FOR ESTIMATING RECHARGE AND BOUNDARY FLUX FROM GROUNDWATER LEVEL OBSERVATIONS,
Institute of Hydrology, Wallingford (England).
P. J. Smith, and R. S. Wikramaratna.
Hydrological Sciences Bulletin, Vol 26, No 2, p 113-136, June, 1981. 11 Fig, 2 Tab, 16 Ref.

Descriptors: *Groundwater recharge, *Transmissivity, *Water level, Fluctuations, Mathematical studies, Estimating equations, Groundwater management, Semiarid lands.

A new method is proposed for the estimation of recharge and boundary flux based on water level and transmissivity observations. It is particularly useful in semiarid regions where a steady state formulation can be used and recharge is confined to certain known areas. When this inferred recharge method is applied to a typical problem, it is an improvement over the implied recharge method. The variances for inferred recharge are satisfactory estimates of those obtained in simulations. Even when these variance estimates are large, alternative hypotheses can be tested about the mechanism of recharge using statistical significance tests. An error in the transmissivity distribution has less effect than an error of the same proportion in the water level observations, which means that this method can be useful in the early stages of modelling studies when only crude assessments have been made. These early results can aid

in the design of a field data collection program. (Small-FRC)
W82-00985

WELL-FIELD DRAWDOWNS USING COUPLED AQUIFER MODEL,
Law Engineering Testing Co., Tampa, FL.
L. H. Motz.
Ground Water, Vol 19, No 2, p 172-179, March/April, 1981. 10 Fig, 6 Ref.

Descriptors: *Drawdown, *Aquifers, *Wells, Model studies, Groundwater movement, Water table aquifers, Pumping tests, Evapotranspiration, Jay B Starkey Wilderness Park, *Florida.

A coupled aquifer model (Motz, 1978) was used to investigate well field drawdowns in the Jay B. Starkey Wilderness Park, Pasco County, Florida. In this model, water pumped from an underlying artesian aquifer originates from leakage through an overlying semipermeable confining bed. The source of this leakage is assumed to be a reduction in evapotranspiration from the overlying water table aquifer. The hydrologic coefficients in the coupled aquifer model were calibrated from observed pumping and water table data; water table and artesian aquifer drawdowns were estimated for different pumping rates. A coefficient of 0.00112 gpd per cu ft was obtained by matching calculated water table drawdowns to observed water table drawdowns caused by five production wells in the park. Five alternative plans for further well development were explored. The best plan recommended that the central and eastern parts of the park be developed. (Cassar-FRC)
W82-00990

DISSOLUTION OF SALT DEPOSITS BY BRINE DENSITY FLOW,
New Mexico Univ., Albuquerque. Dept. of Geology.
R. Y. Anderson, and D. W. Kirkland.
Geology, Vol 8, No 2, p 66-69, February, 1980. 4 Fig, 12 Ref.

Descriptors: *Salts, *Radioactive waste disposal, *Model studies, Waste disposal, Radioactive wastes, Flow, Flow system, Brines, Water pollution sources.

A brine density flow model is applied to the dissolution of evaporites, which has implications for the use of evaporite deposits for the storage of radioactive waste. A model simulating brine flow was constructed in which a source (aquifer) was connected to an overlying chamber containing salt by a capillary tube 0.54 m long and 0.0015 m in diameter. Water was driven through the tube by brine density difference alone and removed salt from the overlying chamber at a rate of about 1 gm/min. Continuous two way flow developed. Dissolution by means of brine flow within the Delaware Basin in western Texas is discussed, and it is suggested that similar processes may operate in other evaporite basins. Fracture systems that provide communication between pressurized and flowing fresh water aquifers and salt bodies have the potential for developing brine flow and a dissolution system. This can lead, as it has in the Delaware Basin, to collapse breccias. The potential for deep-seated dissolution by means of brine flow should be added to factors considered in risk assessment programs when considering waste depositories in evaporites. (Small-FRC)
W82-01016

2G. Water In Soils

MICROBIAL MOBILIZATION OF CALCIUM AND MAGNESIUM IN WATERLOGGED SOILS,
National Aeronautics and Space Administration, Moffett Field, CA. Ames Research Center.
M. P. Silverman, and E. F. Munoz.
Journal of Environmental Quality, Vol 9, No 1, p 9-12, January-March, 1980. 2 Fig, 3 Tab, 18 Ref.

Descriptors: *Soil water, *Calcium, *Magnesium, *Bacteria, Metabolism, Microbiological studies, Anaerobic conditions, Aerobic conditions, Biodegradation, Soil chemistry.

Direct measurements were made of changes in the concentrations of Ca and Mg in soil solutions as a consequence of microbial glucose metabolism and of the rates of Ca and Mg mobilization as affected by the presence or absence of atmospheric 02. Twelve California soils were amended with 0.5% glucose solution and incubated in air and anaerobically for two weeks under waterlogged conditions. In soil solutions incubated in air, there was a decrease of 1 to 2 units in the pH relative to control soils incubated without glucose. There was also a 2.4- to 29.4-fold increase in the Ca content and a 0.7- to 41-fold increase in the Mg content. Under anaerobic incubation a similar decrease in pH was determined, as well as 2.7- to 15.3-fold increases in Ca and 1.5- to 47-fold increases in Mg. Under incubation in air, the amounts of Ca and Mg increased for 3 to 10 days and then decreased. Under anaerobic conditions, concentrations reached maximum values in 7 to 10 days and did decrease later. Microbial production of various organic metabolites from glucose may be responsible for the release of Ca and Mg from exchange sites. In air, these metabolic products become susceptible to biodegradation, but they are relatively stable under anaerobic incubation. (Small-FRC)
W82-00560

EFFECT OF LEACHATE FLOW RATE ON METAL MIGRATION THROUGH SOIL,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
For primary bibliographic entry see Field 5E.
W82-00565

A MATHEMATICAL MODEL FOR PREDICTING MOISTURE FLOW IN AN UNSATURATED SOIL UNDER HYDRAULIC AND TEMPERATURE GRADIENTS,
Saskatchewan Univ., Saskatoon. Dept. of Civil Engineering.
V. Dakshanamurthy, and D. G. Fredlund.
Water Resources Research, Vol 17, No 3, p 714-722, June, 1981. 9 Fig, 2 Tab, 24 Ref.

Descriptors: *Unsaturated flow, *Soil properties, *Pore pressure, Pore water, Soil gases, Soil water, Model studies, Mathematical models, Soil water movement.

A model is developed to predict the moisture flow in an unsaturated soil as a result of hydraulic and temperature gradients. Three partial differential equations (heat flow at above-freezing conditions, water phase and air phase) are solved simultaneously for changes in the combined thermal and hydraulic boundary conditions. Darcy's law is used to describe the flow in the water phase; Fick's law for the air phase; and Fredlund and Morgenstern's constitutive equations for the volume change of an unsaturated soil. Solving the equations produces the temperature, pore water pressure, and pore air pressure distribution with space and time in an unsaturated soil. From these values the quantity of moisture flow may be calculated. Four example problems involve prediction of the moisture flow in an unsaturated subgrade soil such as that below a highway or airfield. The information may also be used to study the dissipation of pore pressures in the compacted core material of an earthfill dam. (Cassar-FRC)
W82-00605

THE EFFECTS OF SODIUM AND ORGANIC MATTER IN SEWAGE EFFLUENT ON WATER RETENTION PROPERTIES OF SOILS,
The Hebrew Univ., Rehovot (Israel). Dept. of Soil and Water Science.
For primary bibliographic entry see Field 3C.
W82-00663

ESTIMATION OF SOIL-MOISTURE CHARACTERISTICS FROM MECHANICAL PROPERTIES OF SOILS,
Bidhan Chandra Krishi Viswa Vidyalaya, Kalyani (India). Dept. of Agricultural Engineering.
R. K. Ghosh.
Soil Science, Vol 130, No 2, p 60-63, August, 1980. 1 Fig, 2 Tab, 13 Ref.

Descriptors: *Soil water, *Estimating equations, *Soil properties, Mathematical studies, Soil water potential, Soil science.

An empirical technique was developed to estimate soil-moisture characteristics. Soil-moisture characteristics can be determined directly from soil physical properties and a single measurement of water potential in bars at some moisture content on a volume basis. The procedure is particularly useful when a reliable soil moisture characteristic curve is not available. Usually, the physical properties of soils can be obtained from published records of routine work for any geographical location. The method is applicable for those soils for which the water potential minus the moisture content can be expressed as the water potential equals the air-entry water potential in bars times the moisture content over the saturated water content after this fraction is raised to the power of a constant. Considerable agreement was found between estimated values using this procedure and experimentally determined values. (Small-FRC)
W82-00785

EFFECTS OF JOULE HEATING ON THERMOCOUPLE PSYCHROMETER WATER POTENTIAL DETERMINATIONS,
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 7B.
W82-00892

SUBSURFACE DRAINAGE AND SEDIMENT TRANSPORT MODEL,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
A. B. Bottcher, E. J. Monke, and L. F. Huggins.
Transactions of the ASAE, Vol 23, No 4, p 870-876, July/August, 1980. 5 Fig, 15 Ref.

Descriptors: *Sediment transport, *Mathematical models, *Subsurface drainage, Drainage, Sediments, Mathematical equations, Computer models, Simulation, Groundwater movement, Flow characteristics.

Since root zone drainage is the main incentive for subsurface drainage, most research in this area has concentrated on water movement; however, the waters involved can carry substantial amounts of sediments and nutrients. A computer model was developed which uses the GASP IV simulation language to simulate water flow and sediment movement from a subsurface drainage system and to predict these activities as a function of time for both single and multistorm events. The flow portion of the model uses a one-dimensional form of the Richard's equation and a steady state tile flow formula by Toksoz and Kirtham (1961). The output of the flow portion of the model directly controls the particle detachment portion of the model, which is based on a force balance relationship. The sediment flush observed at the beginning of some flow events is adequately described by an exponential decay function. Data collected from a 17 hectare drainage system on a Hoytville silty clay soil were used for calibration and directly proportional to drain flow, while drain flow and rainfall were continuously recorded. Moisture deficit replenishment coefficients, deep seepage, and saturated hydraulic conductivity were calibrated. The model was verified through simulation of the most active flow period of the two years during which data were collected. Comparison of the model results with observed data indicated that the model can reliably predict water yield, sediment yield, and the sediment concentration curve. There was, however, some difficulty in simulating the actual shape of the flow hydrograph. This model should facilitate planning for compliance with section 208 of the Federal Clean Water Act and provide a base for more complex nutrient and pesticide transport models. (Carroll-FRC)
W82-00894

RESIDENCE TIMES OF WATER AND SOLUTES WITHIN AND BELOW THE ROOT ZONE,
Institute of Soil Fertility, Groningen (Netherlands).
P. A. C. Raats.
Agricultural Water Management, Vol 4, No, 1-3, p 63-82, 1981. 9 Fig, 43 Ref.

Descriptors: *Estimating equations, *Soil water, *Solute transport, Mathematical studies, Solutes, Salinity, *Root zone, Water quality, Agriculture, *Netherlands.

An approach is presented to the analysis of simultaneous transport of water and solutes within the root zone and in the region between the water table and drains, ditches, or streams. Equations are presented which indicate that within the root zone the travel speed of the water or solute depends primarily on the components of the overall water balance, the average water content, and the distribution of the water uptake. Recent attempts to infer water uptake from salinity data are discussed, as are transport to drains, ditches, or streams induced by an input distributed uniformly over the soil surface. If the ratio of the half-spacing between ditches, drains, or streams and the depth to the impermeable layer is larger than about five, the following are true: The isotherms are horizontal except close to the outlets, and the transit time density distribution is approximately exponential. Estimates are presented for the retardation due to adsorption, for the influence of reactions, and for the influence of dispersion. (Small-FRC)
W82-00932

MODELING WATER FLUX ON STRIP-MINED LAND,
Science and Education Administration, Northeast Watershed Research Center, University Park, PA.
A. S. Rogowski, and B. E. Weinrich.
Transactions of the ASAE, Vol 24, No 4, p 935-940, July/August, 1981. 6 Fig, 4 Tab, 17 Ref.

Descriptors: *Model studies, *Flow measurement, *Soil water, Fluid flow, Flow pattern, Flow profiles, Spoil banks, Mine wastes, Strip mine wastes, Strip mines, Appalachia, *Land reclamation.

An attempt was made to model numerically the infiltration and redistribution of water in reclaimed topsoiled and nontopsoiled Appalachian minesoils. In these minesoils, large size fractions predominate. It was determined that infiltration and redistribution of applied water on topsoiled spoil profiles could be adequately modeled with numerical techniques using either experimentally determined values or moisture characteristics corrected for coarse fragment content and hydraulic conductivities derived from seepage flux. On nontopsoiled profiles, numerical techniques appear inadequate, and a better fit to experimental data can be obtained by subtracting from the flux the amount of water retained by the fine particles and the amount retained on the surface of coarse fragments and then considering the flux to be a function of gravity alone. However, even this approach is not completely satisfactory. At times, when the profile is reasonably dry, water seems to move rapidly through larger channels in the coarse spoil materials without appreciably wetting the rest of the profile. (Baker-FRC)
W82-00944

DRYLAND MANAGEMENT FOR SALINITY CONTROL,
J. Van Schilfgaarde.
Agricultural Water Management, Vol 4, No 1/3, p 383-391, 1981. 18 Ref.

Descriptors: *Salinity, *Water quality management, Water quality, Water resources development, Evapotranspiration, Salt balance, Salts, Farming, *Cropland, Vegetation, Reforestation, Recharge basins, *Great Plains.

Management of salinity in dryland areas may be approached through the maintenance or enhancement in situ of agricultural production, or it may be approached through increasing the yield of good quality water. In the Northern Great Plains of North America, the primary concern is the loss of agricultural production, and solutions to this are sought through the prevention of new and the reclamation of existing salt seeps. This can be accomplished at the recharge site by changing the water balance, or dealt with downstream. In the Red River Valley of North Dakota a different problem exists in that some 160,000 ha of agricultural lands have saline water tables near the surface. In the Lower Rio Grande Valley of Texas, some 40,000 ha of cultivated, nonirrigated soils have salinity problems. The problem facing Western Australia is similar to that of the Northern Great Plains. Excess water percolation due to changes in vegetation resulted in increased lateral movement through semiconfined aquifers. The salts involved are dominantly chlorides deposited in rainfall, and more emphasis is placed here on downstream water quality than on agricultural production. In order to correct dryland salinity problems, various soil properties must be investigated. The most important soil property for the evaluation of water and salt fluxes is the hydraulic conductivity. There are still many difficulties with measuring this property. When changes in water quality are the primary item of interest, the historically well-developed application of potential theory is more useful when interpreted in terms of the stream function rather than the potential function. (Baker-FRC)
W82-01018

SOIL PERCOLATION TESTS,
Indian Health Service, Seattle, WA. Office of Environmental Health.
M. E. Peterson.
Journal of Environmental Health, Vol 42, No 4, p 182-186, January/February, 1980. 2 Fig, 7 Ref.

Descriptors: *Soil properties, *Percolation, *Soil water, Leaching, Seepage, Water loss, Infiltration, Capillarity, Measuring instruments, Testing procedures, Standards.

Even though there is severe criticism of the percolation test, it is still used consistently by private, county, state, and federal agencies throughout the United States. Unless the operator is keenly aware of the sources of error in this test, accurate results will be the exception, not the rule. A recommended procedure is offered. Three or more holes should be dug, spaced uniformly over the proposed site, avoiding the use of tools that will compact or smear the soil interface of the holes. Holes should have a diameter of exactly 8 inches. The bottom and sides of the holes should be carefully scraped with a hard rake or other instrument to provide as natural a soil interface as possible, and loose material removed from the bottom of the holes. Perforated liners should be inserted vertically in the holes and gravel or some other porous supporting material carefully placed between the outside of the liner and the hole wall. About 2 in of gravel shold be added to the bottom of the hole. Holes should be presoaked to assure saturation and swelling of the soil. The percolation time is then measured. A percolation tube is described which facilitates the performance of the test. In addition to performing a percolation test at the site, it is highly recommended that a deep boring be made to look for high groundwater elevation and the presence of bedrock or other unique soil boundaries. (Baker-FRC)
W82-01044

RESPONSE OF FABABEAN YIELD, PROTEIN PRODUCTION AND WATER USE TO IRRIGATION,
Department of Agriculture, Lethbridge (Alberta). Research Station.
For primary bibliographic entry see Field 2I.
W82-01089

2H. Lakes

ANTHROPOGENIC TRACE ELEMENTS AND POLYCYCLIC AROMATIC HYDROCARBON LEVELS IN SEDIMENT CORES FROM TWO LAKES IN THE ADIRONDACK ACID LAKE REGION,
Department of Energy, NY. Environmental Measurements Lab.
For primary bibliographic entry see Field 5B.
W82-00501

SAMPLING EMERGING CHIRONOMIDAE (DIPTERA) WITH SUBMERGED FUNNEL TRAPS IN A NEW NORTHERN CANADIAN RESERVOIR, SOUTHERN INDIAN LAKE, MANITOBA,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
D. M. Rosenberg, A. P. Wiens, and B. Bilyj.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 6, p 927-936, June, 1980. 7 Fig, 4 Tab, 14 Ref.

Descriptors: *Midges, *Sampling, *Population density, Lakes, Trap efficiency, Trapping, Canada.

As part of a study on the effects of reservoir formation on Chironomidae in Southern Indian Lake, the experimental design is discussed and the sampling characteristics of the submerged funnel traps are described. Clay, bedrock, and marsh shorelines were sampled at 1.0, 2.0, 3.5, and 4.5 m depths with four replicate traps at each location. The most common offshore species differed from the most common inshore species. All offshore species were similar but inshore marsh species differed from clay and bedrock species. Precision was estimated at + or - 30% for the twelve traps at each depth and 16 traps for each shoreline type. A minimum of four traps was required to interpret emergence patterns of the most common species with one emergence peak while 16 were required if there were two emergence peaks. Continuous and discontinuous trapping gave similar results. Results indicate that the optimum sampling strategy for mesotrophic lakes would be to trap discontinuously and use many traps. (Small-FRC)
W82-00520

DIEL VARIATIONS OF SELECTED PHYSICO-CHEMICAL PARAMETERS IN LAKE KISSIMMEE, FLORIDA,
Florida Dept. of Environmental Regulation, Tallahassee.
C. W. Dye, D. A. Jones, L. T. Ross, and J. L. Gernert.
Hydrobiologia, Vol 71, No 1/2, p 51-60, May 27, 1980. 7 Fig, 3 Tab, 30 Ref.

Descriptors: *Water quality, *Productivity, *Shallow water, Photosynthesis, *Lake Kissimmee, Florida, Lakes, *Physicochemical properties, Mixing, Conductivity, Wind, Destratification, Hydrogen ion concentration, Dissolved oxygen, Temperature.

Lake Kissimmee, Florida (137 sq km, mean depth 2.5 meters) may be typical of the state's lakes in the central portion of the peninsula. The diel depth profiles of dissolved oxygen, pH, temperature and conductivity made at 2 stations from July 1974 to June 1975 suggest that stratification does not occur. However, a large temperature gradient (about 5 degrees C) appeared on 2 occasions, in July and December 1974, on clear, dead calm days. Generally, any temperature differences disappeared with convective cooling at night and with wind mixing. Dissolved oxygen levels were high, maximum 11.6 mg per liter, and on rare occasions, as low as 4 mg per liter at the bottom during extreme calm in summer. Photosynthesis was the primary factor regulating pH, which was maximum in summer and in afternoon, coinciding with periods of maximum productivity. Conductivity was highest in the wet summer months and lowest during the winter dry season. The anomalous summer increase was probably a result of sewage effluent released into lakes in the Upper Basin chain which in turn flowed into Lake Kissimmee. In winter, water is not discharged from the Upper Basin. (Cassar-FRC)
W82-00535

RELATIONSHIP BETWEEN THERMAL STABILITY AND SUMMER OXYGEN DEPLETION IN A PRAIRIE POTHOLE LAKE,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
M. H. Papst, J. A. Mathias, and J. Barica.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 9, p 1433-1438, September, 1980. 6 Fig, 14 Ref.

Descriptors: *Lakes, *Temperature effects, *Oxygen depletion, Eutrophication, Seasonal variation, Algal growth, Prairies, Thermal stratification, Lake breezes, Mixing, *Fishkill.

Periods of oxygen depletion in prairie pothole lakes which cause summer fishkill have been associated with the collapse of algal blooms, but are not necessarily caused by this collapse. The thermal instability which sometimes follows this collapse plays an important role in summerkill. Thermal stability of the pothole lakes is dependent on wind stress and night-time air temperatures. The present results aid in determining the speed with which oxygen depletion may occur, and correlate the occurence of periods of lake oxygen depletion with variations in weather conditions. The algal biomass may collapse without severe oxygen depletion in these lakes. (Geiger-FRC)
W82-00545

A PROCEDURE USING MODELING AND ERROR ANALYSIS FOR THE PREDICTION OF LAKE PHOSPHORUS CONCENTRATION FROM LAND USE INFORMATION,
Michigan State Univ., East Lansing. Dept. of Resource Development.
For primary bibliographic entry see Field 5G.
W82-00546

MODEL OF THE SEASONAL DYNAMICS OF AN ECOSYSTEM OF A SHALLOW LAKE,
Akademiya Nauk SSSR, Moscow. Inst. of Limnology.
O. V. Belyakova.
Water Resources (English Translation), Vol 7, No 5, p 450-457, September/October, 1980. 4 Fig, 24 Ref. Translated from Vodnye Resursy, No 5, p 130-139, September/October, 1980.

Descriptors: *Mathematical models, *Seasonal variation, *Ecosystems, *Lakes, Mathematical equations, Water temperature, Temperature effects, Solar radiation, Biomass, Aquatic productivity, Energy, Shallow lakes.

In order to understand and predict the reaction of a lake ecosystem to varying external effects, it is first necessary to create a mathematical model of the seasonal dynamics of the components of the ecosystem. The development of a mathematical model of the seasonal dynamics of the biomass and production of the main trophic groups of aquatic organisms and of the concentrations of biogenic elements is discussed. The inputs of the system are the mean monthly values of absorbed solar radiation, the temperature of the water mass, inflow and outflow of the lake, and the amount of production of macrophytes. The outputs of the system include dissipation of heat energy during the vital activity of aquatic organisms, the biomass of chironomids that have emerged and flown away, and the consumption of zooplankton and benthos by fishes. The results obtained on the model were compared with data obtained by direct observation on a mesotrophic lake in northwestern U.S.S.R. This comparison showed that the model provided a satisfactory reproduction of both the overall level of development and seasonal dynamics of the main components of the lake ecosystems. This model can be used to evaluate the role of the main trophic links in the seasonal dynamics of the flow of material and energy in the lake and to evaluate the possible responses of the system to quantitatively different regimes of the input variables. However, it is not suitable for evaluation of potential responses to large disturbances which would create the basis for a different energy regime. (Carroll-FRC)
W82-00552

PROBABILITY-THEORETICAL ANALYSIS OF FLUCTUATIONS IN THE LEVEL OF A CLOSED WATER BODY,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
S. V. Muzylev.
Water Resources (English Translation), Vol 7, No 5, p 403-417, September/October, 1980. 6 Fig, 31 Ref. Translated from Vodnye Resursy, No 5, p 21-41, September/October, 1980.

Descriptors: *Closed lakes, *Hydrologic budget, *Mathematical studies, Mathematical equations, Climatology, Water level fluctuations, Lakes, Stochastic process.

Closed lakes are water bodies from which rivers do not flow. The natural regimes of most of these closed water bodies have been substantially disturbed by economic measures related primarily to irrigation and streamflow regulation. In order to predict the regime of closed lakes, it is first necessary to develop a physical model which correctly reflects the regularities of the fluctuations of their levels. Previous models based on the stochastic character of river inflow and apparent evaporation used a discrete form of notation of the annual increments of components of the water balance. However, all physically real stochastic processes represent continuous functions of time. The use of the concept of continuous processes reduces the problem of water level fluctuations in a closed lake to classical problems of nonequilibrium statistical mechanics and statistical radio engineering. A continuous model describing the fluctuations of the level in a closed water body was used to obtain a quantitative estimate of the effect of the product of level fluctuations and river inflow on the statistical characteristics of the level. This effect can be neglected when the inflow variability is small, but not when the coefficients of variation of the inflow are close to unity. In the simplest case, the correlation function of level fluctuations corresponds to the component of the two-dimensional Markov process. When lags far exceed the correlation time of inflow and apparent evaporation, a first-order Markov process describes the level fluctuations sufficiently well. This continuous model permits identification of the characteristics to the case of cross correlation of the river inflow and apparent evaporation. (Carroll-FRC)
W82-00571

MICROBIAL METABOLISM OF N-NITROSODIETHANOLAMINE IN LAKE WATER AND SEWAGE,
Cornell Univ., Ithaca, NY. Soil Microbiology Lab.
J. R. Yordy, and M. Alexander.
Applied and Environmental Microbiology, Vol 39, No 3, p 559-565, March, 1980. 7 Fig, 16 Ref.

Descriptors: *Nitrogen compounds, *Metabolism, *Lakes, *Wastewater, Microbial degradation, Microorganisms, Seasonal variations, Nitrosamines, Mineralization.

The transformation of N-nitrosodiethanolamine (NDEIA) was studied in samples of lake water and sewage. Water samples were taken from North Lake in the Adirondack Preserve and from Cayuga Lake, both in New York State. Samples were taken about 1 m from the shore, at surface level. Sewage samples at pH 7.8 were collected from the primary settling tank at the Ithaca, NY sewage treatment plant. The mineralization of NDEIA in samples of these three waters was studied. At NDEIA concentrations of 1.1 microgram/ml, mineralization was never noted in the Cayuga Lake and North Lake water samples, even though the process was examined with water collected at different times of the year. In sewage, NDEIA was mineralized, with over 40% of the carbon added as NDEIA being recovered as CO2 when the experiments was completed. Even though NDEIA was not mineralized in the lake water samples, the nitrosamine was metabolized. Breakdown of about 1.0 micrograms of NDEIA per ml in North Lake water and Cayuga Lake water was caused by microorganisms. In North Lake only partial degradation was noted in the September sample, which suggests that depletion of an essential nutrient occurred in the water sample. In sewage, no seasonal variation on the microbial conversion was noted, and the products of metabolism were slowly mineralized. NDEIA was apparently converted to the same organic products in all three samples. Data suggest that these products were modified dimers of NDEIA. (Baker-FRC)
W82-00585

ASSESSMENT OF THERMAL DISCHARGES ON ZOOPLANKTON IN CONOWINGO POND, PENNSYLVANIA,
Radiation Management Corp., Drumore, PA. Muddy Run Ecological Lab.
For primary bibliographic entry see Field 5C.
W82-00592

THEORY OF ECOLOGICAL PREDICTION OF LIMNETIC ECOSYSTEMS,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 6G.
W82-00597

INFLUENCE OF SEASONAL TEMPERATURE ON THE TEMPERATURE OPTIMA OF BACTERIA IN SEDIMENTS OF LAKE GEORGE, NEW YORK,
Oregon State Univ., Corvallis. Dept. of Microbiology.
D. L. Tison, D. H. Pope, and C. W. Boylen.
Applied and Environmental Microbiology, Vol 39, No 3, p 675-677, March, 1980. 1 Fig, 1 Tab, 12 Ref.

Descriptors: *Bacteria, *Temperature effects, Lakes, *Lake George, Seasonal variations, Sediments, Nutrients, Nutrient cycling, Littoral zone, Lake sediments, New York.

The possibility of temperature limiting microbial activity in Lake George during periods of nutrient input and throughout the winter was investigated. Sediment samples were collected from a depth of 1 meter with an Ekman dredge and diluted 1:1 (vol/vol) with lake water. Temperature optima for the heterotrophic utilization of glucose and an amino acid mixture were determined throughout the year. The temperature optimum decreased with decreasing in situ temperature in the fall and winter, suggesting that selection for or adaptation by a psychrotrophic bacterial population occurred. Replicate plating of bacterial isolates from 3 and 20 degrees C indicated that a psychrotrophic bacterial population was present in the sediments throughout the year. These results indicate that decomposition and nutrient cycling processes in the sediments within the littoral zone of Lake George were probably not completely inhibited by winter temperatures, although the process rates were decreased. Utilization rates for glucose in January were about 30% of those in August, but this was thought to be due to a decrease in the numbers of active microorganisms or limitations due to factors other than temperature during the winter. (Baker-FRC)
W82-00606

CONTROL OF WATER WEEDS BY GRASS CARP IN TWO SMALL LAKES,
Marine Dept., Rotorua (New Zealand). Fisheries Research Div.
For primary bibliographic entry see Field 3B.
W82-00609

ACUTE AND CHRONIC EFFECTS OF ALUM TO MIDGE LARVA (DIPTERA: CHIRONOMIDAE),
Kennedy (Michael), Spokane, WA.
For primary bibliographic entry see Field 5F.
W82-00650

SEDIMENTS AS A SOURCE OF PHOSPHATE: A STUDY OF 38 IMPOUNDMENTS,
Department of Water Affairs, Pretoria (South Africa). Hydrological Research Inst.
D. C. Grobler, and E. Davies.
Water S A, Vol 7, No 1, p 54-60, January, 1981. 3 Fig, 4 Tab, 15 Ref.

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Descriptors: *Lake sediments, *Phosphates, *Algal growth, Eutrophication, Suspended sediments, Bottom sediments, Phosphorus, *Nutrients, Nuisance algae, Algae, Catchment areas, Reservoirs, Mathematical studies, *South Africa.

The amount of sediment phosphate available as nutrients for algal growth was examined in sediments from 38 South African impoundments. Selenastrum capricornutum was used in a bioassay technique to determine the availability of sediment phosphate in a 21 day incubation period. When impoundments were grouped according to the geological formation of their catchments, the algal available phosphate fraction and the inorganic phosphate content of the sediments were correlated. Two regression equations were proposed to calculate the algal available phosphate level of the sediments when the inorganic phosphate levels of the sediments are known. In turbid or shallow impoundments the phosphate content of suspended sediments should also be considered as a source of algal nutrients. It was suggested that these data be considered when imposing phosphate standards in South Africa for eutrophication management. (Geiger-FRC)
W82-00653

DISTRIBUTION AND BIOLOGICAL AVAILABILITY OF REACTIVE HIGH MOLECULAR WEIGHT PHOSPHORUS IN NATURAL WATERS IN NEW ZEALAND,
Department of Scientific and Industrial Research, Taupo (New Zealand). Freshwater Section.
E. White, and G. Pane.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 4, p 664-669, April, 1980. 2 Fig, 4 Tab, 8 Ref.

Descriptors: *Phosphorus, *Eutrophic lakes, *Algal growth, Streams, Phosphates, Eutrophication, Dissolved solids, Water pollution effects, Turnover time, Absorption, Nutrients, Chlorophyta, Algae, *New Zealand.

Dissolved phosphorus which is not orthophosphate is present in many eutrophic lakes and streams of the central volcanic plateau of North Island, New Zealand. One of the reactive phosphorus components was shwon by Sephadex gel chromatograms to have a molecular weight of over 5000, while a second component elutes as phosphate-phosphorus. The reactive high molecular weight phosphorus (RHMW-P) usually forms only a small fraction of the dissolved reactive phosphorus (DRP) in streams. In some eutrophic lakes, a characteristic distribution of the two forms exists and the RHMW-P/DRP ratio may be as high as 70-80%. In summer months phosphate-phosphorus dominates over RHMW-P, a situation consistent with the long phosphate turnover rates peculiar to many lakes of this region. Algal growth responses to phosphorus uptake were similar for phosphate-phosphorus and RHMW-P, but the amount of RHMW-P taken up by Chlorella varied from lake to lake. This caused problems in relating lake DRP levels to algal growth responses. (Geiger-FRC)
W82-00659

COMPARISON OF A FEW SYSTEMS FOR THE DETERMINATION OF SAPROBIC AND TROPHIC DEGREE ON THE BASIS OF PLANKTON DATA,
Katholieke Univ., Nijmegen (Netherlands) Lab. of Aquatic Ecology.
G. J. Van Nuland, and J. F. G. M. Meis.
Hydrobiologia, Vol 70, No 3, p 251-256, May 2, 1980. 1 Fig, 2 Tab, 27 Ref.

Descriptors: *Plankton, *Saprobic index, *Trophic level, Ecosystems, Mesotrophy, Water quality, Lakes, Biological properties, Phytoplankton, Zooplankton, Nutrients, Species composition, Comparison studies, Aquatic envrionment.

The biological quality of an aquatic environment, the Haarsteegse Wiel, Vlijmen, the Netherlands, was determined by five different methods. Two methods involved the saprobity; two, the trophic level; and one, chemical data. This water body, which formed following dike bursts on the River Meuse in 1610 and 1740, was studied from April to October 1977. The two methods for determining saprobic index showed, in good agreement, that the water was within the transition range between beta-mesosaprobic and oligosaprobic. The Zelinka and Marvan (1961) method, developed in Czechoslovakia, is to be used with a well-defined community, such as plankton, benthos, or epiphyton (in this study, plankton) and requires an extremely accurate identification of organisms. The Dresscher and van der Mark (1976) technique uses several indicator species in a formula for saprobic index. Since detailed identification is not necessary, it saves time. Objections to this method are the generalization and the disregard of quantities of species found. The methods for determining trophic degree, those of Hutchinson (1967), Rawson (1956), and chemical data, all indicated the Haarsteegse Wiel to be mesotrophic. (Cassar-FRC)
W82-00664

VERTICAL DISTRIBUTION OF MONOSACCHARIDES IN LAKE WATER,
Tokyo Metropolitan Univ. (Japan). Dept. of Chemistry.
M. Ochiai, and T. Hanya.
Hydrobiologia, Vol 70, No 1/2, p 165-169, April, 1980. 3 Fig, 3 Tab, 12 Ref.

Descriptors: *Carbohydrates, *Organic matter, *Monosaccharides, *Lakes, Glucose, Galactose, Eutrophic lakes, Dystrophic lakes, Water analysis, Phytoplankton, Heterotrophic bacteria.

Eight common monosaccharides of the dissolved organic matter were measured in 3 Japanese lakes: Nakanuma, small and eutrophic; Suwako, shallow and eutrophic; and Shirakoma-ike, dystrophic. The ratio of concentrations of carbohydrates analyzed by gas chromatography to those analyzed by the anthrone method ranged from 30.5 to 121% in Suwako, 12.9 to 51.4% in Nakanuma, and 21.2 to 38.6% in Shirakoma-ike. In surface water of Lake Suwako (eutrophic) glucose and galactose represented 40% and 24.4%, respectively, of the carbohydrates, and 16.4 to 19.2% and 18.5 to 19.8%, respectively, in the deeper water. Rhamnose made up 12.2% of surface water carbohydrates and 23.9 to 25.8% in deeper waters. Ribose and arabinose were low from surface to 5 meters; fucose, xylose, and mannose were present in intermediate concentrations. Lake Nakanuma monosaccharide levels were on the same order. In dystrophic Lake Shirakoma-ike, the vertical profiles of most monosaccharides were relatively uniform; galactose, glucose, and mannose were in greatest concentrations, but at smaller concentrations than in the eutrophic lakes. (Cassar-FRC)
W82-00665

CLASSIFICATION OF CENTRAL AMAZON LAKES ON THE BASIS OF THEIR MICROBIOLOGICAL AND PHYSICO-CHEMICAL CHARACTERISTICS,
Max Planck Inst. fuer Limnologie zu Ploen (Germany, F.R.). Dept. of Tropical Ecology.
H. Rai, and G. Hill.
Hydrobiologia, Vol 72, No 1/2, p 85-99, July 10, 1980. 10 Fig, 4 Tab, 51 Ref.

Descriptors: *Classification, *Physicochemical properties, *Microbiological studies, Algae, Nutrients, Amazon River, Flood plains, Lakes, Oxbow lakes, Varzea lakes, Ria lakes, Phytoplankton, Primary productivity, Productivity, Saprophytic bacteria, Bacteria, Chlorophyll a, Deltas, Heterotrophic bacteria, Water quality, *Lake classification, *Amazon lakes, South America.

The physical, chemical, and microbiological characteristics of 24 Central Amazonia Varzea and Ria Lakes, lateral to the Rio Negro and Rio Solimoes, were studied during the low water phase of 1975. Three water types (white, mixed, and black) were differentiated on the basis of physical and nonmetallic inorganic constituents. The eight white water lakes were highest in dissolved oxygen, 5.2-8.9 mg per liter; nitrates, 3.4-52.2 micrograms per liter; ammonium, 78-653 micrograms per liter; Fe(3+), 0.575-16.8 mg per liter; total organic carbon, 8-22.75 mg per liter; pH, 6.6-8.4; and conductivity, 31-80 micro S per cm at 20 degrees C. The 12 black water lakes had the highest Secchi disk transparencies, 95-299 cm. The four mixed lakes were highest in phosphates, 0-49.4 micrograms per liter. Physicochemical parameters with less defined differences among the lakes were: KMnO4, chloride, dissolved organic carbon, and temperature. White water lakes had the highest concentrations of saprobic bacteria, total bacteria, chlorophyll a, and microcrustaceans. Primary production (in mg C per sq meters per day) had a large range: white, 350-1500; mixed, 820-3500; and black 347-10451. Algae in the lakes further characterized the lake waters. White waters were dominated by Melosira, black waters (lower species diversity) by Peridinium, and mixed waters (greatest species diversity) by clean water indicators. (Cassar-FRC)
W82-00666

LIGHT PENETRATION AND THE INTERRELATIONSHIPS BETWEEN OPTICAL PARAMETERS IN A TURBID SUBTROPICAL IMPOUNDMENT,
Orange Free State Univ., Bloemfontein (South Africa). Inst. for Environmental Sciences.
R. D. Walmsley, M. Butty, H. van der Piepen, and D. Grobler.
Hydrobiologia, Vol 70, No 1/2, p 145-157, April, 1980. 7 Fig, 4 Tab, 23 Ref.

Descriptors: *Light penetration, *Turbidity, *Suspended sediments, Transparency, Seasonal variation, Secchi disks, Rust der Winter Dam, *South Africa, Water quality, Subtropical zone, Lakes, *Reservoirs, Stratification, Thermal stratification, Euphotic zone, Silt, Chlorophyll a.

The main factors regulating the temporal and spatial variations in water transparency in a turbid subtropical impoundment (Rust der Winter Dam, South Africa) were allochthonous inputs of silt during summer floods, impoundment morphometry, and the warm monomicitic thermal cycle. Statistically significant relationships were established between Secchi disk transparency (0.6-3.00 meters), surface water turbidity (4.2-25 JTU), mean diffuse attenuation coefficient (0.64-2.00 per meter), and beam attenuation coefficient (1.14-10.60 per meter without a filter). These relationships allowed an approximation of the 1% of surface light intensity depth (corresponding with the euphotic zone) to be made if any one of the parameters were known. Blue light attenuation was greater than red light attenuation because of the effects of suspended clay particles. (Cassar-FRC)
W82-00667

ANNUAL SUCCESSION OF PHYTOPLANKTON IN ONE HEATED POND IN CENTRAL FINLAND,
Jyvaeskylae Univ. (Finland). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-00673

CHEMICAL COMPOSITION OF INTERSTITIAL WATERS IN BOTTOM SEDIMENTS OF SOME POLISH LAKES OF THE WIGRY GROUP (NORTHERN POLAND),
Akademia Rolnicza, Warsaw (Poland). Zaklad Limnologii i Rybactwa.
A. Woroniecka-Stasiak.
Acta Hydrobiologica, Vol 22, No 4, p 347-360, 1980. 5 Fig, 2 Tab, 12 Ref.

Descriptors: *Interstitial water, *Lakes, *Chemical properties, Bottom sediments, Acidity, Alkalinity, Hydrogen ion concentration, Carbon dioxide, Organic acids, Ammonium salts, *Poland, Chemical composition.

The chemical composition of interstitial waters in the sediments of Wigry lakes was investigated in nine lakes. Fifty-one to 65% of sediment weight was interstitial water, and the most important feature of the water was the acid pH, which ranged from 5.6 in Lake Suchar to 6.9 in Lakes Krzywe and Omulowek. High alkalinity was found in the interstitial waters of Lakes Wigry, Omulowek, Krzywe, Muliczne, and Przetaczek. The remaining

lakes had water of the acido-dystropic type. A linear relationship was found between alkalinity and the pH values of interstitial waters saturating some sediments. In harmonic lakes, the acid relation was conditioned by the occurrence of free CO2, and in disharmonic lakes by the occurrence of free CO2 and organic acids. Interstitial waters were a source of organic compounds and mineral salts to the hypolimnion and contained large amounts of iron and phosphorus. Large amounts of ammonium salts were found. In harmonic lakes, denitrification was responsible for the absence of nitrates and nitrites. (Small-FRC)
W82-00675

ORGANOCHLORINE RESIDUES IN KENYA'S RIFT VALLEY LAKES,
National Wildlife Federation, Washington, DC.
For primary bibliographic entry see Field 5A.
W82-00690

THE CHANGING STATUS OF REEDSWAMP IN THE NORFOLK BROADS,
Institute of Terrestrial Ecology, Huntingdon (England). Monks Wood Experimental Station.
For primary bibliographic entry see Field 5C.
W82-00691

REPORT OF THE AQUATIC ECOSYSTEM OBJECTIVES COMMITTEE,
International Joint Commission-United States and Canada, Windsor (Ontario).
For primary bibliographic entry see Field 5G.
W82-00705

AN IN SITU METHOD FOR MEASURING THE PRIMARY PRODUCTIVITY AND STANDING CROP OF THE EPILITHIC PERIPHYTON COMMUNITY IN LENTIC SYSTEMS,
California Univ., Davis. Div. of Environmental Studies.
For primary bibliographic entry see Field 7B.
W82-00756

INTERACTION OF ORTHOPHOSPHATE WITH IRON (III) AND ALUMINUM HYDROXIDES,
Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Chemical Engineering.
L. Lijklema.
Environmental Science and Technology, Vol 14, No 5, p 537-541, May, 1980. 5 Fig, 34 Ref.

Descriptors: *Coagulation, *Phosphates *Lakes, *Iron, *Aluminum, Water treatment, Tertiary wastewater treatment, Wastewater treatment, Chemical reactions, Hydrogen ion concentration, Eutrophication, Lake sediments, Metals, Adsorption.

The influence of pH and aging on phosphate binding by Fe(3+) or aluminum hydroxides is pertinent to water and wastewater treatment and to phosphate exchange between sediments and overlying water in lakes. In laboratory studies, similarly-shaped adsorption isotherms of phosphates on Fe(3+) hydroxide or aluminum hydroxide were obtained at pH values of 5, 6, 7, and 8. Phosphate-P concentrations varied from 0 to 0.2 nmol per liter; ratios of P adsorbed per Fe concentration varied from 0.05 to 0.2. Phosphate adsorption was greater at lower pH and at higher phosphate concentrations. More phosphate was adsorbed when the hydroxides were formed in situ. Freshly precipitated Fe(3+) hydroxide adsorbed more phosphate than 1-day-old precipitates. Ratios of adsorbed phosphate to Fe increased linearly with time over the 1000 hours of the study. Adding acid or base to shift the pH 2 units showed that adsorption and desorption changes are not completely reversible. Practical conclusions drawn from this work are: (1) rapid initial mixing of coagulants in treatment plants is most effective; (2) at low temperatures and slightly acid waters the effective phosphate adsorption can result in negatively charged phosphated complexes, resisting coagulation; (3) at pH 5 phosphate can remove Fe from iron-containing water by membrane filtration with a 0.2 micrometer filter; (4) in lakes, a variation of pH produced by photosynthetic activity can influence the adsorption capacity of the sediment; (5) high release of phosphate and Fe can occur in shallow lakes under reducing conditions throughout the sediment and with high pH in the overlying water. (Cassar-FRC)
W82-00783

THE EFFECT OF SEASON AND LOCATION ON PHOSPHOADENYLATE CONCENTRATIONS AND ADENYLATE ENERGY CHARGE IN TWO SPECIES OF FRESHWATER CLAMS,
Savannah River Ecology Lab., Aiken, SC.
J. P. Giesy, and G. W. Dickson.
Oecologia, Vol 49, No 1, p 1-7, 1981. 3 Fig, 8 Tab, 36 Ref.

Descriptors: *Clams, Ponds, Reservoirs, Lakes, *Savannah River impoundments, Mollusks, Rivers, Phosphates, *Adenosine triphosphate, Baseline studies, Seasonal variation, Monitoring, *Bioindicators, Cooling ponds, *Nuclear powerplants.

Seasonal and size related variations of adenosine triphosphate (ATP), adenosine diphosphate (ADP), 5'-adenylic acid (AMP) and total adenylate concentrations were determined in the papershell clam and Asian clam. The adenylate energy charge was also investigated. Papershell clams were collected from the thermally enriched portion of Par Pond, an impoundment on the U.S. Department of Energy's Savannah River Plant, near Aiken, SC. Asian clams were collected from the Savannah River adjacent to the Savannah River Plant. Seasonal variations were readily observable in all three adenylates as well as in the total adenylate concentration and the adenylate energy charge for each species. The periods of active reproduction cycles for each species were closely tied with the fluctuations in adenylates and energy charges. Possible relationships of the various concentrations measured to the shell length of individual animals were investigated. The different points of collection did not appear to influence the value of the adenylate energy charge on individuals of either species. The adenylate energy charge of the Asian clam was seen to increase after acclimation had occurred to laboratory surroundings and feedings had begun. A deeper understanding of adenylate energy charges and adenylate concentrations is necessary before these parameters can be used as part of a natural background in monitoring programs. (Baker-FRC)
W82-00810

FACTORS INFLUENCING FISH DISTRIBUTION IN TWO DESERT RESERVOIRS, CENTRAL ARIZONA,
Arizona State Univ., Tempe. Forestry Sciences Lab.
J. N. Rinne, W. L. Minckley, and P. O. Bersell.
Hydrobiologia, Vol 80, No 1, p 31-42, April, 1981. 4 Fig, 10 Tab, 47 Ref.

Descriptors: *Reservoirs, *Fish, *Limnology, Temperature effects, Thermoclines, Dissolved oxygen, Seasonal variation, Littoral environment, Littoral zone, Euphotic zone, *Fish populations, *Arizona.

Sampling of fishes, net plankton, phytoplankton pigments, and benthos began in the summer of 1970 and ended in autumn of 1971 in two desert reservoirs in central Arizona. The two reservoirs were Roosevelt Lake and Apache Lake. At full pool Roosevelt Lake approaches Apache Lake in maximum and mean depths, but is far larger, having almost six times the volume of Apache, twice the shoreline, and six times the mean breadth and surface area. The slope is far less severe in Roosevelt Lake. Temperature profiles vary substantially over time in these two low desert lakes, and annual cycles were similar in the two reservoirs. A basic difference between the two was in the depth of the metalimnion, which was located from 10 to 15 m in Roosevelt Lake, and at about half that depth, 5 to 7 meters, in Apache. This was attributable to wind action on the broad, unprotected surface of the former in contrast to the fjord-like nature of Apache Lake. Dissolved oxygen curves generally paralleled seasonal temperature profiles, with high concentrations from surface to bottom during winter and spring and hypolimnic oxygen deficiencies during the summer. Apache Lake was far more transparent. No single factor appeared paramount in delimiting fish population dispersion in the two desert reservoirs. The greatest abundance of fish based on vertical gillnet catches was in the upper 10 meters of water, reflecting the influence of thermocline depth, levels of dissolved oxygen concentration, and euphotic zone. Fish introduced into western reservoirs are intrinsically shallow-water, littoral inhabitants, and remain so due to inherent limnological factors characteristic of mid-latitude lentic systems. (Baker-FRC)
W82-00814

THE NATURE OF SELECTED PRAIRIE LAKE AND STREAM SEDIMENTS,
Saskatchewan Univ., Saskatoon. Dept. of Soil Science.
For primary bibliographic entry see Field 2J.
W82-00815

GRAZING RATE DETERMINATION OF CORYNONEURA SCUTELLATA WINNERTZ (CHIRONOMIDAE:DIPTERA),
Rhode Island Univ., Kingston. Dept. of Zoology.
D. H. Kesler.
Hydrobiologia, Vol 80, No 1, p 63-66, April, 1981. 1 Fig, 10 Ref.

Descriptors: *Midges, *Littoral zone, Littoral drift, Lakes, *Phytoplankton, Aquatic drift, *Rhode Island, Grazing, Standing crops, Aquatic flora, Aquatic animals, Diptera.

The grazing rate of the larval chironomid Corynoneura scutellata Winnertz (Diptera) was investigated. Sampling was carried out in Nonquit Pond, Rhode Island. C. scutellata larvae were collected from the littoral zone. Grazing rates were determined radiometrically at different temperatures. The resulting temperature-grazing function is given. This function was then applied to field data from Nonquit Pond. A maximum grazing rate of 107 mg dry weight/square meter/day was calculated to have occurred in late June of 1978. Calculated C. scutellata grazing rates were compared to periphyton net accumulation rates. The means of these ratios ranged from 3 to 15% with a maximum of 70%, indicating that these larvae are potentially able to affect periphyton standing crop. (Baker-FRC)
W82-00822

NITROGEN AND PHOSPHORUS RECYCLING IN LAKE SAMMAMISH, A TEMPERATE MESOTROPHIC LAKE,
Washington Univ., Seattle. Dept. of Civil Engineering.
R. B. Birch, and D. E. Spyridakis.
Hydrobiologia, Vol 80, No 2, p 129-138, May, 1981. 3 Fig, 3 Tab, 21 Ref.

Descriptors: *Lakes, *Nutrients, *Nitrogen, *Phosphorus, Mesotrophic lakes, Mesotrophy, Trophic load, Dynamics, *Cycling nutrients.

Nitrogen and phosphorus budgets are presented for spring and summer for the trophogenic and tropholytic zones of Lake Sammamish. The budgets are constructed to evaluate the efficiency of nutrient recycling and increase knowledge of the overall nutrient dynamics. The budgets reveal that uptake and solubilization are the dominant fluxes and that nutrient recycling is generally efficient with the possible exception of early spring during the diatom bloom. Solubilization of particulates is much less in the tropholytic zone than the trophogenic zone. This is due to slower decomposition rates there and to the efficiency of solubilization in the overlying trophogenic zone which results in a relatively small particulate influx. Turnover times for the N and P pools are thus much faster in the trophogenic zone than in the tropholytic zone. In the trophogenic zone, however, the dissolved N pool turns over much more slowly than the dissolved P pool due to its larger size relative to algal

growth requirements. Overall there is a net loss of N and P from the water column in spring, primarily due to sedimentation and denitrification, while in summer there is a small net gain due to sediment release and a slight excess of inflow over outflow. (Baker-FRC)
W82-00824

POTENTIAL IMPACT OF SIZE-SELECTIVE PLANKTIVORY ON PHOSPHORUS RELEASE BY ZOOPLANKTON,
Wisconsin Univ.-Madison.
S. M. Bartell.
Hydrobiologia, Vol 80, No 2, p 139-145, May, 1981. 5 Tab, 28 Ref.

Descriptors: *Zooplankton, *Phosphorus, Lakes, Nutrients, Cycling nutrients, *Predation, Fish.

The speculation that size-selective predation by planktivorous fishes affects rates of phosphorus release by zooplankton at the system level through changes in both mean individual size and biomass of zooplankton was investigated. Comparisons were made of estimated rates of P release from zooplankton in lakes before and after introduction of size-selective predators, and comparisons were made among several lakes with varying abundance of predators. A laboratory model of phosphorus release by Daphnia rosea was implemented for published zooplankton data from the lakes. Size-selective feeding reduced average prey size and increased P release per unit biomass. At the system level, decreased prey standing crop associated with higher planktivore abundance could balance the size dependent increase in P release rate. However, estimates of both net reduction and net increase in rate of P release from zooplankton resulted from model application. Size-selective feeding may be important not only in energetic or evolutionary relationships between predator and prey but also in determination of the relative importance of different pathways of phosphorus flow through pelagic systems. (Baker-FRC)
W82-00825

ON LAKE BOTTOM DYNAMICS--THE ENERGY-TOPOGRAPHY FACTOR,
National Swedish Environment Protection Board, Uppsala. Water Quality Lab.
L. Hakanson.
Canadian Journal of Earth Sciences, Vol 18, No 5, p 899-909, May, 1981. 4 Fig, 10 Tab, 13 Ref.

Descriptors: *Lakes, *Bottom sediments, Erosion, Mathematical models, Models, Mathematical studies, Lake morphometry, *Limnology, Lake sediments, Sediments, Lake shores, Lake basins, Dynamics, Basins.

Some of the causal relationships that determine bottom dynamics in lakes are discussed, and a formula is suggested that expresses these causal relationships in terms of simple morphometric parameters. The benefit of such a model is that much valuable information can be gained from a minimum of work. Detailed empirical data from areas dominated by erosion, transportation, and accumulation have been determined for nine Swedish lakes or basins. The model has been calibrated against this set of data. The areal distribution of lake bottom areas dominated by erosion and transportation is governed by an energy factor, a slope factor, and a form factor. The equation which interrelates these factors is presented. Despite the fact that the formula is based on only three morphometrical standard parameters, it yields a surprisingly high correlation, which indicates that it describes the functional relationships in a proper manner. Tests have indicated that this formula is not significantly improved by accounting for the shore irregularity and lake shape factors. It is probable that the model yields the most accurate results for lakes in the size range of 1 to 5000 square kilometers. It is only applicable to single basins. In multi-basin lakes each basin must be treated separately. (Baker-FRC)
W82-00837

SEDIMENT-BASED NUTRITION OF SUBMERSED MACROPHYTES,
Army Waterways Experiment Station, Vicksburg, MS.
J. W. Barko, and R. M. Smart.
Aquatic Botany, Vol. 10, No 4, p 339-352, May 1981. 7 Tab, 48 Ref.

Descriptors: *Macrophytes, *Nutrients, *Sediments, Nitrogen, Phosphorus, Potassium, Uptake, Lakes, Plant growth, Vegetation, *Rooted aquatic plants.

An evaluation was made of the abilities of four submersed freshwater macrophytes to mobilize nitrogen, phosphorus, and potassium from different sediments in relation to their respective requirements for these nutrients. The four species involved were Bacopa caroliniana (Walt.) Robbins, Myriophyllum brasiliense Camb., Potamogeton illinoensis Morong, and Proserpinaca palustris L. With all species, N and P were readily mobilized from each of the sediments and concentrated in plant shoots at levels well above those required for growth. However, the mobilization of K from all sediments was far less effective and may have limited the growth of the species considered. Sediments represent a large and important source of N and P for rooted aquatic macrophytes, but K is probably supplied to these plants primarily from the water. N and P were excreted in only small amounts, if at all, from the species during active growth. However, considerable quantities of these nutrients can be released to the water due to plant senescence and associated decay. This represents an important mode of sediment-nutrient recycling in aquatic systems. (Baker-FRC)
W82-00843

ABSORPTION OF FENITROTHION BY PLANKTON AND BENTHIC ALGAE,
Moncton Univ., (New Brunswick).
For primary bibliographic entry see Field 5B.
W82-00874

MERCURY AND SELENIUM CONCENTRATIONS IN FISH, SEDIMENTS, AND WATER OF TWO NORTHWESTERN QUEBEC LAKES,
Noranda Research Centre, Pointe Claire (Quebec). Process Technology Dept.
For primary bibliographic entry see Field 5B.
W82-00876

AMMONIA AND NITRATE UPTAKE IN THE LOWER GREAT LAKES,
National Water Research Inst., Burlington (Ontario). Aquatic Ecology Div.
T. P. Murphy.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 9, p 1365-1372, September, 1980. 7 Fig, 1 Tab, 26 Ref.

Descriptors: *Lakes, *Primary productivity, *Nitrogen, *Limiting nutrients, Spectrophotometry, *Ammonia, *Great Lakes, Water analysis, Nutrients, Nitrate, Cycling nutrients, Data collections, Incubation, Lake Erie, Lake Ontario.

A simple radiolabeled N technique of emission spectrophotometry has been used to obtain a large data base for nitrate and ammonia uptake kinetics in Great Lakes Erie and Ontario. Short-term incubatin of water samples was necessary to prevent induction of nitrate uptake or changes in the rate of ammonium ion uptake which took place in long-term incubations. During most of the summer, uptake rates of nitrate and nitrate regeneration rates were generally slow. The slow turnover rate of particulate N, low levels of nutrients, and high affinities for ammonia suggest that the summertime primary productivity of the Lower Great Lakes is limited by nitrogen concentrations. (Geiger-FRC)
W82-00882

LIMNOLOGICAL CHARACTERISTICS OF SEVERAL LAKES ON THE LAKE WALES RIDGE, SOUTH-CENTRAL FLORIDA,
Bucknell Univ., Lewisburg, PA. Dept. of Biology.
W. F. McDiffett.
Hydrobiologia, Vol 71, No 1/2, p 137-145, May, 1980. 7 Fig, 3 Tab, 21 Ref.

Descriptors: *Nutrients, *Primary productivity, *Water quality, *Productivity, *Lakes, Eutrophication, *Florida, Phytoplankton, Nitrogen compounds, Phosphorus compounds, Limnology, Watershed development, Chlorophyll a.

Three lakes in southcentral Florida were studied from September 1976 to July 1977 to obtain basic limnological information, focusing on the productivity and nutrient relationships as affected by human activity. The lakes--Annie, Placid, and Francis--are connected seasonally by either natural drainage or man-made canals. Lake Annie is underdeveloped; the other two are partly to completely developed. All three lakes have clear, soft, nutrient-poor water. Primary production and chlorophyll a production is highest in Lake Francis. Productivity estimates (in g carbon per sq meter per year) were 205 for Francis, 75.8 for Annie, and 42.8 for Placid. Water from all three lakes responded to enrichment with N and P, but none to N alone. Lake Francis responded to P addition alone. Francis was judged nearly eutrophic, and the other two lakes oligotrophic in terms of primary productivity, light transmission, and dominant phytoplankton, and mesotrophic in terms of chlorophyll a. The water quality of these lakes appeared to be correlated with development along the shoreline and use of the surrounding watershed. (Cassar-FRC)
W82-00914

FACTORS CONTROLLING PHYTOPLANKTON PRIMARY PRODUCTIVITY IN BYRAM LAKE, MT. KISCO, N.Y., SUMMER, 1977,
Fordham Univ., Bronx, New York. Louis Calder Conservation and Ecology Study Center.
G. S. Kleppel, R. Ingram, and W. B. Samuels.
Hydrobiologia, Vol 70, No 1/2, p 95-101, April, 1980. 3 Fig, 2 Tab, 23 Ref.

Descriptors: *Primary productivity, *Eutrophic lakes, *Water depth, Stratification, Algae, Phytoplankton, Productivity, Eutrophication, Lakes, *Byram Lake, New York.

Accelerated eutrophication and algal blooms in Byram Lake, New York, prompted an investigation of phytoplankton productivity. Results suggest that horizontal and vertical microenvironments exist throughout the lake. At deeper stations, thermal stratification placed inorganic nitrogen in juxtaposition with phytoplankton in the upper metalimnion. At one station, surface productivity was ammonia-limited and bottom productivity was related to P levels. Phytoplankton productivity at a shallow station was inversely related to incident light and temperature. The vascular macrophyte bloom shaded the phytoplankton and decreased its productivity. In late summer the macrophytes decayed and released nutrients. As a result phytoplankton productivity reached a maximum in September. The failure to detect relationships between depth integrated productivity and environmental parameters suggests that the controlling factors were not measured in this study, that multiple parameter interactions regulated productivity, or that different factors were significant at different depths. (Cassar-FRC)
W82-00915

CHEMICAL COMPOSITION OF LABILE FRACTIONS IN DOM,
Tokyo Metropolitan Univ. (Japan). Dept. of Chemistry.
M. Ochiai, T. Nakajima, and T. Hanya.
Hydrobiologia, Vol 71, No 1/2, p 95-97, May, 1980. 2 Fig, 2 Tab, 8 Ref.

Descriptors: *Organic matter, *Amino acids, *Carbohydrates, Degradation, Microbial degradation, Labile fraction, Dissolved solids, Organic carbon, *Chemical composition, Natural waters, Lakes, Decomposition, Lake Nakanuma, *Japan, *Dissolved organic matter.

The labile fraction (biologically derived compounds such as carbohydrates, proteins, amino acids, and lipids) of dissolved organic matter (DOM) in a eutrophic lake was decomposed under anaerobic and aerobic conditions for 20 days. In

anaerobic decomposition total dissolved organic carbon decreased by 20% (initial concentration 4.19 mg C per liter), dissolved amino acids by 15% (initial concentration 0.49 mg C per liter), and dissolved carbohydrates by 48% (initial concentration 0.43 mg C per liter). In aerobic experiments with the same starting concentration, total dissolved organic C decreased by 26%, dissolved amino acids by 23%, and dissolved carbohydrates by 53%. These results show that the dissolved amino acids and dissolved carbohydrate fractions were preferentially decomposed compared with other fractions and are confirmed to be the labile fractions of dissolved organic matter. (Cassar-FRC)
W82-00917

THE USE OF ALGAL ASSAYS AND CHLOROPHYLL CONCENTRATIONS TO DETERMINE FERTILITY OF WATER IN SMALL IMPOUNDMENTS IN WEST VIRGINIA,
West Virginia Univ., Morgantown. Dept. of Biology.
J. Davis, and J. Decosta.
Hydrobiologia, Vol 71, No 1/2, p 19-34, May, 1980. 14 Fig, 7 Tab, 26 Ref.

Descriptors: *Phosphates, *Algae, *Fertility, Eutrophic lakes, Lakes, Artificial lakes, Reservoirs, *West Virginia, Chlorophyll, *Nutrients, Nitrates, Phytoplankton, Eutrophication, Selenastrum capricornutum, Trophic level, Productivity, Phosphorus.

Phosphorus was the limiting nutrient in seven small artificial lakes in West Virginia, according to 21-day algal assay tests with Selenastrum capricornutum. In every case the water was fertile enough for algae to grow well without additional nutrients. All lakes were classified mesotrophic to slightly eutrophic. Sampling was done from December 20, 1975, to October 17, 1976, once each during the spring and fall isothermal periods and biweekly during summer stratification. Total phosphate-P (in micrograms per liter) ranged from 8.1 to 16.2 in spring, 2.18 to 69.9 in summer, and 8.4 to 29.4 in fall. Nitrate-N (in mg per liter) ranged from 0.038 to 0.720 in spring, 0 to 0.370 in summer, and 0.008 to 0.170 in fall. Uncorrected chlorophyll a values (in micrograms per liter) were 1.7 to 61.4 in spring, 4.3 to 232.0 in summer, and 4.5 to 24.5 in fall. (Cassar-FRC)
W82-00919

INORGANIC TRANSFORMATION OF APPLIED PHOSPHORUS IN BRACKISH WATER FISH POND SOIL UNDER DIFFERENT WATER SALINITY LEVELS,
Central Inland Fisheries Research Inst., Barrackpore (India).
G. N. Chattopadhyay, and L. N. Mandal.
Hydrobiologia, Vol 71, No 1/2, p 125-130, May, 1980. 6 Tab, 12 Ref.

Descriptors: *Phosphorus, *Fish ponds, *Salinity, Chemical reactions, Organic matter, Phosphates, *Brackish water, Ponds, Nutrients, Fertilizers, Aquatic soils.

Transformation of phosphorus, applied as 0 or 100 ppm KH_2PO_4, to brackish water fish pond soil was studied at different salinity levels (trace, 10, 20, and 30 ppt) and in the presence and absence of organic matter, a P-free starch. Added P disappeared rapidly from the water phase. For example, without added organic matter and at trace salinity, 44.40 ppm P present in the water phase on the tenth day of incubation decreased to 16.2 ppm on day 100; at 30 ppt salinity, 58.90 ppm P decreased to 13.80 ppm by day 100. Increases in water salinity produced increases in amount of saloid-bound P and decreases in Bray's No. 2 extractable form P. The transformation product in highest concentration was calcium phosphate, especially in more saline water. Lesser amounts of iron phosphate and aluminum phosphate were formed. Addition of organic matter did not affect the transformation of P into calcium phosphate but reduced fixation into the iron phosphate form, increasing the availability of P in water and soil phases. These results suggest that a more effective method of adding P to brackish water ponds would be split doses in combination with organic matter. (Cassar-FRC)
W82-00920

INFLUENCE OF PHOSPHORUS LOADS AND OF SOME LIMNOLOGICAL PROCESSES ON THE PURITY OF LAKE WATER,
Polish Academy of Science, Warsaw. Inst. of Ecology.
Z. Kajak.
Hydrobiologia, Vol 72, No 1/2, p 43-50, July, 1980. 8 Tab, 68 Ref.

Descriptors: *Phosphorus compounds, *Nutrients, *Water quality, *Lakes, Cycling nutrients, Nitrogen compounds, Fish, Agriculture, Eutrophication, Aquatic life, Zooplankton, Limnology, Phytoplankton, Algae, Surface water, Lake sediments, Sediments, Sedimentation, Biomass, Seston, Reviews.

The problem of the relationship between nutrient loads and phytoplankton biomass is reviewed with special emphasis on phosphorus. Total P concentrations in pollution sources vary from 1000 mg per liter in animal waste slurries to 0.01-0.1 mg per liter from atmospheric precipitation and natural forest and meadow runoff. Surfact nonpoint outflow from towns and runoff from bare soil contribute the most P to surface waters. The contribution of agriculture to eutrophication becomes proportionally more important as more facilities remove P from sewage in tertiary treatment. P in lake water is removed by retention in the sediment, but returns again to the epilimnion through water circulation and recycling by algae and other organisms. Fish affect nutrient concentrations by stirring up bottom sediments, eliminating sedimenting feces, releasing nutrients by metabolism, changing the species composition, intensifying the decomposition process, and changing light conditions. In fish ponds with common carp, the addition of silver carp increases the phytoplankton biomass and the rate of P sedimentation and decreases the amount of P released by the zooplankton. (Cassar-FRC)
W82-00923

SIMULATION OF LAKE-WATERSHED SYSTEMS, I. DESCRIPTION AND SENSITIVITY ANALYSIS OF THE MODEL,
Alberta Univ., Edmonton. Dept. of Geology.
For primary bibliographic entry see Field 2A.
W82-00926

SIMULATION OF LAKE-WATERSHED SYSTEMS, II. APPLICATION TO BAPTISTE LAKE, ALBERTA, CANADA,
Alberta Univ., Edmonton. Dept. of Geology.
For primary bibliographic entry see Field 2A.
W82-00927

PREDICTION OF PHOSPHORUS AND NITROGEN CONCENTRATIONS IN LAKES FROM BOTH INTERNAL AND EXTERNAL LOADING RATES,
University of East Anglia, Norwich (England). School of Environmental Sciences.
P. L. Osborne.
Hydrobiologia, Vol 69, No 3, p 229-233, March, 1980. 1 Fig, 2 Tab, 13 Ref.

Descriptors: *Lake restoration, *Phosphorus compounds, *Nitrogen compounds, Lakes, Nutrients, *Eutrophic lakes, Model studies, Seasonal variation, Prediction, Loading rates.

A variation of the Vollenweider model predicting phosphorus and nitrogen concentrations from loading rates was tested with data from a shallow, eutrophic lake, Barton Broad, 70 ha in area and 1 meter deep. Both external and internal loading occurred. Predicted and observed concentrations of P and N in the outflow were similar. Splitting the year into seasons overcame the problem of fluctuations in P and N loading rates (nutrient inputs from land drainage were higher in winter, and internal loading occurred in summer). The model can be used to predict the reduction in loading rate required either to limit phytoplankton population and improve water quality or to determine the nutrient concentrations suitable for reestablishing submerged macrophytes. (Cassar-FRC)
W82-00928

PHOSPHATE MODELS, A GAP TO BRIDGE,
Station Biologique de la Tour du Valat, Arles (France).
H. L. Golterman.
Hydrobiologia, Vol 72, No 1/2, p 61-71, July, 1980. 1 Fig, 3 Tab, 31 Ref.

Descriptors: *Model studies, *Phosphates, *Phytoplankton, Statistical models, Conceptual models, Nutrients, Lakes, Sedimentation, Adsorption, Productivity, Prediction, Loading rates.

Models for predicting phytoplankton productivity as a function of phosphate loading are necessary for water management. This paper discusses the differences between statistical models and dynamic or conceptual models and makes suggestions for bridging the gap between the two. In statistical models, formulas described the relationships between the P-loading and P-concentrations based on the statistical analysis of data derived from a population of lakes. In conceptual models, processes concerning P-dynamics are measured and formulas developed to describe these processes. The constants are then adjusted iteratively to achieve best fit. Conceptual models are difficult to extend to lakes other than those for which they were developed. The easier way to bring the two types of models closer together is to have correct statistical data on total sediment load, water hardness, productivity, rainfall, and other parameters. Then conceptual models can be used for sensitivity analysis and to provide information for further analysis of statistical models. Models based on fluxes have the greatest predictive value and make it easier to apply data from one lake to another. (Cassar-FRC)
W82-00929

REVIVING ACIDIFIED LAKES,
Uppsala Univ. (Sweden). Dept. of Limnology.
W. Rohde.
Ambio, Vol 10, No 4, p 195-196, 1981. 1 Fig, 8 Ref.

Descriptors: *Lake restoration, *Acidic water, *Neutralization, Rehabilitation, Lakes, Acidity, Acid rain, Algae, Bacteria, Water pollution effects, Water pollution treatment, *Sweden, Hydrogen ion concentration, Calcium carbonate.

The progressive acidification of lakes can be somewhat counteracted by the addition of neutralizing materials, but even very acid bodies of water are objects of natural colonization within a short time. Sweden has treated about 1000 lakes by adding calcium carbonate or other neutralizing materials, but the treatment is expensive and must be repeated. When the pH reaches 4 or 5, almost none of the original organisms are able to survive. Japan's volcanic lakes with pH's of 2-5 have existed long enough for acid-tolerant and acidophilic organisms to become established. These lakes include bacteria, fungi, algae, animals, macrophytes, and one species of fish. Thus, water devoid of life is the object of colonization, and research should be undertaken to determine the best autotrophic algae to introduce as pioneers. From naturally acid waters, plankton and benthic algae could be collected and studied, and eventually used to inoculate large bodies of water. At present, the only alternative is to apply neutralizing agents. (Small-FRC)
W82-00933

METHANE FORMATION IN THE ACID PEATS OF OKEFENOKEE SWAMP, GEORGIA,
Michigan State Univ., Hickory Corners. W. K. Kellogg Biological Station.
G. A. King, T. Berman, and W. J. Wiebe.
American Midland Naturalist, Vol 105, No 2, p 386-389, April, 1981. 2 Tab, 14 Ref.

Descriptors: *Methane, *Swamps, Methane bacteria, Peat, Peat bogs, Peat soils, Muck soils, Organic soils, Acidity, Acidic soils, *Okefenokee Swamp, Georgia.

Gas bubbles were collected at several sites in the Okefenokee Swamp in Georgia. Rates of methane production in peat samples were determined by first obtaining cores from the various Cooter Lake and Grant Prairie sites with 4-inch OD Plexiglas coring tubes. Analysis of the gas bubbles suggests that methanogenesis does occur in the Swamp despite the low pH. No apparent trend for lesser amounts of methane was evident among samples from sites with low pH at Cooter Lakes vs. the sites with higher pH at Lake Louise and Grassy Pond. The high content of methane in bubbles relative to carbon dioxide and the lesser solubility of methane indicates that bubbles in Okefenokee peat originate from a methane nucleus. In vitro studies revealed substantial rates of methane production. This production in the swamp could result in the formation of a major habitat, the floating peat batteries, and may be a significant source of methane to the atmosphere. A cycle of sinking-floating batteries controlled by bacterial activity may exist in the peat batteries of the swamp. (Baker-FRC)
W82-00936

MEAN SUMMER CIRCULATION IN LAKE ONTARIO WITHIN THE COASTAL ZONE,
Woods Hole Oceanographic Institution, MA.
G. T. Csanady, and J. T. Scott.
Journal of Geophysical Research, Vol 85, No C5, p 2797-2812, May, 1980. 8 Fig, 1 Tab, 21 Ref.

Descriptors: *Water circulation, Lakes, *Coastal waters, Lake shores, Flow characteristics, Flow profiles, Mathematical models, *Lake Ontario.

The mean flow pattern was observed in the well-resolved coastal zone of Lake Ontario during the summer (July 15 through August 15) of 1972. Detailed velocity and temperature profiles were used to define the summer circulation pattern. Simple equilibrium models of wind-driven flow were used to explain some of the features of the flow pattern. South shore mean currents behaved remarkably like the simple theoretical model of steady wind-driven flow in a two layer basin. North shore mean flow was completely different and lacked coastal jets. This was probably due to momentum (and heat) advection during full upwelling episodes. Thus, the south shore current pattern consisted of divergent coastal jets, the eastern shore had a deep current generated by interface friction below the strong coastal jets, and the northern shore return flow of warm water was probably accomplished at some distance offshore. (Small-FRC)
W82-00967

THE EFFECT OF CHANGES IN THE NUTRIENT INCOME ON THE CONDITION OF LAKE WASHINGTON,
Washington Univ., Seattle. Dept. of Zoology.
W. T. Edmondson, and J. T. Lehman.
Limnology and Oceanography, Vol 26, No 1, p 1-29, January, 1981. 13 Fig, 11 Tab, 55 Ref.

Descriptors: *Phosphorus, *Nitrogen, *Eutrophic lakes, *Nutrients, Lakes, Lake sediments, Seasonal variation, Water pollution, Wastewater disposal, Eutrophication, *Lake Washington, Washington.

Variations in nutrient income resulting from alterations in sewerage arrangements have had a significant effect on the condition of Lake Washington. Between 1941 and 1963, the lake received increasing amounts of secondary sewage effluent from the Seattle, Washington, metropolitan area, with resultant changes in the amount of nutrients in the water and in the kind and quantity of phytoplankton. The lake responded quickly to declining inputs of effluent between 1963 and 1968, when almost all discharges to the lake were discontinued. The amount of nutrients, the quantity of phytoplankton, and the proportion of blue-green algae all decreased during this period. By 1975, the lake could be regarded as having recovered from eutrophication. Calculations of phosphorus and nitrogen income sewage to the lake had much more effect on the phosphorus regime than on the nitrogen regime. Total phosphorus input varied from a high of 204,200 kilograms per year in 1964 to a low of 42,900 in 1973 and 1976, with sewage contributing about 72 percent of the total in 1962. Variation in total nitrogen ranged from a high of 1,419,000 kilograms per year in 1964 to 734,000 in 1976. Seasonal differences were found in the deposition of phosphorus to and release from the sediments. On the average, the sediments retained about 57 percent of the income over the long term. After diversion of the sewage effluent from the lake, there was a slight increase in the proportion of incoming phosphorus lost to the sediments. The amount of phosphorus lost permanently to the sediments during a year was found to be more closely related to the annual income than to the mean concentration in water. (Carroll-FRC)
W82-00987

EXPERIMENTAL MANIPULATION OF ALGAL BLOOM COMPOSITION BY NITROGEN ADDITION,
Department of Fisheries and Oceans, Winnipeg (Manitoba).
For primary bibliographic entry see Field 5C.
W82-00998

HEAVY METAL CONTENTS IN SOME MACROPHYTES FROM SAGINAW BAY (LAKE HURON, U.S.A.),
Cranbrook Inst. of Science, Bloomfield Hills, MI.
For primary bibliographic entry see Field 5B.
W82-01000

A METHOD FOR THE EVALUATION OF CONDITIONS IN A FISH POND SEDIMENT,
Science and Education Administration, Durant, OK. Southern Plains Watershed and Water Quality Lab.
Y. Avnimelech, M. Lacher, A. Raveh, and O. Zur.
Aquaculture, Vol 23, No 1-4, p 361-365, April, 1981. 2 Tab, 6 Ref.

Descriptors: *Bottom sediments, *Fish ponds, *Ecosystems, Phosphorus, Sediments, Organic matter, Fish, Decomposing organic matter, Anaerobic conditions, Measurement techniques.

Intensive fish farms are known to suffer significant decreases in fish growth and increases in the yield coefficient over time. This decline in fish pond fertility with time appears to result from excessive and rapid accumulation of organic carbon and nitrogen compounds in the fish pond sediment, which can cause a reduction in the oxidation potential. Although the rate of fish growth is commonly used to evaluate conditions in the fish pond, it is hard to relate fish growth to the conditions in the sediment at a given time using this method. A method for measuring fish grazing in the sediment has been developed to assist evaluation of the overall conditions in the sediments at a given time. The method involves measuring the extent of grazing of fish at the sediment by counting the phosphorus-32 tagged mud in the digestive tract of fish. The method was tested using two types of sediments (fresh soil and soil which had previously been used in intensive aquaculture systems for about 100 days) and three treatments with nutrient pellets (none, 60 grams, and 100 grams). In the control experiments, nets prevented the fish from grazing. Analysis of the uptake of the tagged mud by the fish showed that the uptake of phosphorus-32 by fish in containers with fresh soil without added nutrients was only slightly higher than the uptake of the tagged mud in the control treatment, which was not negligible. Fish in containers with fresh soil enriched with nutrients had the highest phosphorus-32 uptake. Fish in containers with enriched aged fish pond sediments, which were overloaded and anaerobic, showed phosphorus-32 uptakes which were about one third less than those in the enriched fresh soil. This method is shown to yield consistent results which are in agreement with previous experiences and observations of the fish growth in intensive ponds. (Carroll-FRC)
W82-01019

THE EFFECT OF CONTINUOUS ADVANCED WASTEWATER TREATMENT BY THE CITY OF SPOKANE ON THE TROPHIC STATUS OF LONG LAKE, WA DURING 1979.
Eastern Washington Univ., Chemey. Dept. of Biology.
State of Washington Department of Ecology, Olympia, Document DOE 80-11, October, 1980, 86 p. 18 Fig, 25 Tab, 34 Ref.

Descriptors: *Mesotrophic lakes, Mesotrophy, *Trophic level, *Lakes, Water quality management, *Wastewater treatment, Phosphorus removal, Chlorophyll A, On-site data collections, Hydrologic data collections, Phytoplankton, Phosphates, Water quality, *Long Lake, Reservoirs, Spokane River, *Washington.

The water quality of Long Lake, an impoundment of the Spokane River, was documented in a study conducted during the second year of operation of an advance wastewater treatment facility (AWT) built by the City of Spokane in 1977. Long Lake was found to exhibit mesotrophy, as it had in a study conducted in 1978. Phosphorus removal from the sewage effluent resulted in significantly lower phosphate loads to the reservoir than before the AWT was implemented. Phytoplankton biovolumes were also reduced. Correlations showed that chlorophyll A concentrations gave a reasonable estimate of phytoplankton standing crop. In addition, areal phosphorus loading gave an excellent estimate of mean chlorophyll A concentration. The successional patterns of the major zooplankters were similar to those observed in 1978 and prior to the AWT. Zooplankton standing crops were less dense than those determined before the AWT, possibly the result of decreased food availability. Analysis of variance and least significant difference statistical evaluation showed that mean daily total and orthophosphate loads in 1979 at the AWT sewage effluent (S.E.) sampling station were significantly lower than those prior to AWT, but not from those determined in 1978. The sewage outfall effected an increase of total inorganic nitrogen and orthophosphate concentrations in the river of 1.6 and 2.5 times, respectively. (Garrison-Omniplan)
W82-01070

AN ASSESSMENT OF THE TROPHIC STATUS OF DEER, LOON, AND DIAMOND LAKES,
Washington State Dept. of Ecology, Olympia.
L. Singleton, J. Thielen, and D. Kruger.
Document DOE 80-9, July 1980. 33 p. 13 Fig, 12 Tab, 26 Ref, 3 Append.

Descriptors: *Trophic level, Mesotrophy, *Lakes, *Mesotrophic lakes, *Water pollution effects, Pollution effects, Eutrophication, Oxygen depletion, Water quality, Water quality standards, Data collection, On-site data collections, Hydrologic data collections, Deer Lake, Loon Lake, Diamond Lake, *Washington.

The trophic status of Deer, Loon, and Diamond Lakes, located north of Spokane, Washington, was evaluated during the 1978 growing season. Sampling occurred bi-weekly from May to November. Historical data were also utilized to determine if water quality had changed in any of the lakes. The results indicated that all three lakes are mesotrophic, each having nutrient and chlorophyll A concentrations below the levels established for eutrophic waters. All three lakes experience some degree of hypolimnetic anoxia, with Loon Lake the most anoxic. Deer Lake has the fewest water quality problems of the three, and the least amount of hypolimnetic oxygen depletion. Deer Lake appears able to sustain its present trophic condition longest and therefore should probably be the last of the three lakes sewered. Diamond and Loon Lakes both have some water quality problems which indicate they are not as stable. Loon Lake showed a significant decrease in water clarity and a significant decrease in the mean secchi disk depth. The anoxia observed in Diamond Lake was not as severe as in Loon Lake; however, it is still noteworthy. The water quality of Diamond Lake appears to be spatially affected by sludge beds present from previous log rafting practices. The sewering of Loon and Diamond Lakes needs further evaluation utilizing current demographic and land usage trends present at each lake. Conditions seem to have changed little since the DOE study in 1973; another study is recommended for 1983. (Garrison-Omniplan)
W82-01072

GONAD DEVELOPMENT, FECUNDITY, AND SPAWNING SEASON OF LARGEMOUTH BASS IN NEWLY IMPOUNDED WEST POINT RESERVOIR, ALABAMA-GEORGIA,
Alabama Cooperative Fishery Research Unit, Auburn.
T. J. Timmons, W. L. Shelton, and W. D. Davies.
Technical Papers of the U.S. Fish and Wildlife Service. No 100, 1980. 8 p. 2 Fig, 2 Tab, 28 Ref.

Descriptors: *Reservoir fisheries, *Bass, *Spawning, *Seasonal distribution, *Fish eggs, Fish populations, Fish establishment, Mature growth stage, Environmental effects, *West Point Reservoir, Alabama, Georgia.

After the filling of a new reservoir provides a large area and volume of water for fish population expansion, largemouth bass usually thrive for the first 3 to 10 years, after which growth rate slows. Little is known about the fecundity and sexual maturity of the early year classes of fast-growing largemouth bass in reservoirs in the southeast. West Point Reservoir, an impoundment of the Chattahoochee River, was impounded in October 1974 and filled to full power pool by May 1975. Because high turbidity precluded observation of nest-building and spawning, the spawning period was determined by observing the frequency distribution of ovarian egg diameters and calculating gonosomatic indices. The percentage of body weight contributed by the ovaries and frequency distributions of ovarian egg diameters were reliable indicators of the spawning season of the largemouth bass in the reservoir in 1977. Spawning began in mid-April and continued until mid-June. Some fish apparently spawned more than once, but no summer or fall spawning was indicated. Individual fecundity, determined by a dry weight method, ranged from 6,232 to 117,241 mature eggs for fish over 300 mm in total length. Eggs matured at a size larger than those described in other studies of largemouth bass. The fast-growing initial year classes (1975 and 1976) of largemouth bass dominated the reproducing population. (Moore-SRC)
W82-01080

THE IMPACT OF A NATURAL DRAWDOWN ON THE GROWTH OF FOUR EMERGENT SPECIES IN A PRAIRIE GLACIAL MARSH,
Iowa State Univ., Ames. Dept. of Botany and Plant Pathology.
A. G. Van der Valk, and C. B. Davis.
Aquatic Botany, Vol 9, No 4, p 301-322, December, 1980. 6 Fig, 5 Tab, 20 Ref.

Descriptors: *Marshes, *Drawdown, Water level, Drought, *Aquatic plants, Vegetation, *Ecological effects, *Eagle Lake, Iowa.

The impact of a natural drawdown in 1977 on the growth of four dominant emergent species at Eagle Lake, Iowa was investigated. Three of the species (Scirpus validus Vahl, Sparganium eurycarpum Engelm. and Typha glauca Godr.) dominate the polydominant communities of the cyclic zone of the Lake. S. eurycarpum and T. glauca also grow in monodominant communities in the non-cyclic zone. Scirpus fluviatilis Gray is found only in small monodominant stands in the non-cyclic zone. Growth of the three species was severely hampered by the drought. The drought, however, reversed a decline in vigor which had started before the drought in Scirpus validus Vahl. The drought enabled this species to exist in the marsh for two more years. The data suggest that periodic drawdowns enable several emergent species to coexist in a community due to their diverse responses to the disturbance. (Baker-FRC)
W82-01096

2I. Water In Plants

TRANSPIRATION, STOMATAL CONDUCTANCE, AND PHOTOSYNTHESIS OF TOMATO PLANTS WITH VARIOUS PROPORTIONS OF ROOT SYSTEM SUPPLIED WITH WATER,
Department of Agriculture, Harrow (Ontario).
C. S. Tan, A. Cornelisse, and B. R. Buttery.
Journal of the American Society for Horticultural Science, Vol 106, No 2, p 147-151, March, 1981. 3 Fig, 4 Tab, 14 Ref.

Descriptors: *Tomatoes, *Root development, *Irrigation requirements, Plant growth, Water requirements, *Transpiration, Photosynthesis, Stomatal transpiration, Soil moisture, Water conservation, Agriculture, Water stress, Soil water.

Tomato (Lycopersicon esculentum Mill.) plants were grown in sectional boxes so that each quadrant of the root system could be watered separately. Withholding water from 1 or 2 quadrants did not reduce transpiration, photosynthesis, stomatal conductance, or leaf surface area, suggesting that the absorption capacity of the tomato roots increased in response to the transpirational demand. The shoot:root ratio of the plants increased as the proportions of roots supplied with water increased, 18.4 at 25% watered to 27.9 at 100% watered. Withholding water from 25, 50, and 75% of the root system for two weeks, followed by full watering caused no apparent damage to the root systems in the dry quadrants. Transpiration (1.98-2.45 kg per day), photosynthesis (8.7-10.6 mg per sq dm per hour), and stomatal conductance (0.19-0.24 cm per sec) recovered fully. These results suggest that there is no need to irrigate the entire root system. (Cassar-FRC)
W82-00504

WATER RELATIONS OF THREE COWPEA CULTIVARS (VIGNA UNGUICULATA L.),
Ibadan Univ. (Nigeria). Dept. of Agronomy.
O. Babalola.
Plant and Soil, Vol 56, No 1, p 59-69, 1980. 3 Fig, 3 Tab, 14 Ref.

Descriptors: *Water stress, *Growth rates, *Crop yields, Soil water, Roots, Water use efficiency, Evapotranspiration, Cowpea, *Nigeria, Soil-water-plant relationships.

Three cowpea cultivars were investigated to determine the effect of water stress at different growth stages with respect to floral abscission and other growth parameters. Root system development and soil moisture extraction patterns were determined, and water use efficiency under dryland farming was investigated. Soil moisture stress significantly reduced growth and yield (34-46%) of all three. For Ife Brown variety, a semi-erect type, grain yield reduction was highest when stress was imposed at flowering/podding stages. There was no reduction in yield for New Era, a spreading type. Ife Brown was most sensitive to decreased matric potential, and New Era exhibited the highest formal abortion. Evapotranspiration was higher for New Era and Ife Brown than for Adzuki, an erect type. Water use efficiency was highest for New Era and least for Adzuki. New Era may not be suitable for intercropping, but Ife Brown may be popular because its drought susceptibility is intermediate. (Small-FRC)
W82-00607

THE EFFECT OF TEMPERATURE ON SALT UPTAKE BY TOMATO PLANTS WITH DIURNAL AND NOCTURNAL WATERLOGGING OF SALINIZED ROOTZONES,
Victorian Dept. of Agriculture, Ferntree Gully (Australia). Scoresby Horticultural Research Station.
D. W. West, and J. A. Taylor.
Plant and Soil, Vol 56, No 1, p 113-121, 1980. 1 Fig, 2 Tab, 4 Ref.

Descriptors: *Temperature effects, *Salinity, *Accumulation, *Tomatoes, Waterlogging, Root zone, Roots, Sodium chloride, Sodium ions, Chloride ions, Compairson studies.

Tomato plants were grown at three temperatures with the rootzones of half the plants waterlogged for the day or night period of each 24 hours. Other plants were grown with drained rootzones, and all plants were irrigated with saline (0.09 M NaCl) nutrient solution. Increase in temperature resulted in increases in leaf Na-ion and Cl-ion concentrations in plants with drained rootzones. In waterlogged plants, the maximum leaf concentration of the ions occurred at 20C. There were no differences in ion concentrations at 10C between drained and waterlogged rootzones. Waterlogging of the rootzones resulted in higher concentrations of ions in leaf and stem tissues at 20 and 28C. No differences were found in the Na and Cl ions in plant tops when plants were waterlogged during the day or night. As temperature increased, transpiration increased, but no other treatment dependent responses were noted. Thus, the direct importance of temperature of growth on the interaction between salinity and waterlogging was demonstrated. (Small-FRC)
W82-00608

MOISTURE TRANSPORT IN A SOIL-PLANT SYSTEM: A MATHEMATICAL MODEL AND FINITE ELEMENT ANALYSIS,
Weyerhauser Co., Centralia, WA.
P. Farnum, and G. F. Carey.
Advances in Water Resources, Vol 4, No 2, p 67-76, June, 1981. 10 Fig, 1 Tab, 26 Ref.

Descriptors: *Soil-water-plant relationships, *Mathematical models, *Water transport, Plant water potential, Soil water, Evapotranspiration, Finite element method, Mathematical studies.

A comprehensive integrated model was developed for the mathematical analysis of moisture transport from the soil through an individual plant to the atmosphere. The important features associated with non-linear time-dependent diffusion in a non-homogeneous soil are incorporated, including local flow to the individual roots. The flow system is modeled by modeling separate flow subsystems. The model and analysis were used to assess given environmental conditions and to assist in establishing planting guidelines in reforestation. The model's intrinsic value lies in hypothesis testing, including the proposed improvement or elaborations on particular local features. Also, models of the soil-plant system can be incorporated and their effect on the entire system determined. Model predictions compared well with actual experimental results. (Small-FRC)
W82-00648

THE EFFECT OF HEIGHT OF WATER TABLE ON THE GROWTH OF HOLCUS LANATUS WITH REFERENCE TO LOLIUM PERENNE,
Oxford Univ. (England). Dept. of Agricultural Science.
T. A. Watt, and R. J. Haggar.
Journal of Applied Ecology, Vol 17, No 2, p 423-430, August, 1980. 6 Fig, 1 Tab, 15 Ref.

Descriptors: *Soil-water-plant relationships, *Plant growth, *Water table, Water level, Soil water table, Experimental data.

Plants of Holcus lanatus L. and Lolium perenne L. occur frequently in wet sites. They invade sown areas earlier and spread more rapidly on heavy, poorly drained sites. Plants of the two weeds were grown in monocultures and in 50:50 mixtures in free-draining conditions and with water table levels of 5, 11, or 21 centimeters below the soil surface in an effort to determine the effects of depth of the water table on their growth. At the first harvest all three stand types produced the highest yields with the lowest water table, with yields decreasing with increasing height of water table. At subsequent harvest, the free-draining treatment resulted in the highest yields. The absence of significant species times stand type and stand type times water table interactions indicate that there was no difference between the effects of interspecies or intraspecies competition. There was no significant difference between the percentage nitrogen contents of the two grasses in monocultures, with increasing water table height resulting in lower concentrations of nitrogen in both species. While L. perenne did not produce surface roots, coverage of the soil surface by surface roots of H. lanatus ranged from 15% in free-draining soil to 83% in the high water table treatment. There was also an increase in the number of nodes producing roots in H. lanatus with increasing height of water table. These results indicate that adaptations made

by the H. lanatus plant when growing in soil with a high water table may contribute to their long-term survival at the expense of short-term shoot production. (Carroll-FRC)
W82-00654

CONSUMPTIVE USE AND DAILY EVAPOTRANSPIRATION OF CORN UNDER DIFFERENT LEVELS OF NITROGEN AND MOISTURE REGIMES,
Andhra Pradesh Agricultural Univ., Hyderabad (India). Dept. of Agronomy.
For primary bibliographic entry see Field 2D.
W82-00660

ANNUAL PLANT PRODUCTION-PRECIPITATION RELATIONS IN ARID AND SEMI-ARID REGIONS,
Botanical Research Inst., Pretoria (South Africa).
M. C. Rutherford.
South African Journal of Science, Vol 76, No 2, p 53-56, February, 1980. 1 Fig, 35 Ref.

Descriptors: *Crop production, *Rainfall rate, Productivity, Precipitation intensity, *Semiarid lands, *Arid lands, Semiarid climates, Climates, Water stress, Mathematical studies.

An attempt is made to appraise published relations between annual precipitation and annual plant community production for arid and semi-arid areas. In many cases formulas used are not suitable for these areas. Usually their unsuitability is due to a lack of supporting data or such other reasons as the arbitrary extrapolation of results from short intervals of a growing season over longer periods, the integration of the moisture regime with other important environmental factors, the assumption of linear or identity relations between moisture regime and production, and the limitation of the prediction to only part of the potential plant production. Discussion is given of Walter's relation, in which mean annual precipitation is related to above-ground herbaceous production for semi-arid areas of South West Africa. Discussion is also given to Rosenzweig's and Lieth's relations. The Rosenzweig curve relates annual actual evapotranspiration and above-ground plant production over a much greater range of annual precipitation than Walter's equation. Lieth's Miami Model and the C. W. Thornthwait Memorial Model both predict total production above and below ground. It is concluded that future work in this field would benefit from a clear definition of the term 'production,' objective sampling, full presentation of the data, inclusion of other climatic variables to help refine production relations and improve levels of predictability, and adequate testing of available relations before application, with the derivation of new relations where necessary. (Baker-FRC)
W82-00693

GROWTH AND NITROGEN FIXATION OF AESCHYNOMENE UNDER WATER STRESSED CONDITIONS,
Florida Univ., Gainesville. Dept. of Agronomy.
S. L. Albrecht, J. M. Bennett, and K. H. Quesenberry.
Plant and Soil, Vol 60, No 2, p 309-315, 1981. 1 Fig, 3 Tab, 23 Ref.

Descriptors: *Water stress, *Nitrogen fixation, *Tropical regions, Waterlogging, Drainage, *Legumes, Soil properties, Soil porosity, Soil moisture retention, Flooding, Nitrogen, Soil moisture deficiency, Moisture deficiency, Plant growth, *Aeschynomene, Soil-water-plant relationships.

The tolerance of nitrogen fixation was studied in several accessions of Aeschynomene americana in response to various levels of soil moisture. The accessions of A. americana were subjected to periods of flooding or soil water deficits to determine stress effects on nitrogen fixation. Cuttings of 22 field grown accessions were rooted in sand and transplanted to a mixture of Wauchula sand, peat and perlite in pots. Nitrogenase activity was determined by the acetylene reduction assay. Both flooding and drought treatments showed increased root weights. The flooding treatment did not significantly reduce nodule weight, percent nodulation, or nitrogenase activity, whereas soil moisture deficits caused reductions in these variables. Many of the accessions have effective mechanisms for maintaining active nodules under flooded conditions. Flooded plants maintained leaf water, osmotic and turgor potentials which were similar to those of the well-watered controls. Droughted plants appeared to have much lower nodule water potentials. Flooded plants maintained leaf water relationships which were slightly more favorable than those of the well-watered controls, although the differences were small. It is not known which factors specifically allow waterlogged A. americana to fix nitrogen. Accessions which showed good growth and nitrogen fixation under flooding in the greenhouse will be tested on seasonally waterlogged areas to measure performance in the field. (Baker-FRC)
W82-00758

WATER DYNAMICS IN THE SOIL-PLANT-ATMOSPHERE SYSTEM,
Science and Education Administration, Temple, TX. Grassland, Soil and Water Research Lab.
J. T. Ritchie.
Plant and Soil, Vol. 58, No. 1-3, p 81-96, 1981. 4 Fig, 34 Ref.

Descriptors: *Soil-water-plant relationships, *Agriculture, *Soil water, *Crop production, Atmospheric pressure, Transpiration, Mathematical models.

Water dynamics in the soil-plant-atmosphere system are determined by the capacity of the soil water reservoir, its depletion and replenishment, and its efficient management for crop production. Water balance calculations using computers provide a means for accurate estimations of crop yields, early warning about food shortages, and reliable irrigation scheduling and water resource planning. Reliable water balance evaluations depend upon accurate estimation of evaporation from soil and plants. Incomplete crop canopy or a deficiency of water in the root zone may cause a discrepancy between actual evaporation and maximum evaporation. Since it is almost impossible to generalize about plant response to water deficit using soil measurements, attention has been focused on the use of plant measurements for this parameter. Physical measurements sensitive to crop water deficit include plant stomatal resistance and plant water potential. However, both of these measurements are difficult to utilize for operational purposes. Accurate water balance modelling also requires estimation of the amount of water infiltration into the soil from precipitation or irrigation, which can be accomplished using either physical models of hydrologic processes or statistical models fitted to experimental data. (Carroll-FRC)
W82-00759

TEMPERATURE AND WATER RELATION PATTERNS IN SUBALPINE UNDERSTORY PLANTS,
Wyoming Univ., Laramie. Dept. of Botany.
W. K. Smith.
Oecologia, Vol 48, No 3, p 353-359, 1981. 6 Fig, 1 Tab, 30 Ref.

Descriptors: *Plant growth, *Water requirements, Transpiration, Mountains, Cold regions, Water stress, *Temperature effects, Forests, Rocky Mountains.

A comparison was made of the temperature and water relations of seven understory species that are abundant and grow sympatrically in the understory of the coniferous forests of the Rocky Mountains. Several general characteristics in the water relations of the seven species emerged. Soil moisture remained relatively high throughout the summer even though minimum plant xylem water potentials commonly decreased below minus 1.0 MPa, especially for the more shallow rooted herbaceous species. Leaf temperatures and conductances rose sharply during exposure to sunflecks, along with corresponding increases in transpiration and decreases in xylem water potentials. Midday wilting occurred for four of the seven species, all of which were herbaceous. Turgor was regained fairly rapidly during subsequent shade periods. Stomata on either leaf surface appeared to remain fully open when oriented away from direct sunlight. The stomatal opening in the morning occurred rapidly for sunlit leaves compared to a more gradual opening for plants in the shade. The amount of incident light on abaxial surfaces was not sufficient to cause full stomatal opening. The study indicated that midday wilting may be a common understory phenomenon within coniferous forests in the Rocky Mountains. Apparently, either water uptake from the soil or water transport from the roots to the leaves was not sufficient to support the transpiration demand for these herbaceous species, in contrast to the two species which were more deeply-rooted, and shrubby in nature. (Baker-FRC)
W82-00760

WATER STATUS OF SOIL AND VEGETATION IN A SHORTGRASS STEPPE,
Colorado State Univ., Fort Collins. Natural Resource Ecology Lab.
O. E. Sala, W. K. Lauenroth, W. J. Parton, and M. J. Trlica.
Oecologia, Vol 48, No 3, p 327-331, 1981. 6 Fig, 17 Ref.

Descriptors: *Vegetation, *Soil water, Moisture stress, Water stress, Water loss, Water supply, Water shortage, Water scarcity, Water deficit, Moisture availability, *Steppes, North America, Soil-water-plant relationships, Semiarid climates, Plant growth, Available water.

Patterns of water availability were investigated in the semiarid shortgrass steppe region of North America. Specifically, attempts were made to describe the status and transfers of water among the soil-plant-atmosphere compartments during a drying cycle, the pattern of water losses from a completely wet soil profile, and how some physiological plant variables were affected throughout a drying cycle. The study site was on the piedmont or northcentral Colorado at Pawnee Site, about 61 km northeast of Fort Collins. Principal perennial species on the study site were blue grama, fringed sagewort, plains pricklypear, and needleleaf sedge. Plant and soil water measurements were taken on 15 dates during a 56 day dry cycle. At the beginning of the cycle, water loss occurred exclusively from the top layer. After that the next deeper layer also began contributing water to the total loss. Sixteen days passed before water potential values significantly different from zero were recorded in the 15 cm depth layer. In the deepest layer, 60 cm, water loss began to occur 39 days after the start of the study. Through the first 50 days of plant growth, leaf conductance and water potential at noon slowly declined. After 50 days these levels decreased rapidly. The predawn water leaf potential remained unchanged during the first 45 days, decreasing rapidly thereafter. Predawn leaf water potentials were highly correlated with water potentials of the wettest layer. It appeared that the root surface area limited the water flow through an important part of the day in this semiarid ecosystem. Axial root resistance did not appear significant in determing equilibrium status between leaves and the wettest soil layer. (Baker-FRC)
W82-00761

COMPARATIVE FIELD WATER RELATIONS OF FOUR CO-OCCURING CHAPARRAL SHRUB SPECIES,
San Diego State Univ., CA.
S. W. Roberts, P. C. Miller, and A. Valamanesh.
Oecologia, Vol 48, No 3, p 360-363, 1981. 4 Fig, 18 Ref.

Descriptors: *Water requirements, *Plant growth, Seasonal variations, *Chaparral, Shrubs, Water potentials, Drought, Water shortage, Moisture stress, Water stress.

Seasonal water use patterns were investigated in chaparral shrubs using the null-balance approach and evaluating the method with regard to previous measurements of water use patterns in these same shrubs. Field measurements of xylem pressure po-

tential and leaf conductance were made through a summer drought cycle of Adenostoma fasciculatum, Ceanothus greggi var perplexens, Quercus dumosa, and Arctostaphylos glauca, from June through November 1978 at Echo Valley, California. Progressive drought development was noted over the seasonal courses of minimum water potential measurements, with a further clear seasonal segregation by species becoming evident. Maximum conductances showed differences between species, and in A. fasciculatum there were further differences by leaf age class. No differences in maximum conductances between old and new leaves of A. glauca were noted; in general this plant showed the lowest maximum conductances. A peak in October of maximum conductance was noted in association with a short period of precipitation. Diurnal variation of water potential-leaf conductance relations showed large hysteresis early in the season for A. fasciculatum leaves on the equator-facing slope. The hysteresis decreased as the drought progressed. These findings suggest that early in the season the water is available to the shrubs and therefore stomatal behavior is largely governed by a complex array of environmental factors. Late in the season, however, stomatal behavior becomes increasingly dominated by tissue water status. (Baker-FRC)
W82-00762

THE EFFECT OF ENVIRONMENTAL UNCERTAINTY ON MORPHOLOGICAL DESIGN AND FLUID BALANCE IN SARRACENIA PURPUREA L.,
Stanford Univ., CA. Dept. of Biological Sciences.
J. Kingsolver.
Oecologia, Vol 48, No 3, p 364-370, 1981. 10 Fig, 17 Ref.

Descriptors: *Water potentials, *Plant morphology, *Pitcher plant, Leaves, Evaporation, Precipitation, Drying, Rainfall, Simulation, Model studies.

The morphological design of pitcher plant leaves was considered with respect to their fluid balance in variable environments. Leaves of different sizes and geometries were compared with respect to fluid loss and fluid gain rates. Responses of these different geometries to variations in the hydric environment were analyzed. General design principles were sought in variable and unpredictable environments, with the aim of finding the leaf shape which minimizes the probability that the leaf will lose all of its fluid at any time. The major components of the leaf fluid balance were taken to be precipitation and evaporation, with all other components neglected for the predictions of leaf fluid levels. The temporal distribution of rainfall at the study area is highly non-uniform, with no measurable precipitation occurring on 62% of all days, and with less than 1.0 cm/day falling on 75.5% of the days on which precipitation fell. While no single design criterion can determine the morphology of an organism, it became increasingly clear that continual maintenance of positive fluid balance may be a relevant design criterion for leaf geometry. In terms of both shape and leaf size, the pitcher leaf of Sarracenia purpurea is indeed an effective design for reducing desiccation frequency. Desiccation is related not to the mean but to the variation in fluid volume during the season. The pitcher leaf integrates meteorological information over the time period which corresponds closely to the temporal distribution of variation in rainfall. The leaf thus acts as a low-pass filter which selectively removes the high frequency components of rainfall variation. (Baker-FRC)
W82-00811

PLANT-WATER RELATIONS AND ADAPTATION TO STRESS,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
N. C. Turner, and J. E. Begg.
Plant and Soil, Vol 58, No 1-3, p 97-131, 1981. 6 Fig, 2 Tab, 180 Ref.

Descriptors: *Water stress, *Soil-water-plant relationships, Water deficit, Crop yield, Crop production, Plant morphology, *Plant growth, Plant physiology, Soil water, Evaporation, Rainfall, Literature reviews.

Water deficits affect the growth and yield of plants in many ways. While dramatic increases in yields of cereals have been experienced in areas having a regular supply of water assured through rainfall or irrigation, arid and semi-arid regions have experienced much smaller increases over the past 40 years. Improved varieties and higher fertilizer use are not as effective in increasing yields in water-limited environments as they are in more temperate regions or in areas in which irrigation can be provided. Large year-to-year variations in rainfall in Mediterranean-type environments also result in large year-to-year variations in yield per unit area. In order to achieve crop increases in cereal production in semi-arid areas, crops must be designed for adversity, particularly a limited and variable water supply. The development of crop water deficits, and the responses of plants to these deficits, are described. Plants possess a variety of developmental, morphological, and physiological mechanisms which enable them to adapt to water deficits. Rapid phenological development after germination has been widely adopted for crops in semi-arid environments. Developmental plasticity is also highly desirable for crops in these areas. Physiological mechanisms which enable plants to adapt to water stress include seed priming, stomatal control of water loss, osmotic adjustment, and cellular tolerance of dehydration. In order to improve the grain yield of crops in a Mediterranean-type environment, it is necessary to increase the water passing through the crop in transpiration, increase the water use efficiency, and/or increase the proportion of total dry matter going to the grain. While the agronomist works to ensure that the most efficient use is made of available water, the breeder must try to produce a cultivar that will give a greater yield under water-limited conditions. (Carroll-FRC)
W82-00812

CLONAL VARIATIONS IN THE WATER RELATIONS OF RED OSIER DOGWOOD DURING COLD ACCLIMATION,
Minnesota Univ., St. Paul. Lab. of Plant Hardiness.
E. A. Bray, and L. R. Parsons.
Canadian Journal of Plant Science, Vol. 61, No. 2, p 351-363, April, 1981. 8 Fig, 2 Tab, 16 Ref.

Descriptors: *Cold regions, *Acclimatization, *Trees, *Dogwood, Moisture availability, Water use efficiency, Variability.

Studies were made to determine if red osier dogwood acclimating to cold under natural photoperiod and temperature undergoes changes in water relations similar to those demonstrated in plants acclimated in growth chambers and to determine if water relations account for differences in hardiness of several climatic races of red osier dogweed. Cuttings were taken from plants in the University of Minnesota arboretrum and field plots. The races of dogwood could be divided into two groups: Oregon, Idaho and Montana varieties became hardy to between -25 and -30 degrees C, and Alaska, North Dakota and Washington varieties became hardy to between -37 and -42 degrees C. After the initial frost, daytime stomatal resistance increased first in the Alaska clone and then in the Washington, Montana and North Dakota clones, but not in Idaho and Oregon clones. The remaining water relations parameters measured did not show differences among the races of dogwood. Stem water content of all clones decreased into mid-October, when they reached a similar water content of about 1 g water/g dry weight. Midday leaf xylem pressure potential of all clones increased during acclimation. Relative water content of the stems decreased during acclimation, but later increased. The water relations parameters of the outdoor acclimation process were very similar to those reported for growth chamber studies. Thus it was concluded that dogwood races from various natural locations acclimated at different rates in a common field location. (Baker-FRC)
W82-00839

SEDIMENT-BASED NUTRITION OF SUBMERSED MACROPHYTES,
Army Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 2H.
W82-00843

SOME ASPECTS OF PLANT WATER RELATIONS IN ALASKAN ARCTIC TUNDRA SPECIES,
San Diego State Univ., CA.
S. Oberauer, and P. C. Miller.
Arctic and Alpine Research, Vol. 13, No. 2, p 205-218, May, 1981. 1 Fig, 5 Tab, 21 Ref.

Descriptors: *Plant water potential, *Tundra, *Alaska, *Arctic, Water potentials, Polar regions, Arctic zone, Cold regions.

Four sites including a snow patch, a south facing slope, a north facing slope, and a tussock tundra ridge were selected for water availability measurements in arctic and alpine tundra. Xylem pressure potentials and interrelations between relative water content, xylem pressure potential, and leaf conductance of several species which are common in tussock and montane tundra were compared at these four Alaskan sites in 1977 and 1978. Evergreen shrubs were found to have the lowest leaf conductances, graminoids and forbs the highest. The relations between relative water content, xylem pressure potential and leaf conductance were not unique to a growth form nor to a vegetation zone. Although different species attained different minimum pressure potentials, individuals of a species showed similar potentials in a variety of sites. The narrow range of minimum potentials of a species and the similar behavior of species within a site indicate strong selection segregating species. (Baker-FRC)
W82-00846

WATER STRESS AND COLD HARDINESS IN FIELD-GROWN CITRUS,
Florida Univ., Gainesville. Dept. of Fruit Crops.
F. S. Davies, D. W. Buchanan, and J. A. Anderson.
Journal of the American Society for Horticultural Science, Vol. 106, No. 2, p 197-200, March 1981. 2 Fig, 1 Tab, 24 Ref.

Descriptors: *Citrus fruits, *Frost protection, *Irrigation effects, Water stress, Oranges, Fruit crops, Crop yield, Orchards, Trees, *Florida.

The treatment which permitted the least frost damage in Orlando tagelo (Citrus reticulata Blanco x Citrus paradisi Macf.) trees was no fall irrigation and under-tree sprinkling during a frost; leaf drop was 11.5% and undamaged fruit, 60%, following a frost in December 1979, in wich leaf temperature remained below -3.9C for 8 hours. Trees suffered the worst damage with fall irrigation and no sprinkling during frost. Intermediate damage was allowed by fall irrigation plus frost irrigation and no fall irrigation plus no under-tree sprinkling. Although the soil moisture content of irrigated blocks was significantly greater than for non-irrigated blocks during fall, afternoon leaf xylem water potentials and stem water contents were comparable. (Cassar-FRC)
W82-00864

WATER REQUIREMENT FOR SUGARCANE PRODUCTION,
Agricultural Research and Education Center, Belle Glade, FL.
For primary bibliographic entry see Field 3F.
W82-00899

INVESTIGATIONS OF CONTROL MECHANISMS OF GERMINATION UNDER WATER STRESS,
Department of Agriculture and Fisheries for Scotland, Edinburgh.
T. W. Hegarty, and H. A. Ross.
Israel Journal of Botany, Vol 29, No 1-4, p 83-92, 1980/1981. 2 Fig, 4 Tab, 17 Ref.

Descriptors: *Water stress, *Germination, *Water potentials, *Plant growth substances, Seeds, Plant

growth, Plant physiology, *Plant water potential, Planting management.

Seedling growth immediately after germination was able to proceed at water potentials lower than those that permitted germination in most varieties of seeds studied. This differential could be reduced by growth regulators, which made the water potential of seed germination more negative. The difference was eliminated by a combination of ethrel and kinetin in red clover and lucerne. Evidence suggests that the process in germination most sensitive to water stress is the initiation of cell elongation. The differential sensitivity to moisture stress is suggested as a form of dormancy. This control mechanism shows variations in operation and response to external stimuli and depends on genetic and environmental factors. (Cassar-FRC)
W82-00912

PHOTOSYNTHESIS AND GROWTH IN POPULATIONS OF POPULUS DELTOIDES FROM CONSTRATING HABITATS,
Illinois Univ. at Urbana-Champaign. Dept. of Botany.
A. B. McGee, M. R. Schmierbach, and F. A. Bazzaz.
American Midland Naturalist, Vol 105, No 2, p 305-311, April, 1981. 4 Fig, 2 Tab, 13 Ref.

Descriptors: *Plant growth, *Habitats, Floodplain, Drought, *Soil types, Transpiration, Trees, Respiration, Photosynthesis, *Soil-water-plant relationships, *Populus deltoides.

The degree and expression of ecological differentiation among populations of Populus deltoides from three contrasting habitats were examined. The influence of some edaphic conditions upon growth, photosynthesis and transpiration in these populations was investigated. Ramets of floodplain, strip-mine and sand-dune origin were grown in soils of each locality and growth parameters were measured for representative members of each population. The photosynthetic response of flooded and droughted individuals in their native soils was investigated. While the populations were different in some responses, they all accumulated more biomass in the nutrient-rich floodplain soil. Soil type incluenced all growth parameters measured, but plant origin influenced only sme of these paramenters. Photosynthesis declined in all populations when root systems were flooded. This decline was delayed in sand-dune plants until after day 12, due perhaps to their stomatal conductance increasing initially and then declining. Response to drought was different also among the three populations. These findings indicate that Populus deltoides grows well across a wide range of soil conditions but exhibited ecological differentiation in the three contrasting habitats it usually occupies. (Bker-FRC)
W82-00935

THE MANIFESTATION OF DEHYDRATION AVOIDANCE IN WHEAT BREEDING GERMPLASM,
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Div. of Field Crops.
A. Blum, G. Gozlan, and J. Mayer.
Crop Science, Vol 21, No 4, p 495-499, July/August, 1981. 3 Fig, 4 Tab, 11 Ref.

Descriptors: *Wheat, *Water stress, *Drought, Crop yield, Crop production, Irrigation effects, Stomata, Plant physiology.

The existence of and variability in dehydration avoidance was investigated within a random sample of advanced and well-adapted wheat. Selected genotypes were planted in each test and two replicate plots. Half of the plots were irrigated every 12 to 17 days, while stress blocks were not irrigated after September 24. Significant variation was found among the 19 genotypes tested in their midleaf water potentials during a stress period. Leaf water potential was correlated with the final number of grains per spike across genotypes of similar phenology in one test where drought stress developed during the spike development stage. Large variations in stomatal response were found, which indicated that dehydration avoidance in only a few of the genotypes may have resulted from stomatal sensitivity and closure at low stress levels. Most avoidant genotypes had relatively open stomata. Thus, a selection method for dehydration avoidance was investigated which, when combined with other available tests for drought resistance, may lead to the establishment of a logistic breeding program for improved yield and drought resistance in wheat. (Small-FRC)
W82-00958

VEGETATIONAL ANALYSIS OF BIG RUN BOG, A NONGLACIATED SPHAGNUM BOG IN WEST VIRGINIA,
West Virginia Univ., Morgantown. Dept. of Biology.
R. K. Wieder, A. M. McCormick, and G. E. Lang.
Castanea, Vol 46, No 1, p 16-29, March, 1981. 2 Fig, 2 Tab, 15 Ref.

Descriptors: *Bogs, *Vegetation, *Plant populations, Population density, Spatial distribution, Shrubs, Mosses, Herbs, *West Virginia, *Big Run Bog.

Although there have been numerous studies of the vegetation of Sphagnum-dominated bogs and peatlands in glaciated areas and of the vegetation in extensive Sphagnum-dominated areas in nonglaciated regions, the numerous small sized bogs in nonglaciated regions have been largely ignored. The composition and distribution of the vegetation in a small, relatively undisturbed nonglaciated Sphagnum bog in West Virginia was investigated. Vegetation was sampled from late June through early September, 1977, in a series of nested quadrants in Big Run Bog in West Virginia. The following four community types were identified using a minimum variance cluster analysis of the data: Sphagnum-Eriophorum virginicum, Sphagnum-shrub, Polytrichum-shrub, and Polytrichum-Carex canescens. These four community types cover about 85 percent of the surface of the bog, with Sphagnum communities occurring in 122 of the 126 quadrants and Polytrichum occurring in 91 of the quadrants. Vascular herbaceous species cover about 50 percent of the surface of the bog. Upright shrubs are of relatively minor importance, and most of the shrub species are generally found near the edge of the bog. The six tree species were represented by only a few individuals, and dead trees and saplings were more numerous than live ones. Several species found in the Big Run Bog have generally boreal distributions but are found at or near the southern limit of their natural ranges in Sphagnum bogs in West Virginia. Marked changes in the composition of bog vegetation have been attributed to alterations of water table level. Frequent alterations of water table level resulting from intermittent beaver habitation may be responsible for the failure of the vegetation to segregate into distinct communities in this bog. The pattern of community distribution may be related to cation concentration of surface water, pH of surface water, and soil moisture, as well as to water table fluctuations. (Carroll-FRC)
W82-00992

PHOTOSYNTHETIC RECOVERY OF RESURRECTION SPIKEMOSSES FROM DIFFERENT HYDRATION REGIMES,
Vanderbilt Univ., Nashville, TN. Dept. of General Biology.
W. G. Eickmeier.
Oecologia, Vol 46, No 3, p 380-385, September, 1980. 5 Fig, 2 Tab, 29 Ref.

Descriptors: *Desert plants, *Photosynthesis, *Drought resistance, Xerophytes, Spikemosses, Mosses, Arid climates, Plant physiology, Humidity, Texas.

The patterns and mechanisms of photosynthetic activity recovery of two resurrection spikemosses were compared in the laboratory. The two plants, found in the southwest Texas desert, were Selaginella lepidophylla Hook. and Grev. (hot, arid, low elevation, xeric environment) and S. pilifera A. Br. (high elevation, mesic environment). Photosynthetic competence was achieved much more rapidly in S. lepidophylla than in S. pilifera. Although chloramphenicol, a chloroplast protein synthesis inhibitor, significantly inhibited resumption of C02 uptake in both species, inhibition was greater in S. pilifera. The level of conserved ribulose 1,5-bisphosphate carboxylase specific activity was significantly greater in S. lepidophylla. These results support the hypothesis that desiccation produces less damage to the photosynthetic system in plants from more xeric environments than in plants from mesic environments. (Cassar-FRC)
W82-01010

SEASONAL PATTERNS OF LEAF WATER RELATIONS IN FOUR CO-OCCURRING FOREST TREE SPECIES: PARAMETERS FROM PRESSURE-VOLUME CURVES,
Duke Univ., Durham, NC. Dept. of Botany.
S. W. Roberts, B. R. Strain, and K. R. Knoerr.
Oecologia, Vol 46, No 3, p 330-337, September, 1980. 8 Fig, 37 Ref.

Descriptors: Water potentials, *Drought, *Leaves, Soil-water-plant relationships, Trees, Osmotic pressure, Plant water potential, Forests, Seasonal variation, *Forests.

Leaf water relationships were studied in 4 forest tree species (Ilex opaca Ait., American holly; Cornus florida L., flowering dogwood; Acer rubrum, red maple; and Liriodendron tulipfera L., tulip poplar) during April-August 1977, a dry summer. Initial osmotic potentials (the value of the osmotic component at full turgidity) were highest at the start of the growing season and decreased as the summer progressed. Precipitation after a dry period caused an increase in initial osmotic potentials. All species but Acer maintained leaf turgor throughout the season; during the July drought Acer leaves lost some turgor at midday. Younger Ilex leaves had higher early season initial osmotic potentials than overwintering leaves from the same tree. In Liriodendron the osmotic potentials of the leaves appeared to be related to the resistance of these leaves to drought conditions. The osmotic water fraction (fraction of total leaf water available to affect osmotic potentials) was greatest in young tissue early in the season and declined throughout the season. The measured water relationships agreed with the relative positions of the species along a water-availability gradient in the order Cornus (wettest), Acer and Liriodendron (intermediate), and Ilex (driest). This suggests that these trees coexist in a drought situation because each species uses water maximally at different stages of the water availability cycle. (Cassar-FRC)
W82-01011

DRYLAND CROPPING STRATEGIES FOR EFFICIENT WATER-USE TO CONTROL SALINE SEEPS IN THE NORTHERN GREAT PLAINS, U.S.A.,
Science and Education Administration, Mandan, ND. Northern Great Plains Research Center.
For primary bibliographic entry see Field 3F.
W82-01023

WATER RELATIONS, SOIL FERTILITY, AND PLANT NUTRIENT COMPOSITION OF A PYGMY OAK ECOSYSTEM,
Fisheries and Wildlife, Columbia, MO.
P. B. Reich, and T. M. Hinckley.
Ecology, Vol 61, No 2, p 400-416, 1980. 11 Fig, 3 Tab, 54 Ref.

Descriptors: *Water stress, *Nutrients, *Forests, *Ecosystems, Moisture availability, Growth, *Pygmy oaks, Trees, Soil properties, Seasonal variations, Temperature effects.

A study was conducted to describe the seasonal and spatial patterns of soil-plant moisture and nutrient relations for both a pygmy and a non-pygmy forest; to examine diurnal trends in plant water deficit, leaf conductance, and certain environmental variables; and to describe differences between seedling growth of acorns from pygmy and non-pygmy oaks. The study site was Buzzard's Roost, an unusual pygmy oak ecosystem in southwest Missouri. Pygmy forest soil was very acidic, with

low levels of calcium and magnesium and high levels of aluminum. Adjacent non-pygmy forests had higher pH, Ca and Mg, and lower Al levels. Diurnal and seasonal patterns of xylem pressure potential, leaf conductance, and soil moisture content illustrated the development of very severe tree water deficits at Buzzard's Roost. Predawn and midday xylem pressure potentials decline to as low as -3610 and -4200 kPa, respectively, accompanied by complete daytime stomatal closure. However, other factors indicated that water stress was not the major factor or causative agent in the stunting process. Very low nutrient levels in the soil may be partly responsible for the existence of the pygmy oak forest. The xeric site characteristics add another severe stress to this ecosystem. The adverse soil factors set up a 'feedback' system in which nutrient loss, acidification, and changing ion solubilities increase the soil impoverishment. (Baker-FRC)
W82-01034

SOIL MOISTURE RELATIONS IN THE SOUTHERN CALIFORNIA CHAPARRAL,
San Diego State Univ., CA. Dept. of Biology.
For primary bibliographic entry see Field 2D.
W82-01035

WATER VAPOR CONDUCTANCE AND CO2 UPTAKE FOR LEAVES OF A C4 DESERT GRASS, HILARIA RIGIDA,
California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology.
P. S. Nobel.
Ecology, Vol 61, No 2, p 252-268, 1980. 5 Fig, 32 Ref.

Descriptors: *Grasses, *Moisture availability, Soil moisture, *Soil-water-plant relationships, Photosynthesis, Transpiration, *Desert plants, Arid-zone hydrology, Hydrology, Arid zone, Arid lands, Arid climates, Carbon dioxide, Soil water, Hilaria rigida.

Transpiration and photosynthesis were examined over a 2 year period in the field and in laboratory conditions to help reconcile the prevalence of Hilaria rigida with potentially adverse ambient environmental factors. Availability of soil water appeared to be the major influence on seasonal stomatal activity of Hilaria rigida over the study period in the Colorado desert section of the Sonoran desert. Major stomatal opening occurred for 4.6 mo in the relatively cool winter-spring and for 1.7 mo in the late summer-early fall. The temperature optimum for carbon dioxide uptake was generally above daytime temperatures, particularly in the winter. When the daytime growth temperature was raised from 16 to 49 degrees C in laboratory experiments, the temperature optimum for CO2 uptake shifted from 29 to 43 degrees C. Besides the rather high temperature optimum for CO2 uptake, H. rigida displayed other typical C4 characteristics including Kranz anatomy, a low CO2 compensation point, and a lack of light saturation of CO2 uptake at full sunshine. Under optimal field conditions, the CO2 uptake rate can be higher than that reported for other species. The accompanying high after use efficiency may help explain the success of this hardy grass in both the Mojave and Sonoran deserts. (Baker-FRC)
W82-01039

RESPONSE OF FABABEAN YIELD, PROTEIN PRODUCTION AND WATER USE TO IRRIGATION,
Department of Agriculture, Lethbridge (Alberta). Research Station.
K. K. Krogman, R. C. McKenzie, and E. H. Hobbs.
Canadian Journal of Plant Science, Vol 60, No 1, p 91-96, January, 1980. 4 Fig, 2 Tab, 7 Ref.

Descriptors: *Moisture availability, *Crop yield, Moisture stress, Drought, Irrigation, Farming, *Fababeans, Seeds, Straw, Soil moisture, *Soil water-plant relationships, *Alberta, Canada.

The yield and quality responses of fababeans to variable soil moisture levels were investigated and the water requirements of this crop in southern Alberta were determined. Soil moisture was varied by time of stopping irrigation or by level of maintained moisture. Increased supplies of soil moisture increased the yields of seed, straw and crude protein. Evapotranspiration for the growing season averaged 544 mm, which is 16% greater than that of irrigated cereals. Efficiency of water use was about constant over the range of treatments, and yields were linearly correlated with evapotranspiration. Soil moisture must be maintained at least above 50% of the available range to achieve the full yield potential of fababeans. The potential yield of crude protein equals or exceeds that of other irrigated crops in southern Alberta. While limitations such as annual variations in length of growing season may prevent the attainment in all years of maximum yields as demonstrated in the tests conducted in this experiment, fababeans will produce high yields of seed and straw, representative of high production of vegetable protein, if soil moisture stress is not allowed to develop. (Baker-FRC)
W82-01089

2J. Erosion and Sedimentation

SEDIMENT SURVEYS IN THE DEPARTMENT OF WATER AFFAIRS,
Department of Water Affairs, Pretoria (South Africa).
For primary bibliographic entry see Field 7B.
W82-00680

DEBRIS FLOW DEPOSITS OF EARLY MIOCENE AGE, DEADMAN STREAM, MARLBOROUGH, NEW ZEALAND,
Canterbury Univ., Christchurch (New Zealand). Dept. of Geology.
D. W. Lewis, M. G. Laird, and R. D. Powell.
Sedimentary Geology, Vol 27, No 2, p 83-118, August, 1980. 16 Fig, 53 Ref.

Descriptors: *River basin development, *Geologic history, *Sediments, Flow, *Debris basins, Sandstones, Conglomerate rocks, Deadman stream, *New Zealand.

An analysis is presented on conformable succession of Early Miocene conglomerates and sandstones lying between massive marine mudstones in Deadman Stream, Marlborough, New Zealand. The coarse sediments were deposited by various subaqueous debris-flow mechanisms during an early pulse of tectonism that ultimately resulted in Plio-Pleistocene eversion of the Kaikoura Mountains. High-viscosity flows and slurry-creep flow meahanisms are reflected in sparse pebbly mudstones and rare sandy conglomerates. Low-viscosity flows are reflected by other deposits that have little mud matrix. The largest clasts in the deposits have a preferred planar orientation and a preferred long-axis orientation parallel to flow direction. Microfossil data from the mudstones indicate sedimentation in an environment of outer neritic to upper bathyl aspect. Most detritus is abraded, and deposits generally fill broad shallow channels. Channeling appeared to remain relatively fixed throughout the accumulation of hundreds of meters of superimposed, commonly amalgamated debris-flow deposits. The focus of deposition probably lay shoreward of any submarine canyon or fan. (Small-FRC)
W82-00694

HOLOCENE SEQUENCES ON AN EMBAYED HIGH-ENERGY COAST: AN EVOLUTIONARY MODEL,
Geological Survey of New South Wales, Sydney (Australia). Dept. of Mineral Resources and Development.
P. S. Roy, B. G. Thom, and L. D. Wright.
Sedimentary Geology, Vol 26, No 1/3, p 1-19, April, 1980. 7 Fig, 1 Tab, 35 Ref.

Descriptors: *Estuaries, *Sedimentation, *Erosion, Sands, Sediment transport, Tidal effects, Coasts, Model studies, Marine geology, *Australia.

An evolutionary model is proposed to account for the three types of Holocene embayment fill which can be applied to coastal erosion studies. Southeastern Australia has an embayed high-energy coast which shows varying degrees of infilling. The three types of embayment fill are open ocean, barrier estuary, and drowned river valley. In mid-Holocene times, the rapid accumulation of marine sand resulted in the formation of coastal sand barriers and of estuaries that progressively infilled with fluvial deposits. There is evidence that erosion dominated over accretion during the Late Holoene; sandy bays were deepened and many barriers retreated. Using the model, with extreme or prolonged wave erosion, barriers may be destroyed and estuarine deposits relocated to produce mixed fluvial/marine sediments. Also, when an estuary completely infills and river sand is supplied to the coast, similar polygenetic sediments are produced. Coastal erosion may be countered or reversed in cases such as these. Thus, the same mechanisms seem to add or remove sand, although the exact mechanism and its perhaps cyclic nature are not well understood. (Small-FRC)
W82-00695

MOVEMENT OF LOOSE, SANDY DETRITUS BY SHALLOW WATER FLOWS: AN EXPERIMENTAL STUDY,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Soils.
A. J. Moss, P. H. Walker, and J. Hutka.
Sedimentary Geology, Vol 25, No 1/2, p 43-66, January, 1980. 10 Fig, 30 Ref.

Descriptors: *Sediment transport, *Overland flow, *Sand, Sediments, Flow channels, River flow, Saltation, Suspended sediments, Suspended load, Bed load, Erosion rate, Erosion, *Detritus.

The interactions between flowing water and natural, loose, sandy detritus which contained small amounts of clay, silt, and pebbles were studied in flumes using small discharges over a large range of slopes. All flows strong enough to move the full size range of bed material were supercritical and channel systems always replaced the initial sheet flows after general sediment movement began. Behaviorally distinct suspended, saltation, and contact loads were found in flows as little as 1 millimeter deep. While suspended load was entrained wherever suitable particles were exposed, saltation load was always entrained to full transportational capacity in the upstream few centimeters of the bed, with later entrainment downstream balanced by deposition. Channel formation and geometry and the transportation of suspended and contact loads were largely controlled by the interaction between saltatory particles and the flow. Saltation changed from the movement of particles in individual trajectories to migration as ballistic dispersions with increased flow vigor. While saltatory grains moved in individual trajectories, transport rate increased rapidly with slope. However, the rheologic layer formed when the bed-load concentration reached about 25 percent by volume, after which transport rate increased less strongly with slope, closely following a stream-power law. Small rills were found to transport little sand when the slope was less than 0.01. However, transporting power increased significantly through the slope range 0.01 to 0.04 and became enormous by a slope of 0.3. Small overland discharges acquired considerable power to transport pebbles when flow was concentrated into channels. Processes in small channels were found to closely parallel those in rivers for the most part, but repetitive sedimentary structures contrasted sharply with those of deeper, subcritical flows. (Carroll-FRC)
W82-00776

THE NATURE OF SELECTED PRAIRIE LAKE AND STREAM SEDIMENTS,
Saskatchewan Univ., Saskatoon. Dept. of Soil Science.
D. W. Oscarson, J. S. Rogers, P. M. Huang, and W. K. Liaw.
International Revue der Gesamten Hydrobiologie, Vol 66, No 1, p 95-107, 1981. 3 Fig, 5 Tab, 45 Ref.

Descriptors: *Sediments, *Chemical analysis, Clays, Lakes, Streams, Hydrobiology, Nutrients,

Pollutants, Organic matter, Minerals, *Saskatchewan, Canada.

The nature of sediments of selected lakes and streams of the upper Qu'Appelle River basin was examined. Sediment samples were taken from five lakes: Buffalo, Pound, Pasqua, Echo, Mission, and Katepwa, and the Qu'Appelle River, plus two of its tributaries. Principal crystalline clay minerals present in the colloidal fractions of the sediments were smectite, vermiculite, kaolinite, mica, quartz, and feldspar. The cation-exchange capacity of the sediments varied from 16.3 to 28.8 meq/100 g, and the pH ranged from slightly acid to slightly alkaline. The hydrous oxides of Al, Fe, Mn, and Si were present in significant quantities in both the colloidal and noncolloidal fractions of the sediments. These oxides may exert the dominant chemical control on nutrient movement and pollutant movement in aquatic environments. Calcium and magnesium carbonates comprise a significant fraction of the sediments. Most of the carbon in the sediments is in the organic form. The organic carbon content varied from 1.2 to 6.0%. Since crystalline clay minerals, poorly ordered sesquioxides, and organic matter play a vital role in the retention and cycling of nutrients and pollutants, knowledge of the nature and properties of sediments is essential in efforts to preserve and improve the quality of natural water systems. (Baker-FRC)
W82-00815

ON LAKE BOTTOM DYNAMICS--THE ENERGY-TOPOGRAPHY FACTOR,
National Swedish Environment Protection Board, Uppsala. Water Quality Lab.
For primary bibliographic entry see Field 2H.
W82-00837

GRAPHED EQUILIBRIUM PARAMETERS OF CHANNELS FORMED IN SEDIMENT,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
A. W. Peterson, and T. Blench.
Canadian Journal of Civil Engineering, Vol 7, No 1, p 93-104, 1980. 7 Fig, 1 Tab, 55 Ref.

Descriptors: *Rivers, *Channels, Bed load, Flumes, Irrigation canals, Canals, Computers, Gravel, Sand, Sedimentation, *Erosion, Reviews, Graphical methods, *Channeling, Channel forming, Sediment transport, Alluvial rivers.

The origin and potential of the four-dimensional charts produced from numerical data obtained from the equilibrium dimensions of sand rivers, gravel rivers, and laboratory flumes is presented. Problems in this field have included gross disagreements among sediment load predictions from various formulas, improper transfer of flow information to rivers and canals, and differences between sand and gravel rivers. These are caused by flumes working in a transition between phases, lack of communication between workers in the field, and inapplicability of pure deductive methods to fluid-solid mixtures. Examples of the subjects discussed are Indian sand-bed canal observations, information on gravel rivers, Cooper's (1970) world flume data analysis, and the Peterson Q-factor (volumetric water discharge) and S (slope). References chosen from the multitude written on this subject feature usable photos, graphs, and tables; freedom from specialized mathematics and speculation; and references to further useful information sources. (Cassar-FRC)
W82-00881

SUBSURFACE DRAINAGE AND SEDIMENT TRANSPORT MODEL,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2G.
W82-00894

EFFECT OF SLOPE LENGTH ON EROSION FROM LOW SLOPES,
Science and Education Administration, Oxford, MS. Sedimentation Lab.
C. K. Mutchler, and J. D. Greer.
Transactions of the ASAE, Vol 23, No 4, p 866-869, 876, July/August, 1980. 2 Fig, 3 Tab, 6 Ref.

Descriptors: *Erosion rates, *Soil erosion, *Slope degradation, Mathematical studies, Slopes, Erosion, Runoff, Mathematical equations.

There is general acceptance of the premise that erosion increases with increasing slope length and that soil loss is proportional to slope length to some power, m. Investigations conducted over several years have resulted in the use of 0.5 as the slope length exponent for sloping farmland, with lower values being recommended for slopes of less than 4 percent. Since most of the intensively farmed flood plain soils in the United States are located on land comprised of nearly flat slopes, field studies were undertaken to determine the slope length exponents for these slopes. Simulated rainfall was applied to eight erosion plots ranging from 23 to 813 meters long on a slope of 0.2 percent. The study results support the slope length exponents recommended in Agriculture Handbook 537, although those exponents may be conservative for slopes of 1 percent. It is recommended that consideration be given to lowering the exponent to 0.15 for slopes less than 0.5 percent and to 0.2 for slopes between 0.5 and 1.0 percent. Ponding of water on part of the slope will cause the soil loss from the nearly flat slopes to be less than that predicted by the Universal Soil Loss Equation. (Carroll-FRC)
W82-00896

AERIAL PHOTOGRAPHY AS AN AID TO CROPLAND EROSION ANALYSIS,
Texas Christian Univ., Fort Worth. Dept. of Geology.
K. M. Morgan, D. R. Morris, G. B. Lee, R. W. Kiefer, and G. D. Bubenzer.
Transactions of the ASAE, Vol 23, No 4, p 907-909, 913, July/August, 1980. 2 Fig, 4 Tab, 10 Ref.

Descriptors: *Cropland, *Soil erosion, *Aerial photography, Photography, Remote sensing, Erosion rates, *Erosion control, Land management, Land use, Soil conservation, Data collections.

The development and implementation of effective soil conservation programs requires areawide erosion analysis. The Universal Soil Loss Equation is generally used to compute long-term soil losses from agricultural fields due to rill and interrill erosion for use in conservation planning. However, use of this equation is dependent on the collections of various data through field surveys. Remote sensing can provide total coverage of land use activities in watersheds and can supply accurate erosion information to agencies developing management plans for soil conservation. Color and color infrared photography at the scale of 1:60,000 were used to extract information about cropland management and conservation practices in Dane County, Wisconsin. Cropland management information determined by aerial photography included crop type, plowing, surface residue, and rotation. Information on erosion control practices covered contouring, strip cropping, and waterways. A detailed field survey of this agricultural watershed was also conducted by the Dane County Regional Plan Commission. The soil loss predictions developed on the basis of the results of the interpretations of the remote sensing air photographs were found to be in close agreement with the predictions made on the basis of the field survey results and computations made using the Universal Soil Loss Equation. (Carroll-FRC)
W82-00902

SEDIMENT SIZES ERODED FROM CROP ROW SIDESLOPES,
Science and Education Administration, Oxford, MS. Sedimentation Lab.
L. D. Meyer, W. C. Harmon, and L. L. McDowell.
Transactions of the ASAE, Vol 23, No 4, p 891-898, July/August, 1980. 5 Fig, 4 Tab, 16 Ref.

Descriptors: *Soil erosion, *Particle size, *Sediments, Soil properties, Physical properties, Erosion, *Cropland, Storm runoff, *Furrows.

The soil eroded from row sideslopes of land in rowcrop production and other interrill areas constitutes a significant proportion of the sediment from cultivated cropland during erosive rainstorms. The size distribution of these sediments is a major determinant of their transportability by runoff and their potential for subsequent deposition. Crop row sideslopes of ten soils, mostly silt loams, were tested under simulated rainstorms to determine the size distribution of the undispersed eroded sediment. These size distributions were compared with those of dispersed eroded sediment and of the original soil surface. The sizes of sediment eroded from crop row sideslopes varied considerably from soil to soil, both in magnitude and in distribution pattern. Aggregates comprised much of the sediment from cohesive soils. Sediments from fine soils were often coarser than those from soils with larger primary particle sizes due to the greater aggregation of the fine soils. Sediment sizes were not significantly affected by major changes in rainfall intensity, continued erosion, or the presence or absence of crop canopy. The undispersed eroded sediment was coarser than either the surface soil or the dispersed sediment for all soils, and much coarser for many soils. The size distribution of interrill sediment appears to be a fairly distinct characteristic of a given soil in a given condition. (Carroll-FRC)
W82-00903

INTERPRETATION OF SURFACE-WATER CIRCULATION, ARANSAS PASS, TEXAS, USING LANDSAT IMAGERY,
Texas Univ. at Austin.
For primary bibliographic entry see Field 7B.
W82-00904

SEDIMENT YIELD FROM A FLATLAND WATERSHED,
Science and Education Adinistration, Oxford, MS. Sedimentation Lab.
C. E. Murphree, and C. K. Mutchler.
Transactions of the ASAE, Vol 24, No 4, p 966-969, July/August, 1981. 3 Fig, 3 Tab, 6 Ref.

Descriptors: *Sedimentation, *Deltas, *Mississippi River, Rivers, Sediments, Sediment load, Sediment erosion, Erosion, Watersheds, Watershed management, Watershed protection, *Mississippi Delta.

Erosion and sediment yields from two adjacent watersheds in the Mississippi Delta over a 5 year period are reported. The watersheds are located on the G. L. McWilliams Farm near Clarksdale, Mississippi. One watershed had a silt loam soil and the other a silty clay soil. Practically all precipitation was in the form of rainfall. Both watersheds had been used for continuous cotton production for many years, including the 5 yr study period. The five annual amounts of rainfall were well distributed around their 5 yr average, which was within 2% of the long-term average amount. The 5-yr average monthly values differed greatly. Simple linear relationships were developed by grouping the sediment yield, runoff, and rainfall data by seasons. An equation for runoff was derived as a function of precipitation for data collected from November to June and another equation for data collected from July to October. Storm runoff was related to precipitation, and sediment yield was related to storm runoff during two seasons of the year. These equations were then combined to relate sediment yield to monthly rainfall for four separate crop and climatic periods. The equations derived should be suitable for predicting sediment yields and runoff from much of the 140,000 ha of graded flatland in the delta region. Care should be taken in using them outside of this climatic area. Erodibility of soils must be considered when predicting sediment yield. As these results represent sediment yield from watersheds with an essentially unrestricted outlet, they thus represent maximum values to be expected. (Baker-FRC)
W82-00941

MECHANICS OF MUDFLOW MOBILIZATION IN LOW-ANGLED CLAY SLOPES,
Michigan State Univ., East Lansing. Dept. of Civil and Sanitary Engineering.
L. E. Vallejo.

Engineering Geology, Vol 16, No 1/2, p 63-70, July, 1980. 2 Fig, 2 Tab, 17 Ref.

Descriptors: *Mudflows, *Clays, *Soil mechanics, Estimating equations, Erosion, Rocks, Slopes.

An analytical explanation of mudflow mobilization on flat surfaces is presented. Mudflows consisting of a mixture of hard clay fragments or rocks with mud can be considered a mass of concentrated grains that are dispersed in a flowing medium. The movement of the grain flow and the unit weight of the fluid medium can be quantified. The least slope angles of mudflow were calculated using the Bagnold theoretical method for field cases, and the calculated results compared well with field measurements. The Bagnold method is an alternative to the undrained loading and the excess pore water or artesian pressure effects which have been used to explain mudflow mobilization on some low angled slopes. The Bagnold method is successful because it is based on the assumption that a mixture of solids and fluid will flow instead of slide. It is an excellent tool to interpret mobilization of mudflows made up of hard clay fragments or pieces of rock in a soft clayey matrix such as mud. (Small-FRC)
W82-00989

CHEMICAL MASS-WASTING OF THE NORTHERN YUCATAN PENINSULA BY GROUNDWATER DISSOLUTION,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2K.
W82-01015

2K. Chemical Processes

MODELING OF PROCESSES OF DECOMPOSITION OF ORGANIC MATTER IN BOTTOM SEDIMENTS,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
For primary bibliographic entry see Field 5B.
W82-00553

CORRELATION OF MICROBIAL DEGRADATION RATES WITH CHEMICAL STRUCTURE,
Environmental Research Lab., Athens, GA.
N. L. Wolfe, D. F. Paris, W. C. Steen, and G. L. Baughman.
Environmental Science and Technology, Vol 14, No 9, p 1143-1144, 1980. 2 Fig, 22 Ref.

Descriptors: *Natural waters, *Microbial degradation, Biodegradation, *Organic compounds, Phenols, Kinetics, Hydrolysis, Sediments, Chemical reactions.

Relationships are established between structure and reactivity for the microbial degradation of selected organic compounds. Second-order microbial degradation rate constants were determined in natural water samples for six compounds and were found to correlate with the second-order alkaline hydrolysis rate constants. Also, second-order microbial degradation rate constants for four phthalate esters were obtained with organisms from sediment-water samples. These were shown to correlate with the second-order alkaline hydrolysis rate constants. Similar correlations are demonstrated for the rates of oxidation of substituted phenols by mixed microbial cultures isolated from soils and Hammett constants. It is important to note that the correlations demonstrated here offer some insight into a method of predicting microbial degradation rate constants in natural waters and perhaps soils as well. (Baker-FRC)
W82-00621

INFLUENCE OF GASEOUS NITRIC ACID ON SULFATE PRODUCTION AND ACIDITY IN RAIN,
Environmental Sciences Research Lab., Research Triangle Park, NC.
For primary bibliographic entry see Field 5B.
W82-00642

ACID PRECIPITATION: THE IMPORTANCE OF NITRIC ACID,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
J. N. Galloway, and G. E. Likens.
Atmospheric Environment, Vol 15, No 6, p 1081-1085, 1981. 7 Fig, 26 Ref.

Descriptors: *Acid rain, *Nitric acid, *Sulfuric acid, Fossil fuels, Air pollution effects, Environmental effects, Precipitation.

Using the information on temporal trends of sulfate and nitrate ions accumulated from the long-term precipitation data collected at Hubbard Brook Experimental Forest, New Hampshire, temporal trends were determined in the maximum contributions of sulfuric acid and nitric acid to the acidity of the precipitation. Nitric acid in acid rain was introduced primarily by increased emissions of NOX from fossil fuel combustion. Its contribution to the acidity of precipitation is becoming increasingly significant. The maximum contribution of H2SO4 to the acidity of precipitation is 73% in summer and 59% in winter. For HNO3, it is 31% in summer and 61% in winter. This analysis indicated that the importance of H2SO4 has decreased by about 30% relative to HNO3 and HNO3 has increased by about 50% relative to H2SO4 for the years studied. These conclusions should be applicable to most of the eastern United States. (Small-FRC)
W82-00643

ACIDITY FLUCTUATIONS AT A BROADLAND SITE IN NORFOLK,
Ministry of Agriculture, Fisheries, and Food, Norwich (England). Coypu Research Lab.
L. M. Gosling, and S. J. Baker.
Journal of Applied Ecology, Vol 17, No 2, p 479-490, August, 1980. 5 Fig, 3 Tab, 20 Ref.

Descriptors: *Acidity, *Environmental effects, *Acidic soils, Water pollution, Chemical properties, Aquatic plants, Aquatic animals, Agriculture, Pyrite, Wetlands, Acidic water, Water, Sulfates, Oxidation, Sulfides, *Sulfuric acid, Tropical regions, *Soil chemistry.

Acid sulfate soils, which are soils containing a relatively high level of sulfides which on oxidation form sulfuric acid, pose serious problems for agriculture in tropical regions. The main difficulty experienced from such soils in Great Britain has been the clogging of field drains with ochre deposits. However, Calthrope Broad, a wetland site in Norfolk, experienced an abrupt change in acidity from near-neutrality to just above pH 3.0 in 1970. As a result, the entire fish population of the area died, as did freshwater mussels and most aquatic macrophytes. The first rise in acidity brought a dramatic invasion by the acidophilous alga Tribonema minus. The pH of free water returned to neutrality after a period of acute acidity, but similar fluctuations occurred in most years between 1971 and 1979. Dams maintain the perched water table in the area around the broad during the winter, but evaporation and seepage cause extreme drops in water levels during the summer. As a result, the agricultural soil, which was rich in pyrites, was subjected to alternate drying and saturation, causing oxidation of the pyrite and formation of sulfuric acid. Treatment by the addition of lime in 1978 maintained neutral water in the broad, even though the acidity of the water in adjacent ditches continued to fluctuate. While all plant groups present before 1970 reappeared, only one fish species has returned to the area. (Carroll-FRC)
W82-00656

TRACE CONSTITUENTS IN CLOUD WATER, RAINWATER AND AEROSOL SAMPLES COLLECTED NEAR THE WEST COAST OF INDIA DURING THE SOUTHWEST MONSOON,
Bhabha Atomic Research Centre, Bombay (India). Air Monitoring Section.
For primary bibliographic entry see Field 2B.
W82-00676

CHEMISTRY OF LAKE WATER AND GROUNDWATER IN AREAS OF CONTRASTING GLACIAL DRIFTS IN EASTERN MINNESOTA,
Southern Illinois Univ. at Edwardsville. Dept. of Biological Sciences.
R. B. Brugam.
Hydrobiologia, Vol 80, No 1, p 47-62, April, 1981. 4 Fig, 7 Tab, 18 Ref.

Descriptors: *Lakes, *Chemical composition, Water analysis, Salts, Deicers, Calcium, Magnesium, Sulfates, Carbonates, Silicon dioxide, Groundwater, Ions, Roads, Water pollution sources, *Groundwater, Glacial drift, Glacial aquifers, Glacial lakes, *Minnesota.

During the winter of 1977-78 water samples were collected from 28 lakes in east-central Minnesota, 15 from Superior-lobe drift and 13 from Grantsburg-lobe drift. Groundwater samples were collected from wells near each lake. The major sources of ionic input into the study lakes are assumed to be groundwater and direct runoff from the watershed. Mann-Whitney U tests were used to determine if any statistical significance could be attached to differences between major-ion concentrations of lakes on tills of the Superior versus Grantsburg lobe. Concentrations of Ca(2+), Mg(2+), HCO3(-), SO4(-) were significantly higher in samples of groundwater from the Grantsburg lobe. No correlation was noted between groundwater concentrations of particular ions and lake-water concentrations of the same ions, implying that the sources of dissolved ions in lake water are shallow groundwater and soil leachates rather than the deeper groundwater sampled here. Na(+) and Cl(-) concentrations in some lakes appear to be strongly influenced by the use of de-icing salt on highways in winter rather than by differences in drift lithology. (Baker-FRC)
W82-00821

EFFECTS OF ION-PAIRING ON CALCULATIONS OF IONIC ACTIVITIES OF MAJOR IONS IN FRESHWATER,
Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.
C. E. Boyd.
Hydrobiologia, Vol 80, No 1, p 91-93, April, 1981. 2 Tab, 7 Ref.

Descriptors: *Natural waters, *Ionic interference, *Ions, Mineralization, Chemical reactions, Chemical composition, Chemical potential, Metals, Inorganic chemicals, Ion-pairing.

The objective of this study was to determine whether ion pairing had an appreciable effect on the calculation of ionic concentration, ionic strength, and ionic activities of major ions in natural waters. Measured ionic concentrations for 10 waters which represented a wide range in water chemistry were obtained from Livingstone. Ionic activities were first calculated by using the Debye-Huckel equation to calculate activity coefficients for all ions and multiplying the activity coefficients by the measured molar concentrations of the ions to give activities. Next, the iterative procedure of Adams was used to calculate ionic activities that were corrected for ion-pairing. Ion-pairing had no significant effect on ionic activities of Cl(-), Na(+), or K(+). The effect of ion-pairing on ionic activities of bicarbonate was slight. The influence of ion-pairing on ionic strength and ionic activities of Ca(2+), Mg(2+), and SO4(2-) increased with increasing ionic strength. The effect of ion pairing on the calculation of ionic strength was also substantial in the highly mineralized samples. These findings suggest that it is important in rigorous work to correct for ion-pairing in calculating ionic activities for all water samples except those that are not appreciably mineralized. A large percentage of the total iron, manganese, zinc, and copper in water exists as ion-pairs rather than as free ions. (Baker-FRC)
W82-00823

RELATIONSHIPS BETWEEN WATER CHEMISTRY AND RESPIRATION RATE IN SEVERAL POPULATIONS OF LYMNAEA PEREGRA MULLER (GASTROPODA:MOLLUSCA),
G. Dussart, and R. Kay.

Hydrobiologia, Vol 69, No 1/2, p 57-65, March, 1980. 4 Tab, 34 Ref.

Descriptors: *Chemical properties, *Mollusks, *Respiration, Oxygen, Hardness, Calcium, Potassium, Cations, Anions, Correlation analysis, Water quality.

In this investigation of the effects of water chemistry on L. peregra, the most important components producing such effects were determined. Specimens were obtained in North West England; respiration rates were studied in the laboratory, and the effects of water chemistry on weight-specific oxygen consumption were noted. Some relationship was found between water chemistry and wet-dry weight ratios, between oxygen consumption and live-wet weight, and between oxygen cosumption and shell-free dry weight. There were interpopulation differences in respiration rates between snails from different sites within the same water hardness classification. Calcium and potassium concentrations appeared to significantly affect respiration rates when tested in waters of varying cations but constant anion concentrations. Cations included calcium, sodium, magnesium, and potassium. The anion used was bicarbonate. No significant differences were found in respiration rates of populations of snails taken from the same site but in different years. (Small-FRC)
W82-00854

BIOGEOCHEMISTRY OF THOREAU'S BOG, CONCORD, MASSACHUSETTS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
H. F. Hemond.
Ecological Monographs, Vol 50, No 4, p 507-526, December, 1980. 14 Fig, 6 Tab, 42 Ref.

Descriptors: *Bogs, *Hydrogen ion concentration, *Acidity, Swamps, Chemical properties, Acid rain, Peat soils, Ions, Geologic history, *Biochemistry, *Thoreu's Bog, Massachusetts.

The pH control mechanism of the bog system of Thoreau's Bog or Gowings Swamp is presented in terms of the interaction of mineral acidity and weak acids. This bog is a floating-mat Sphagnum bog developed in a glacial kettle hole. The bog is ombrotrophic, with an annual water input of 1.45 m and an annual runoff of 0.24 m. Metal inputs are: 88 mg/sq m/yr for K, 132 mg/sq m/yr for Mg, and 54 mg/sq m/yr for Pb. The distribution of K and Mg is vertical in accordance with the inhomogeneous ion exchange chemistry of peat, while lead is distributed in accordance with historical trends in atmospheric lead fallout. Net peat accumulation rate was 180 g/sq m/yr, and annual storage rates were 36 mg/sq m/yr for K, 54 mg/sq m/yr for Mg, and 46 mg/sq m/yr for Pb. Organic acids at concentrations of 10 to the minus 3rd power eg/liter maintain bog acidity at pH 3.8. The contribution of acid rain is offset by alkalinity increases of the same magnitude resulting from sulfate reduction and nitrate uptake. (Small-FRC)
W82-00887

ANALYSIS OF PRECIPITATION CHEMISTRY AT A CENTRAL PENNSYLVANIA SITE,
Pennsylvania State Univ., University Park. Dept. of Meteorology.
V. C. Bowersox, and R. G. De Pena.
Journal of Geophysical Research, Vol 85, No C10, p 5614-5620, October, 1980. 10 Fig, 2 Tab, 11 Ref.

Descriptors: *Chemistry of precipitation, *Sulfates, *Acid rain, Acidity, Nitrates, Ammonia, Hydronium ion, Snow, Storms, Seasonal variation, Pennsylvania, Rain, Precipitation.

Data collected at the multistate atmospheric power production pollution study (MAPPPS) precipitation chemistry network were analyzed in detail. Precipitation was sampled on a storm-by-storm basis at a rural central Pennsylvania site during the period January 1, 1977, to December 31, 1978. Samples were analyzed for sulfate, nitrate, ammonium, and hydronium ion concentrations. Sulfate concentration varied seasonally, with high values in summer and low values in winter. Sulfate is of interest as the major determinant of precipitation acidity, particularly in rain. The principal contributor to H3O was sulfuric acid, but the acidity of snow was determined principally by NO3. The NH4 in precipitation can be explained by assuming equilibrium between cloud water and gaseous ammonia in air. There was a good stoichiometric balance of the four major inorganic ions. Knowledge of the nature of acid-determining components in rain can be used to help establish strategies to control the quality of precipitation. (Small-FRC)
W82-00980

MASS-TRANSPORT LIMITATION TO THE RATE OF REACTION OF GASES IN LIQUID DROPLETS: APPLICATION TO OXIDATION OF SO2 IN AQUEOUS SOLUTIONS,
Brookhaven National Lab., Upton, NY.
S. E. Schwartz, and J. E. Freiberg.
Atmospheric Environment, Vol 15, No 7, p 1129-1144, 1981. 14 Fig, 2 Tab, 29 Ref.

Descriptors: *Oxidation, *Sulfur compounds, Sulfur dioxide, Water pollution sources, Clouds, Fog, Chemical reactions, Mass transfer.

The role of mass transport in the oxidation of sulfur dioxide to sulfate in aqueous droplets is considered. As in any gas-liquid reaction, competition between mass transport and reaction is involved. Characteristic times associated with the several steps in the overall process have been identified, and expressions presented whereby these characteristic times may be evaluated for reactions in spherical drops. By comparing these characteristic times it may be determined whether a measured rate of reaction is equal to the intrinsic reaction rate or is limited by mass transport in the gas phase, at the air-water interface, or in the aqueous phase. Criteria are suggested that must be fulfilled for spatial and temporal uniformity to be achieved under experimental conditions or in the ambient atmosphere. Three steady-state criteria must be satisfied in order for a steady state to be achieved. After a steady state is reached, the concentration profiles may or may not be established at the surface, depending on the relative magnitudes of the several characteristic times. A theoretical model is presented wherein the extent of decrease in reaction rate may be calculated for each of the three mass-transport limiting processes, for a reaction that is first order in the concentration of the dissolved reagent species, and for mass transport in each of the two phases occurring by molecular diffusion. This theoretical framework has been applied to an examination of laboratory studies of sulfur dioxide oxidation in suspended droplets and to consideration of mass transport limitation to the rate of oxidation of sulfur dioxide in clouds and fogs. (Baker-FRC)
W82-00994

CHEMICAL MASS-WASTING OF THE NORTHERN YUCATAN PENINSULA BY GROUNDWATER DISSOLUTION,
Geological Survey, Reston, VA.
B. B. Hanshaw, and W. Back.
Geology, Vol 8, No 5, p 222-224, May, 1980. 2 Fig, 9 Ref.

Descriptors: *Erosion rates, Saline-freshwater interfaces, *Dissolution, Calcite, *Yucatan Peninsula, *Chemical degradation, Grounwater recharge, *Carbonate rocks, Limestone, Recharge, Solubility.

The northern part of the Yucatan Peninsula is the site of chemical erosion in its Tertiary carbonate rocks, predominantly limestone. For the 65,500 sq km study area, the mean annual discharge (equivalent to recharge) is 9800 million cu meters or 8.6 million cu meters for each 1 km of the 1100 km coastline. The area is flat and lowlying, with no stream channels. Rainfall averages 1000 mm per year. Soil cover is thin, infiltration is rapid, and transmissivity of the limestone is very high. Inland, the recharging fresh water becomes saturated with calcite, dissolving about 37.5 metric tons of calcite per sq km per year as it flows toward the coast. At the coast, the saline water also becomes saturated with calcite. When these two saturated waters of different salinities mix in the dispersion (or active mixing) zone the resulting solution is capable of dissolving as much as 1.2 nmol per liter additional calcite (or an additional 8.6 million mol per km coastline per year). The discharge near Xel Ha is about nine times greater than the average for the coastline. Calculations indicate that the lagoon in this area could be chemically incised within 3000 years. The zone of dispersion, about 3 m thick and extending 1 km inland, could completely dissolve in about 8700 years. (Cassar-FRC)
W82-01015

PHOSPHORUS, NIROGEN, AND ORGANIC CARBON FLUX IN A HEADWATER STREAM,
Georgia Univ., Athens. Dept. of Zoology.
J. L. Meyer, G. E. Likens, and J. Sloane.
Archiv fur Hydrobiologie, Vol 91, No 1, p 28-44, March, 1981. 5 Tab, 46 Ref.

Descriptors: *Streams, *Nutrients, *Chemical properties, Phosphorus, Nitrogen, Carbon, *Ecosystems, Seasonal variation, Organic carbon, Nitrogen compounds, Particulate matter, Dissolved solids, Gases, *Solute transport, Chemical reactions, Environmental effects.

Physical, chemical, and biological processes which transform nutrients entering a stream ecosystem affect the rate of transport of the element as well as its availability to the biological community. The processes responsible for these conversions in a particular stream will vary in form, rate, and relative importance for different elements. The processing of phosphorus, nitrogen, and organic carbon in Bear Brook, a forest stream in New Hampshire, were examined by constructing mass balances for each element over a one-year period. Annual inputs of nitrogen exceeded exports by 8 percent, while exports of phosphorus exceeded inputs by 12 percent. An earlier study assumed that the organic carbon budget was balanced. The stream exported 69 percent of the coarse particulate organic carbon inputs, 78 percent of coarse particulate organic nitrogen inputs, and 73 percent of coarse particulate organic phosphorus inputs in the form of fine particulates (between 0.45 micrometers and 1 millimeter), dissolved solids (less than 0.45 micrometers), or gases. Organic carbon was exported primarily in the gaseous or dissolved fraction, phosphorus was exported mostly as fine particulates, and nitrogen was transformed primarily to dissolved matter. Fluvial inputs had lower carbon to nitrogen and carbon to phosphorus ratios and a higher nitrogen to phosphorus ratio than did fluvial exports. There was a lower nitrogen to phosphorus atomic ratio in fluvial exports during the growing season than during the rest of the year. The discharge relationships observed for these elements suggest that annual changes in streamflow have different effects on the export/input ratio for each element, with organic carbon budgets showing the least variation, followed by nitrogen. The phosphorus budget appears to be the most sensitive to changes in the annual discharge. (Carroll-FRC)
W82-01021

NUTRIENT BUDGET STUDIES FOR FORESTS ALONG AN ELEVATIONAL GRADIENT IN NEW MEXICO,
New Mexico Univ., Albuquerque. Dept. of Biology.
J. R. Gosz.
Ecology, Vol 61, No 3, p 515-521, 1980. 1 Fig, 2 Tab, 24 Ref.

Descriptors: *Nutrients, *Ecosystems, Forests, Cycling nutrients, *Watersheds, Soils, Hydrology, Calcium, Magnesium, Potassium, Sodium, *New Mexico, Nutrient budget.

This paper reports studies of element inputs in bulk precipitation and outputs in stream water for a number of watersheds in New Mexico. These watersheds are located in the Tesuque Watershed Study area in the Sangre de Cristo Mountains. A number of vegetational zones occur in this area due to the influence of elevation on temperature and moisture gradients. The net organic matter increment of one of the watersheds has been estimated to be negative. The patterns in the output

and net change of calcium, magnesium, potassium and sodium among watersheds are related to soil chemistry and stream discharge rates. These factors may not be related to soil chemistry and stream discharge rates. These factors may not be related to the net organic matter increment of the ecosystem. Actual atmospheric inputs of these elements to some of the ecosystems may be an order of magnitude greater than those measured in bulk precipitation. Nitrogen outputs in stream water are strongly regulated by all of the watershed ecosystems, including the one which appears to have a negative net oganic increment. Low losses of nitrogen in stream water, however, do not mean that a system will minimize other types of N losses such as denitrification. Nutrient budgets generated from bulk precipitation and stream water discharge in the Southwest cannot prove or disprove hypotheses about nutrient regulation by net organic matter increment. Additional inputs and outputs must be quantified before a valid test can be made of the hypothesis. (Baker-FRC)
W82-01036

2L. Estuaries

MEASUREMENT OF PH IN THE ESTUARINE ENVIRONMENT ON THE NBS SCALE. (LA MESURE DU PH EN MILIEU ESTUARIEN SUR L'ECHELLE NBS),
McGill Univ., Montreal (Quebec). Dept. of Chemistry.
For primary bibliographic entry see Field 7B.
W82-00521

PARTITIONING OF NO. 2 FUEL OIL IN CONTROLLED ESTUARINE ECOSYSTEMS. SEDIMENTS AND SUSPENDED PARTICULATE MATTER,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
P. J. Gearing, J. N. Gearing, R. J. Pruell, T. L. Wade, and J. G. Quinn.
Environmental Science and Technology, Vol 14, No 9, p 1129-1136, September, 1980. 6 Fig, 2 Tab, 52 Ref.

Descriptors: *Estuarine environment, *Oil pollution, *Sediments, Suspended sediments, Suspended solids, Ecosystems, Ecology, Hydrocarbons, Fate of pollutants.

The interaction of oil hydrocarbons with estuarine suspended particulate matter and sediments is considered. No. 2 fuel oil was added as a dispersion in semiweekly doses to three controlled estuarine ecosystems. Samples of suspended particulate matter and sediments were analyzed by gas chromatography for saturated and aromatic hydrocarbons. Fractionation of the oil in the water column by adsorption to particulate matter resulted in the sedimentation of about 50% of the insoluble, saturated hydrocarbons, but less than 20% of the more soluble, aromatic hydrocarbons. The oil-derived hydrocarbons were slowly mixed down through the bioturbation zone. Biodegradation and other processes effected the removal of most of the hydrocarbons soon after the additions ended, but a residue of 10-20% in the form of branched alkanes, cycloalkanes, and aromatics in an unresolved complex mixture persisted more than 1 year later. (Baker-FRC)
W82-00541

CIRCULATION AND ENERGETICS OF A DEEP, STRONGLY STRATIFIED INLET,
Institute of Ocean Sciences, Sidney (British Columbia).
H. J. Freeland, and D. M. Farmer.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 9, p 1398-1410, September, 1980. 8 Fig, 3 Tab, 18 Ref.

Descriptors: *Model studies, *Fjords, *Flow characteristics, *Flow friction, *Tidal effects, Mathematical models, Inlets, Flow characteristics, Stratification, Mixing, Tidal hydraulics, Froude number, *Saline-freshwater interfaces, *Knight Inlet, British Columbia.

A theoretic model describing steady flow in a strongly stratified fjord inlet was compared to the observed flow behavior of Knight Inlet, British Columbia. Some aspects of the model gave closer agreement with reality than others. The model was useful in assessing the limit of small interfacial friction coefficients. Interfacial friction was previously thought to dominate the flow. Inlets of this type possess circulations which usually adjust to maintain the interfacial Froude number at unity near the mouth. However, evidence is presented to show that Knight Inlet does not conform to this pattern. The mean circulation in this inlet was found to be driven by tidal interactions with little contribution from the wind. (Geiger-FRC)
W82-00547

RELATIONSHIPS BETWEEN ENVIRONMENTAL FACTORS, BACTERIAL INDICATORS, AND THE OCCURRENCE OF ENTERIC VIRUSES IN ESTUARINE SEDIMENTS,
Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
For primary bibliographic entry see Field 5A.
W82-00574

FACTOR ANALYSIS KF THE IMPACT OF THE ENVIRONMENT ON MICROBIAL COMMUNITIES IN THE TVARMINNE AREA, SOUTHERN COAST OF FINLAND,
Zoological Station, Tvarminne (Finland).
For primary bibliographic entry see Field 5C.
W82-00672

EFFECTS OF ENVIRONMENTAL FACTORS ON MICROBIAL POPULATIONS IN BRACKISH WATERS OFF THE SOUTHERN COAST OF FINLAND,
Zoological Station, Tvarminne (Finland).
P. Vaatanen.
Applied and Environmental Microbiology, Vol 40, No 1, p 48-54, July, 1980. 4 Tab, 29 Ref.

Descriptors: *Microbial studies, *Environmental effects, Populations, Temperature effects, Wind, Seasonal variations, *Finland, Coasts, *Estuarine environments, Brackish water, Seawater, Microorganisms, Humic acids, Chlorophyll, Organic matter, Rainfall, Wastewater outfalls, Effluents, Wastewater.

The effects of environmental factors on seasonal changes in microbial populations were studied in the Tvarminne area, off the southern coast of Finland. Samples were collected at surface levels over 1 to 2 week intervals in 1976-78. Fourteen microbiological and 10 environmental parameters were determined. Stepwise multiple regression analysis was used to explain seasonal variation in the microbiological parameters. Separate analyses were made of the data from the open-water and ice-covered periods. In analyses of data from both periods, the environmental factors included accounted for a significant proportion of the variation in the parameters for community respiration (90%) and bacterial spores (80%), and a smaller proportion (60-65%) of the variation in total counts of bacteria and plate counts of psychrophiles and yeasts. Lower values (40-55%) were obtained for the variation in the other microbiological parameters. The environmental factors with maximal contributions were organic matter, water temperature, chlorophyll, and salinity, but rainfall and winds also explained part of the variation in some microbiological parameters. In winter studies the results differed from all other seasons, the variation being controlled by parameters indicative of freshwater outflows, including humic matter, salinity, water temperature, and rainfall. (Baker-FRC)
W82-00683

SPATIAL DISTRIBUTIONS OF POLLEN IN SURFACE SEDIMENTS OF THE POTOMAC ESTUARY,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
G. S. Brush, and R. S. DeFries.
Limnology and Oceanography, Vol 26, No 2, p 295-309, March, 1981. 5 Fig, 6 Tab, 23 Ref.

Descriptors: *Pollen, Sediment transport, Land use, *Estuaries, *Sediments, Tracers, *Potomac River, Trees, Deposition, Tidal effects, *Spatial distribution.

Tree pollen in surface sediments of the Potomac Estuary was proportionally representative of trees growing in the area for many of the species (oak, pine, birch, hickory, elm, ash, and hazelnut-ironwood). No pollen from the tulip poplar, a major tree, was found in sediments, probably because its flowers do not release pollen to the air. Sweet gum, red maple, beech, holly, and black gum were underrepresented by the pollen, and a few minor species were overrepresented. Pollens from trees restricted to the upper watershed 60 km upstream of the tidal limit were not present in downstream estuarine deposits. Comparisons of the variability in the pollen data and in the corresponding tree data from the adjacent watershed led to conclusions that pollen grains are differentially dispersed before being deposited and are not transported great distances. These studies imply a possible use of pollen as tracer particles to determine the effects of land use on one part of a watershed on various parts of the estuary. (Cassar-FRC)
W82-00757

QUANTITATIVE ASSESSMENT OF TIDAL WETLANDS USING REMOTE SENSING,
National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
For primary bibliographic entry see Field 7B.
W82-00781

GENERAL MORPHOLOGY AND SEDIMENT PATTERNS IN TIDAL INLETS,
South Carolina Univ., Columbia. Dept. of Geology.
M. O. Hayes.
Sedimentary Geology, Vol 26, No 1/3, p 139-156, April, 1980. 16 Fig, 1 Tab, 29 Ref.

Descriptors: *Inlets, *Sedimentology, *Tidal effects, Estuaries, Sediment transport, Morphology, Deltas, Channel morphology, Tides, Sandbars.

Inlet-affiliated sedimentary barrier island units usually include an ebb-tide delta, a flood-tide delta, and inlet-fill sequences created by inlet migration and recurved spit growth. Ebb-tide deltas include a main ebb channel flanked by linear bars on either side and a terminal lobe at the seaward end. The channel is bordered by a platform of sand with swash bars. Here the sand is coarse and contains polymodal cross-bedding with a slight ebb dominance. Flood-tidal deltas include a flood ramp and bifurcating flood channels on the seaward side and ebb shields, ebb splits, and spillover lobes on the landward side. A stratigraphic sequence of a typical flood tidal delta would be bidirectional, large-scale crossbedded sand at the base, predominantly large-scale crossbedded sand in the middle, and finer-grained tidal flat and marsh sediment at the top. Inlets migrate depending upon such variables as rate of longshore sediment transport and depth of inlet. Inlet-fill contains coarse, bidirectional crossbedded sediments at the base, polydirectional crossbedded sands in the middle, and finer-grained aeolian sands at the top. (Small-FRC)
W82-00792

EFFECT OF PH AND REDOX POTENTIAL ON CONCENTRATION OF DISSOLVED NUTRIENTS IN AN ESTUARINE SEDIMENT,
Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.
R. D. De Laune, C. N. Reddy, and W. H. Patrick, Jr.
Journal of Environmental Quality, Vol 10, No 3, p 276-279, July/September, 1981. 2 Fig, 2 Tab, 17 Ref.

Descriptors: *Nutrients, *Marine sediments, *Estuaries *Hydrogen ion concentration, *Oxidation-reduction potential, Phosphorus, Carbon, Ammonia, Iron, Manganese, Sediments, Dissolved solids, Gulf of Mexico.

Although both sediment redox potential and sediment pH have been shown to affect the exchange

of nutrients at the sediment-water interface, most studies dealing with these effects have been theoretical in nature. This study investigated the combined effect of pH and redox potential on the concentrations of dissolved organic carbon, phosphorus, ammonia, iron, and manganese in an estuarine sediment in the Gulf of Mexico. Sediment suspensions were maintained under conditions of controlled pH (5.0, 6.5, and 8.0) and controlled redox potentials (-200, 0, 250, and 500 mV). Nutrient concentrations were found to be strongly influenced by changes in sediment pH and in redox potentials. Dissolved organic carbon increased from 42 micrograms per milliliter at pH 5.0 and 500 mV to 93 micrograms per milliliter at pH 8.0 and -200 mV. Decreasing sediment redox potential and pH resulted in increases in the concentrations of soluble phosphorus, ammonia, iron, and manganese. Phosphorus concentrations ranged from 0.002 micrograms per milliliter at pH 8.0 and 500 mV to 0.215 micrograms per milliliter at pH 5.0 and -200 mV. The concentrations of iron and manganese ranged from less than 0.1 micrograms per milliliter at pH 8.0 and 500 mV to 101 and 13 micrograms per milliliter, respectively, at pH 5.0 and -200 mV. The influence of sediment redox potential and pH on concentration gradients between interstitial and overlying water can result in fluxes of dissolved constituents to and from the sediment. The results of this study demonstrate the need to consider the influence of variables such as sediment redox potential and pH in models of the diffusion of chemical and biochemical reactive elements across the sediment-water interface. (Carroll-FRC)
W82-00795

ESTIMATION OF MATERIAL FLUXES IN AN ESTUARINE CROSS SECTION: A CRITICAL ANALYSIS OF SPATIAL MEASUREMENT DENSITY AND ERRORS,
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
For primary bibliographic entry see Field 7A.
W82-00816

THE ASSAY OF ADENOSINE 5'TRIPHOSPHATE EXTRACTED FROM SALT-MARSH MICROBIOTA,
South Carolina Univ., Columbia. Dept. of Biology.
L. H. Stevenson, C. A. Wilson, and T. H. Chrzanowski.
Canadian Journal of Microbiology, Vol. 27, No. 6, p 633-635, 1981. 1 Fig, 1 Tab, 9 Ref.

Descriptors: *Adenosine triphosphate, *Salt marshes, Chemical analysis, Enzymes, Bacteria, *Estuaries, Microorganisms, Marshes, Coastal waters, Tidal marshes, Aquatic life.

Data were collected to test the theory that the method employed to assay the adenosine 5'-triphosphate extracted from aquatic microbiota influences the temporal pattern of ATP density in the water of a salt-marsh creek. Water was collected from within the North Inlet Marsh, near Georgetown, SC. The sampling location monitored the major exchange point between the marsh and the Atlantic Ocean. Water was collected from 0.2 meters below the surface at 1.5 hr intervals comprising several tide cycles during February of 1979. The effect of the secondary emission pattern on the quantification of ATP was studied through 52 samples taken during the two expeditions. Assays using the integration approach produced values that were from 1.13 to 8.22 times higher than values determined by peak height analysis of the unfiltered samples and from 1.18 to 16.39 time higher in water that had been prefiltered by passage through a 1.0 micron filter. The latter samples contained bacteria as the only viable microbiota. ATP concentration values determined by integration averaged 3.6 times greater than values determined by peak height in the unfiltered samples and 4.8 times greater in the 1.0 micron filtered samples. Extracts prepared from biota in high-tide or oceanic waters did not have as great an enhanced secondary emission pattern as did extracts of samples collected at low tide. It would appear that bacteria were responsible for most of the enhanced secondary emissions observed in samples collected at or near low tide. Thus the method used to assay ATP extracted from environmental samples markedly influences the data recovered. (Baker-FRC)
W82-00838

ENRICHMENT OF THE AGRICULTURAL HERBICIDE ATRAZINE IN THE MICROSURFACE WATER OF AN ESTUARY,
Smithsonian Institution, Edgewater, MD. Chesapeake Bay Center for Environmental Studies.
For primary bibliographic entry see Field 5B.
W82-00877

DIEBACK OF SALT-WATER CORDGRASS (SPARTINA ALTERNIFLORA LOISEL.) IN THE LOWER CAPE FEAR ESTUARY OF NORTH CAROLINA: AN EXPERIMENTAL APPROACH TO RE-ESTABLISHMENT,
North Carolina State Univ. at Raleigh. Dept. of Botany.
R. A. Linthurst, and E. D. Seneca.
Environmental Conservation, Vol 7, No 1, p 59-66, Spring, 1980. 6 Fig, 5 Tab, 39 Ref.

Descriptors: *Spartina, *Marsh plants, *Plant growth, Vegetation, *Estuaries, Ecosystems, Marshes, Wetlands, Plant communities, Salt marshes, *Cape Fear Estuary, North Carolina.

Panne dieback of Spartina alterniflora in the Lower Cape Fear Estuary of North Carolina prompted a study, starting in 1975, of this phenomenon and the recolonization potential in the affected marshes. By September 1978 all three sites investigated (2 above and 1 below mean high water) had naturally recolonized by seeding, mainly S. alterniflora. Volunteers at the lower site were largely S. alterniflora; at the 2 higher sites, Salicornia europaea, Distichlis spicata, Scirpus robustus, and Spartina patens were also found. Experimental plots within each dieback site were regenerated most rapidly by volunteer plants transplanted from areas similar to the dieback sites and/or plants with large rhizome systems. It was concluded that this dieback was a short-term phenomenon and that natural recolonization, not man's revegetation attempts, was the major factor in reestablishment of the plants. (Cassar-FRC)
W82-00889

EFFECTS OF TEMPERATURE, PH, SALINITY, AND INORGANIC NITROGEN ON THE RATE OF AMMONIUM OXIDATION BY NITRIFIERS ISOLATED FROM WETLAND ENVIRONMENTS,
University of West Florida, Pensacola. Dept. of Biology.
R. D. Jones, and M. A. Hood.
Microbial Ecology, Vol 6, No 4, p 339-347, 1980. 3 Fig, 24 Ref.

Descriptors: *Nitrification, *Oxidation, *Ammonium, *Estuarine environment, Nitrogen, *Wetlands, Temperature, Salinity, Hydrogen ion concentration, Bacteria, Marshes, Sodium, Potassium, Nitrate, Nitrite, Nitrogen cycle, Cycling nutrients.

The transformation of nitrogen and its recycling are extremely important to the productivity of aquatic ecosystems. Although factors affecting ammonium oxidation in agricultural soils and sewage have been investigated, information on factors affecting nitrification in wetland environments is lacking. Ammonium-oxidizing bacteria were examined in a freshwater marsh and in an estuarine bay over a 2-year period. Two predominant species of Nitrosomonas were consistently isolated, one from each environment. A closed culture, high cell density assay was used to determine the effects of temperature, pH, salinity, sodium, potassium, nitrite, nitrate, and ammonium concentrations on nitrification. Maximum oxidation of ammonium by the freshwater isolate occurred at 35 degrees C, pH 8.5, salinities of 0.3 to 0.5 percent sodium and potassium, and ammonium concentrations exceeding 0.5 grams per liter. The estuarine isolate exhibited maximum activity at 40 degrees C, pH 8.0, salinities of 0.5 to 1.0 percent sodium and potassium, and 0.2 grams of ammonium per liter. The sodium requirement of the estuarine isolate could be partially substituted by potassium, suggesting that the organism is a true estuarine bacterium. Salinities below 0.5 percent may severely reduce oxidation of ammonium by the bacterium in the estuarine environment. While nitrate had no significant effect on either isolate, certain combinations of ammonium nitrite were inhibitory, especially to the estuarine species. The data indicate that oxidation of ammonium by isolates from wetlands is influenced by pH and temperature and that estuarine nitrifiers may be more sensitive to and more extensively affected by salinity, ammonium concentrations, and nitrite than are isolates from fresh waters. (Carroll-FRC)
W82-00910

SEASONAL INFLUX AND DECOMPOSITION OF AUTOCHTHONOUS MACROPHYTE LITTER IN A NORTH TEMPERATE ESTUARY,
New Hampshire Univ., Durham. Jackson Estuarine Lab.
M. N. Josselyn, and A. C. Mathieson.
Hydrobiologia, Vol 71, No 3, p 197-208, June, 1980. 8 Fig, 4 Tab, 38 Ref.

Descriptors: *Detritus, *Aquatic plants, *Decomposition, Estuaries, Spartina, Zostera, Ascophyllum, Fucus, Nutrients, Great Bay, New Hampshire, Maine, Coastal waters, Salt marshes, Marshes, Algae, Nitrogen, Phosphorus, Seasonal variation.

The seasonal contribution and detrital processing of autochthonous plant litter in the Great Bay Estuary system of New Hampshire and Maine was studied for 18 months. Monthly strand line collections at two inner estuarine sites and one open coast site provided information on the seasonal influx of litter derived from each species, the halophytes, Spartina alterniflora Loisel and Zostera marina L., and the seaweeds, Ascophyllum nodosum L. Le Jolis and Fucus vesiculosus L. v. spiralis Farlow. S. alterniflora ditrital inputs were maximal in spring; Z. marina inputs, in summer. Seaweed litter was 35-85% of the total strand lien throughout the year. In the estuary the seaweeds contributed 1 to 3 times as much detrital matter as did the vascular plants, on the open coast 50 times as much. Seaweeds decomposed 3-10 times faster than vascular plant litter (which contains more cellulose) under similar environmental conditions. Decomposition was faster under submerged conditions. Nutrient depletion occurred in litter within the strand line. N and P enrichment from microbial activity and rapid leaching of carbonaceous substrates were observed under submerged conditions. (Cassar-FRC)
W82-00918

MICROBIOLOGICAL STUDIES OF A 'VIRGIN' SALT-FRESH WATER TRANSECT AT NORTH POINT, JAMES BAY, CANADA. I: BACTERIOLOGICAL ASPECTS,
Canada Centre for Inland Waters, Burlington (Ontario).
B. J. Dutka, and K. K. Kwan.
Hydrobiologia, Vol 72, No 3, p 273-280, July 2, 1980. 8 Fig, 2 Tab, 12 Ref.

Descriptors: *Baseline studies, *Bacteria, Wetlands, Salt marshes, Marshes, *James Bay, *Canada, Water analysis, *Microbiological studies, Sulfur bacteria, Eutrophication, Biomass, Saline-freshwater interfaces, Biodegradation, Sediments.

Bacterial populations were studied in water and sediment samples along a salt-fresh water shoreline transect at North Point, James Bay in northern Canada. Microbiological analysis showed that there was a very large microbial population, the greatest density occuring at the seawater stations. The few fecal indicator bacteria were a result of the animal population, not man's presence. Organic sulfur-reducing bacterial increased from 10,000 per 100 ml at the seawater stations to 100,000 per 100 ml at the brackish-fresh water interface. Sulfur-oxidizing bacteria varied from 10 to 100 per 100 ml, with highest densities in the marshland stations. Population patterns of ammonifying and denitrifying bacteria were quite similar to each other, with

ammonifiers 10 times more plentiful than denitrifiers. At the sea stations ammonifiers were high and denitrifiers low, with peaks of both in the salt marsh area. The high bacterial and heterotroph populations in the seawater stations indicate very eutrophic water. The potential biodedradation capacity of these waters is much greater than was formerly expected. (Cassar-FRC)
W82-00921

MICROBIOLOGICAL STUDIES OF A 'VIRGIN' SALT-FRESH WATER TRANSECT AT NORTH POINT, JAMES BAY II. MYCOLOGICAL ASPECTS,
Canada Centre for Inland Waters, Burlington (Ontario).
J. P. Sherry, and S. R. Kuchma.
Hydrobiologia, Vol 74, No 2, p 113-117, September 1, 1980. 3 Fig, 13 Ref.

Descriptors: *Fungi, *Baseline studies, Wetlands, Marshes, *James Bay, *Canada, Water analysis, Sediments, *Microbiological studies, Saline-freshwater interfaces.

Baseline values for fungi were determined along a salt-fresh water transect in the unimpacted North Point, James Bay, Canada, area. Fungi levels in water samples increased linearly from 28-70 CFU per 100 ml at the salt water end of the transect to 13,000-16,000 CFU per 100 ml at the fresh water end. In sediments the highest fungal densities were found inland at sites with rich, black organic sediments. Lowest fungi levels were found in sediments composed of clay and shingle fragments. (Cassar-FRC)
W82-00922

TRACE METAL FLUXES TO NEARSHORE LONG ISLAND SOUND SEDIMENTS,
New Hampshire Univ., Durham. Dept. of Earth Sciences.
For primary bibliographic entry see Field 5B.
W82-01040

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

SUPERSEPARATION: SORET EFFECT REVERSED,
Scripps Institution of Oceanography, La Jolla, CA. Physiological Research Lab.
H. T. Hammel, and J. E. Maggert.
Separation Science and Technology, Vol 15, No 2, p 81-87, 1980. 1 Fig, 1 Tab, 2 Ref.

Descriptors: *Desalination apparatus, *Separation techniques, Soret effect, Osmotic pressure, Salt balance, Drinking water.

The Soret effect is attributed primarily to the fact that osmotic pressure is uniform across a solution when one side is heated and the other is cooled. When Whatman no. 40 filter paper was interspersed throughout an aqueous solution to minimize disturbance of the Soret effect caused by convection, the Soret effect was reversed. The concentration increased exponentially from nearly pure water at the cooled surface to many times the initial concentration at the heated surface. If the solution and filter paper were degassed, then the Soret effect was normal. It was concluded that microbubbles of air were entrained in the solution by the filter paper so that water vaporized on the warmer side of each bubble and condensed on the cooler side, thereby concentrating the solution near its heated surface and diluting it near its cooled surface. Continuous separation of seawater into potable water from the cooled surface was not possible in the described cell as the entrapped air in the filter paper was slowly absorbed by the condensate and removed from the cell. Continuous production of potable water was achieved, however, from a film of seawater flowing down a heated surface and supported a fraction of a millimeter from a cooled surface on which the vapor condensed and drained into a collecting trough below. (Baker-FRC)
W82-00791

3B. Water Yield Improvement

CONTROL OF WATER WEEDS BY GRASS CARP IN TWO SMALL LAKES,
Marine Dept., Rotorua (New Zealand). Fisheries Research Div.
C. P. Mitchell.
New Zealand Journal of Marine and Freshwater Research, Vol 14, No 4, p 381-390, 1980. 4 Fig, 19 Ref.

Descriptors: *Weed control, *Aquatic plants, *Carp, *Fish, Lakes, Plant growth, Waihi Beach Reservoir, Parkinsons Lake, *New Zealand, Lake restoration.

Chinese grass carp (Ctenopharyngodon idella Val.), averaging 2 kg in weight, were incrementally stocked over a 3 year period in 2 small New Zealand lakes, Waihi Beach Reservoir, a water supply impoundment, and Parkinsons Lake, a eutrophic sand dune lake with no defined outlet. In Waihi Beach Reservoir a stocking density of 26 fish per ha resulted in a change in plant species dominance (due to preferential feeding) but no long term reduction of standing crop. A stocking density of 37-52 per ha was required to heavily reduce the aquatic vegetation over 2 summers. In Parkinsons Lake 37-44 carp per ha eliminated all vegetation by midsummer. The most palatable species were Potamogeton ochreatus and Eleocharis sphacelata. At higher stocking densities, these and Egeria densa and Nitella hookeri were virtually eliminated. A more accurate estimate of weed removal rates would result if calculated on the basis of littoral zone area or number of aquatic plants. Since the degree of weed control depends on so many factors (plant growth, fish growth, mortality rates, water temperature, and standing crop), it is difficult to determine the optimum stocking density. Removal of stocked carp was difficult. However, this is necessary if aquatic weed control growths are to be managed rather than eliminated. (Cassar-FRC)
W82-00609

SEEDING-OPPORTUNITY RECOGNITION IN WINTER OROGRAPHIC CLOUDS,
Utah Water Research Lab., Logan.
G. E. Hill.
Journal of Applied Meteorology, Vol 19, No 12, p 1371-1381, December, 1980. 14 Fig, 2 Tab, 18 Ref.

Descriptors: *Cloud seeding, *Weather modification, Moisture deficiency, *Artificial precipitation, Rainfall, Cloud physics, Clouds, Temperatures, Orography, Orographic precipitation.

Basic meteorological parameters used to develop the present cloud seeding hypothesis for winter orographic storms are: cloud-top temperature, updraft speed, supercooled liquid water concentration, and precipitation rate. Analysis of supercooled water concentrations and precipitation as functions of cloud-top temperature and orographic updraft speeds indicates that seedability is marked by cloud-top temperatures from minus 22 degrees to zero degrees C and updraft speeds of 1 mile/second or greater. This hypothesis is substantiated by taking aircraft icing reports as representing supercooled water concentrations, and taking cross-barrier flow as representing vertical motion. The potential precipitation yield increases as the square of the cross-barrier wind speed increases within the suitable cloud-top temperature range. About 20% of the winter orographic clouds offer such high potential. High seedability is expected to be associated with post-frontal conditions where the cross-barrier flow is strong, high-level subsidence is occurring, and the moisture is still high at mountaintop levels, or where weak low-level moisture systems are moving with strong airflow. (Baker-FRC)
W82-01005

VARIATIONS IN PRECIPITATION PARAMETERS BETWEEN DROUGHT AND NON-DROUGHT PERIODS IN TEXAS AND SOME IMPLICATIONS FOR CLOUD SEEDING,
National Weather Service Stoneville, MS.
For primary bibliographic entry see Field 2B.
W82-01006

3C. Use Of Water Of Impaired Quality

RECYCLING URBAN STORMWATER FOR PROFIT,
Environmental Protection Agency, Edison, NJ.
R. Field, and C-Y. Fan.
Water/Engineering and Management, Vol 128, No 4, p 30-33, April, 1981. 2 Fig, 6 Tab, 25 Ref.

Descriptors: *Storm runoff, *Reclaimed water, *Water reuse, *Urban runoff, Storm water, Combined sewer overflows, Wastewater treatment, Industrial water.

Current urban storm water control and treatment technology leading to its reuse in industrial cooling and processes, irrigation, and recreational water supply are presented. Although storm water pollutant concentration varies with time and location during a storm and from one storm to another, the BOD5 is usually close to that of municipal sewage secondary effluent, and the suspended solids concentration is similar to that of raw sanitary wastewater. Combined sewer overflow quality lies between that of untreated sanitary sewage and urban storm runoff. Physical treatment units are more effective than biological systems because they can handle the highly variable flow rates and pollutant concentrations. The treatment chosen depends on the desired use: low level treatment for irrigation water and high level treatment for boiler feed water. A table lists four categories of waters, AA, A, B, and C, with the maximum concentrations of metals, anions, color, etc., allowed for each classification. A hypothetical case study of a 100 acre industrial complex illustrates the planning process. After the demand and quality requirements in each category of water quality are decided, storage and treatment facilities are designed for each class of water. Next, costs are determined. Three reuse alternatives are compared: all city water, all storm water except for potable water, and all storm water except for potable water and process water. The cheapest alternative in this case reuses stormwater for irrigation process and cooling water and gives a total water supply cost of $1.54 million, saving $800,000 over the use of city water for these purposes plus for potable water. (Cassar-FRC)
W82-00524

EFFECTS OF MUNICIPAL WASTE WATER EFFLUENT ON PERFORMANCE AND FEED QUALITY OF MAIZE VS. REED CANARYGRASS,
Science and Education Administration, St. Paul, MN.
G. C. Marten, W. E. Larson, and C. E. Clapp.
Journal of Environmental Quality, Vol 9, No 1, p 137-141, January-March, 1980. 5 Tab, 9 Ref.

Descriptors: *Wastewater farming, *Crop yield, *Corn, Grasses, Wastewater irrigation, Wastewater disposal, Crop production, Forages, Feeds, Fodder, Proteins.

The field quality and yields of dry matter, digestible dry matter, and crude protein of maize and reed canarygrass were determined when fields were managed for maximum yield and when irrigated with two levels of municipal wastewater effluent. The three treatments of plots were a control consisting of well water and mineral fertilizer, application of 5 cm of wastewater per week, and application of 10 cm of water per week. In the second through fourth year, the maize fodder was more digestible than any of the reed. The reed canarygrass always contained more crude protein than the maize. Seventeen to 36% more dry matter and 23 to 41% more digestible dry matter was yielded by the maize fodder. These differences

were reduced as effluent applications increased. Reed canarygrass yielded from 30 to 52% more crude protein per hectare. Thus, perennial grasses seem to have a superior capacity when compared to maize for removing nitrogen from soil treated with wastewater effluent. The grasses yielded the most protein per hectare but the least digestible dry matter when treated with effluent. (Small-FRC)
W82-00564

ISOLATION AND IDENTIFICATION OF PATHOGENIC MICROORGANISMS AT WASTEWATER-IRRIGATED FIELDS: RATIOS IN AIR AND WASTEWATER,
Hebrew Univ., Jerusalem (Israel). Environmental Health Lab.
For primary bibliographic entry see Field 5A.
W82-00579

IRRIGATION AND DRAINAGE WATERS OF A NEW IRRIGATION ZONE IN THE HUNGRY STEPPE AND POSSIBILITIES OF THEIR USE,
V. A. Molodtsov.
Water Resources (English Translation), Vol 7, No 5, p 422-430, September/October, 1980. 1 Fig, 5 Tab, 5 Ref. Translated from Vodnye Resursy, No 5, p 89-99, September/October, 1980.

Descriptors: *Irrigation, *Drainage waters, *USSR, Hungry Steppe, Water demand, Chemical analysis, Mineralization, Flushing, Chemical composition, Asia, Salts, Saline soils.

An acute shortage of fresh water resources is developing in Central Asia as a result of increasing irrigation. The mineralization and chemical composition of rivers of Central Asia, especially the Syr Darya, have changed significantly since the 1950s. The increased mineralization of the Syr Darya is primarily the result of the inflow of drainage waters from the Fergana Valley. The possibility of using waters having increased mineralization for flushing saline soils has commanded considerable interest as the need for fresh water sources has become more acute. The mineralization and chemical composition of irrigation and drainage waters of the newly irrigated zone in the Hungry steppe were observed monthly for three years in an effort to determine their suitability for use in flushing operations. These studies indicated that the use of drainage waters for flushing salinized soils was feasible in three regions of the Hungry Steppe. The waters of the Central Hungry Steppe Collector Drain (CHD) could be used for flushing the area confined to the Dzhetysai and Sardobin depressions, which contain meadow solonchaks with more than 2 percent toxic salts in the upper 1 meter layer. Drainage waters from group collector drains can be used for flushing areas in the southeastern part of the Hungry Steppe, including parts of the Khavast alluvial fan and the eastern part of the Dzhizak Steppe. Waters of Central Collector Drain No. 7 can also be used to flush the peripheral territory of the Khavast alluvial fan. The waters of the collection drains of the Khavast alluvial fan and the CHD can be used to flush the territory of the Khavast alluvial fan adjacent to the Sardobin depression. Drainage waters in the territory of the Dzhiil'min part of the Dzhizak Steppe could conceivably be used for flushing if vertical drains were constructed and well discharges were large. Drainage waters in the rest of the Hungry Steppe are not suitable for flushing soils in their vicinity. (Carroll-FRC)
W82-00658

EFFECT OF IRRIGATING LOAMY SAND SOIL BY LIQUID SEWAGE SLUDGE ON ITS CONTENT OF SOME MICRONUTRIENTS,
Ain Shams Univ., Cairo (Egypt). Dept. of Soils.
For primary bibliographic entry see Field 5E.
W82-00661

THE EFFECTS OF SODIUM AND ORGANIC MATTER IN SEWAGE EFFLUENT ON WATER RETENTION PROPERTIES OF SOILS,
The Hebrew Univ., Rehovot (Israel). Dept. of Soil and Water Science.
S. Burns, and E. Rawitz.
Soil Science Society of America Journal, Vol 45, No 3, p 487-493, May-June, 1981. 7 Fig, 3 Tab, 17 Ref.

Descriptors: *Soil moisture retention, *Wastewater irrigation, Soil properties, Effluents, *Organic matter, *Sodium, Moisture availability, Irrigation, Infiltration.

A set of laboratory experiments conducted to test effects of sewage effluent on the water relations of soil under simulated drop irrigation is presented. Soil used was taken from two separate depths at Kfar Kayarok in the Israeli Coastal Plain. Under the conditions of this study, no amount of sewage water approximately equivalent to one season's irrigation in the field was sufficient to increase the soil's capacity to retain water. No ponding occurred, and aerobic conditions were maintained. Allowing the soil to dry a few days between irrigations was the determining factor in preventing ponding. When using effluent for crop irrigation, as opposed to utilizing cropland for effluent disposal, the intermittent wetting and drying regime is the more representative of field conditions. Effluent sodium adsorption ratio (SAR) was instrumental in increasing the amount of water held, by deflocculating the soil. Soil drying enhanced organic matter-clay complex formation between soil clay colloids and the organic solids introduced by the sewage effluent. In finer soil, these complexes were fairly stable and produced cracking in the surface which can be useful in field water management. In coarser soil less stable, organic matter-clay complexes were formed, which were easily destroyed by simulated rain application, resulting in redispersion and soil-pore blockage by organic colloisds. (Baker-FRC)
W82-00663

THAMES REARS CARP IN SEWAGE.
Water, No 38, p 38, May, 1981.

Descriptors: *Fish farming, *Wastewater, Water reuse, Fish stocking, Fisheries, Fish, Carp, Wastewater lagoons, Lagoons, England.

Sewage treatment lagoons have been stocked annually with excess stocks of small fry, and these are cropped 12 months later when they have reached about 17 cm in length. This creates a secondary function for the lagoons, the rearing of fish for which all the feed is provided by the effluent, and yet which achieve a marketable value in one year. Five hundred Kg. of quality rough fish have been removed from the Stanford lagoons by sewage operators and divisional scientific staff using the electro-fishing method. Before being distributed, the fish are given a thorough health check. The screening is very thorough, as these fish then go on to healthy fisheries. A random sample from each batch is checked for any irregularities. (Baker-FRC)
W82-00681

SALINE WATER USE AND DISPOSAL OPPORTUNITIES; COLORADO RIVER WATER QUALITY IMPROVEMENT PROGRAM,
Bureau of Reclamation, Boulder City, NV.
Special Report, Sepember, 1981. 153 p, 20 Fig, 31 Tab, 50 Ref, 4 Append.

Descriptors: *Saline water, *Impaired water use, *Cooling water, *Waste water disposal, Coal slurry pipelines, Saline water systems, Industrial water, Fuel, Solar energy, *Colorado River basins.

Saline concentrations in the Colorado River are increasing and will continue to increase as the Basin States develop their lands and available water resources. Without a program of salinity control, continued development will result in increased damages to agricultural, municipal, and industrial users. An assessment was made of the potential technical and economic feasibility of collecting saline water in the Colorado River Basin, transporting it for practical use in energy production, and exporting and disposing of wastewater in a cost-effective manner. Sixteen saline water sources were evaluated in various collection configurations for local use or export. The total water volume considered as potential sources for use or disposal is 610,000 acre-feet. Efforts were directed to highlighting opportunities of using saline water in powerplant cooling and industrial processing as well as coal slurry pipelines. The most promising beneficial use cases appear to be: local use of saline water for powerplant cooling; and a coal slurry pipeline carrying 50 or 100 million tons of coal per year to southern California using saline water as the transport medium. Other potential uses include salt gradient solar ponds for desalting and power generation. Wastewater and blowdown collection and disposal service were also examined for energy development sites located near saline water pipeline collection systems. If a long-distance pipeline is developed for other purposes, economies of scale may make wastewater collection and disposal a viable alternative. (Moore-SRC)
W82-00717

QUALITY OF IRRIGATION WATER AND EFFECTS OF SULFURIC ACID AND GYPSUM ON SOIL PROPERTIES AND SUNDANGRASS YIELDS,
Arizona Univ., Tucson. Dept. of Soils, Water, and Engineering.
B. J. Alawi, J. L. Stroehlein, E. A. Hanlon Jr, and F. Turner Jr.
Soil Science, Vol 129, No 5, p 315-322, May, 1980. 2 Fig, 1 Tab, 6 Ref.

Descriptors: Saline soils, *Sulfuric acid, *Gypsum, *Irrigation effects, Irrigation water, *Soil properties, *Crop yield, Infiltration rate, Sudangrass.

A study is presented which was designed to show the effects of continuous irrigation with waters of different qualities on soil properties and crop yields. Also, the extent to which relatively low rates of sulfuric acid and gypsum can be used beneficially to reduce soil salinity and sodium and improve infiltration rates and crop yields was determined. Plots were irrigated over a three year period with water which had a salinity content varying from ECw of 3.2 times 10 to the 3rd power to 0.55 times 10 to the 3rd power millimhos/cm. Different soil slainities resulted, and the exchangeable sodium percentage ranged from 18.4 to 24.0 in the surface 30 cm of soil. Over a two year period, Sudangrass yields increased with decreasing water salinity after the addition of relatively low rates of 93% H2S04 and gypsum. Yields were increased by H2S04 and gypsum with all three waters the first year, but only by H2S04 the second year. Thus, sulfuric acid was generally superior to gypsum for reducing soil salinity and exchangeable sodium percentage. (Small-FRC)
W82-00767

2,500 ACRES OF WASTEWATER IRRIGATION,
J. F. Blair.
BioCycle, Vol. 22, No 3, p 30-31, May/June, 1981.

Descriptors: *Irrigation water, *Wastewater irrigation, Water reuse, Agriculture, Pipelines, Water conveyance, Water storage, Lubbock, Texas.

Near Lubbock, Texas, 7.2 mgd of treated wastewater pumped through a 16 mile pipeline will irrigate 2500 acres of cropland. At the end of the 27 inch watertight pipeline are three 15 inch lines leading to earthen storage lagoons, each 50-100 acres in area and 13 ft in depth. From the lakes, water is pumped through center pivot sprinkler systems. It is expected that cotton production will increase to 1.5 bales per acre from the nonirrigated yield of 0.5 bales per acre. Forty years' experience with wastewater irrigation on the nearby 4,000 acre Gray farm have shown that seepage never reached below 15 ft and did not enter the Ogallala aquifer. (Cassar-FRC)
W82-00769

GROWTH OF THE BAY SCALLOP, ARGOPECTEN IRRADIANS, IN A WASTE RECYCLING AQUACULTURE SYSTEM,
Woods Hole Oceanographic Institution, MA.
R. Mann, and R. E. Taylor, Jr.
Aquaculture, Vol. 24, No. 1/2, p 45-52, May, 1981. 2 Fig, 1 Tab, 14 Ref.

Descriptors: *Water recovery, *Aquaculture, *Recycling, Mollusks, *Aquatic animals, *Scallops, Wastewater treatment, Water quality, Growth, Impaired water use.

This report presents results of studies of the growth of Argopecten irradians both in a pilot scale waste recycling aquaculture system, and in laboratory systems at four temperatures when fed on phytoplankton cultured in sewage-seawater mixtures. Juvenile A. irradians were grown successfully on a diet of phytoplankton cultured in sewage-seawater mixtures. A. irradians increased from initial live and dry meat weights of 1.15 g and 0.043 g respectively, to terminal values of 9.08 g and 0.599 g, respectively. This corresponds to instantaneous growth rates for live weight and dry meat weight of 0.009 and 0.013, respectively. High mortalities were evident towards the end of the experiment, with a terminal value of 33%, giving an instantaneous mortality rate value of 0.0016. In laboratory experiments of 12 weeks in length at 12, 15, 18 and 21 degrees C, juvenile A. irradians gave values of 0.01, 0.013, 0.018, and 0.016 for live weight, 0.015, 0.015, 0.016, and 0.013 for dry weight and 0.038,0.038, 0.037 and 0.040 for instantaneous mortality rate at the respective temperatures. A. irradians exhibited specific growth rates comparable to or higher than those previously recorded for other bivalve species cultured in waste recycling systems. However, a considerable reduction in the presently high mortality rate will be needed to make A. irradians a prime candidate for practical application. (Baker-FRC)
W82-00842

MASSIVE CULTIVATION OF MICROALGAE: RESULTS AND PROSPECTS,
Kernforschungsanlage Juelich (Germany, F.R.). Inst. fuer Biotechnologie III.
For primary bibliographic entry see Field 5D.
W82-00913

ENVIRONMENTAL EFFECTS OF WATER REUSE SCHEME,
Sewage Reclamation Dept., Tel Aviv (Israel).
E. Idelovitch.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE3, p 561-570, June, 1980. 4 Fig, 4 Tab, 7 Ref.

Descriptors: *Wastewater renovation, *Environmental effects, *Water reuse, *Israel, Water supply, Water demand, Water resources development, Water treatment facilities, Wastewater treatment.

Due to the scarcity of water supplies in Israel, it is not feasible to discharge wastewater into the sea. First, such discharge would be environmentally unsound. Second, the wastewater should be treated for reuse as a source of supply for agricultural, industrial, and even municipal consumers. The Dan Region Project in the Tel Aviv Metropolitan Area is the largest and most advanced water reuse scheme in Israel. The first stage of the project, now in operation, comprises facilities for advanced treatment and groundwater recharge of wastewaters discharged from the Southern Tel Aviv Metropolitan Area. These facilities serve a total population of about 400,000 and have a capacity of 20,000,000 cubic meters per year or about 15 mgd. The second part of the project deals with wastewater from the northern and eastern parts of the Tel Aviv Metro Area. Prior to the completion of the first stage, most of the wastewater which is now treated had been discharged into the Mediterranean Sea. The water now undergoes biological and physicochemical treatment, and is then recharged to the groundwater aquifer by intermittent spreading over sand basins. The reclaimed water will be used to supplement nonpotable needs. The oxidation ponds in the first stage remove settleable solids, sand, suspended solids, soluble biodegradable matter, nitrogen, and heavy metals, within a process of algae growth. A high lime-magnesium process removes suspended solids, bacteria, viruses, and some inorganic dissolved solids. The polishing ponds provide for stripping of free ammonia at high pH and for recarbonation of the lime treated effluent by absorption of carbon dioxide. (Baker-FRC)
W82-00973

EFFECTS OF WATER QUALITY ON FORAGE PRODUCTION,
Texas Tech Univ., Lubbock. Dept. of Plant and Soil Science.
R. E. Zartman, T. D. Miller, J. R. Goodin, and M. Gichuru.
Journal of Environmental Quality, Vol 9, No 2, p 187-190, April/June, 1980. 4 Tab, 15 Ref.

Descriptors: *Cooling water, *Irrigation effects, *Forages, Irrigation water, Water quality, Crop yield, Alfalfa, Municipal water, Water reuse, Electric powerplants, Crop production, Lubbock, *Texas.

The effects of water quality on forage production were investigated in a 4-yr field study conducted at the Jones Station Facility in Lubbock, Texas. Three application rates (high, medium, and low) of electric powerplant cooling water and city water were used to irrigate fourwinged saltbush (Atriplex canescens) and alfalfa (Medicago sativa) stands started on a Friona fine sandy loam in 1975. Alfalfa crops reacted favorably to irrigation, with the highest yields occurring in the high-irrigation city water treatment, followed by the high irrigation blowdown water treatment. Alfalfa stands receiving medium irrigation levels produced moderate yields, while the dryland production decreased during the course of the experiment. Irrigation had little effect on yields of Atriplex stands. No differences in forage yield were found between fields irrigated with city and cooling water. It was concluded that alfalfa production benefits by irrigation with either blowdown or city water. (Geiger-FRC)
W82-01002

HEALTH ASPECTS OF URBAN WATER CONSERVATION,
East Tennessee State Univ., Johnson City. Dept. of Environmental Health.
C. S. Bishop, and V. A. Sikora.
Journal of Environmental Health, Vol 42, No 5, p 250-252, March/April, 1980. 1 Ref.

Descriptors: *Water demand, *Conservation, Water supply, Water supply development, *Water reuse, Potential water supply, Water shortage, *Public health, Urban areas.

The nature, potential scope and limitations of the federal urban water conservation program in relationship to environmental health are considered. As demand for additional water supplies grows, conservation becomes increasingly important. Environmental health professionals must help insure that a comprehensive approach will be taken and that forthcoming innovations will not jeopardize the public health. Approaches to decrease the consumption of water include reducing pressure in the distribution system, use of water saving devices, reducing leakage, in-home wastewater recycling systems, and increased water prices. Each of these possibilities has potential problems which must be understood before they are undertaken. A great deal of controversy exists concerning reusing wastewater in the home. The concept of a split system in which water used for washing is then used for toilet flushing is interesting. However, it may lead to cross connection and the potential for contaminated water to enter the potable water supply, creating a health hazard for a large number of people. Any such water saving devices will probably be installed as a novelty and will not be used uniformly throughout a system. They may then be misused by subsequent owners of a home or by tenants. Building inspectors view this as a potential problem. (Baker-FRC)
W82-01047

3E. Conservation In Industry

GROUND-WATER USE FOR COOLING: ASSOCIATED AQUIFER TEMPERATURE CHANGES,
California Univ., Berkeley. Lawrence Berkeley Lab.
M. J. Lippman, and C. F. Tsang.
Ground Water, Vol 18, No 5, p 452-458, September/October, 1980. 4 Fig, 3 Tab, 11 Ref.

Descriptors: *Cooling water, *Injection wells, *Electric powerplants, Aquifer management, Powerplants, *Water conservation, Thermal pollution, Heated water, Groundwater.

Water and energy conservation could result if cooling waters from a steam-electric plant are injected into an aquifer for later use in heating, industry, or agriculture. This paper analyzed a simple system comprising one withdrawal and one injection well and concluded that, at rates of 3.65 million cu meters per year, the wells are usable for 2 to 8 years before the temperature of the extracted water becomes too hot to produce a cooling effect. In actual field use a much larger number of wells would be used, extending the life of the well field. The heating effects in confined aquifers are localized around the injection wells. When well operation ceases, the hot water plume drifts in the direction of the groundwater flow, gradually cooling. (Cassar-FRC)
W82-01014

3F. Conservation In Agriculture

SALINE IRRIGATION WATER.
World Farming, Vol 23, No 1, p 24, January/February, 1981.

Descriptors: *Saline water, *Irrigation practices, *Sprinkler irrigation, Water injury, Water pollution effects, Salt tolerance, Irrigation efficiency.

Sprinkling irrigation water during the evening or night can reduce leaf salt absorption by half compared with daytime sprinkling. Irrigation should be infrequent and heavy, with sprinkler rotations of 1 min or less to prevent drying between cycles. As little as 200 ppm of salts in irrigation water can injure crops if leaves accumulate salt. Furrow or flooding irrigation causes less salt injury than sprinkler irrigation for the more sensitive crops: citrus, stone fruit trees, almonds, peppers, potatoes, tomatoes, alfalfa, barley, safflower, sesame, and sorghum. (Cassar-FRC)
W82-00512

YIELD AND WATER USE OF VEGETABLE CROPS WITH SEEPAGE AND DRIP IRRIGATION SYSTEMS,
Agricultural Research and Education Center, Bradenton.
A. A. Csizinszky.
Florida Scientist, Vol 43, No 4, p 285-292, Fall, 1980. 1 Fig, 6 Tab, 6 Ref.

Descriptors: *Irrigation efficiency, *Vegetable crops, *Water use efficiency, Corn, Broccoli, Squash, Drip irrigation, Seepage, Crop yield, Water conservation, Conservation.

The effects of seepage and drip irrigation on crop yield were studied in spring 1978 on broccoli (Brassica oleracea L., Italica Group cv. 'Green Comet Hybrid'), sweet corn (Zea mays cv. 'Silver Queen'), and zucchini squash (Cucurbita pepo cv. 'Fordhook'). Yields per plant in kg (seepage and drip, respectively) were: broccoli, 0.307 and 0.198; corn, 0.191 and 0.189; and zucchini, 6.13 and 6.32. Plant densities for seep irrigation were 70-85% of the densities for drip irrigation. Yields per hectare in tons (seepage and drip, respectively) were: broccoli, 3.76 and 3.15; corn, 10.68 and 12.14; and zucchini, 45.21 and 60.67. Seepage irrigation plots received water at a constant rate of 13.31 liters per sq meter per day, and the amount of water with the drip system was adjusted every 10 days. Total amounts of water received during the growing season in liters per sq meter (seepage and drip, respectively) were: broccoli, 752 and 216; corn, 978 and 355; and zucchini, 1124 and 359. Water use (in liters) to produce 1 kg of marketable yield were: broccoli, 1999 and 684; sweet corn, 916 and

193; and zucchini, 249 and 59, for seepage and drip irrigation, respectively. (Cassar-FRC)
W82-00544

TRAVELING SPRINKLER SYSTEM AND METHOD,
Toro Co., San Marcos, CA. (Assignee).
E. J. Hunter.
U.S. Patent No 4,204,642, 33 p, 43 Fig, 8 Ref; Official Gazette of the United States Patent Office, Vol 994, No 4, p 1260-1261, May 27, 1980.

Descriptors: *Patents, *Irrigation systems, *Sprinkler irrigation, *Application equipment, Irrigation efficiency, Irrigation practices, Irrigation operation and maintenance.

A low capital investment system for irrigating a relatively large area field, comprises a mobile base, and a sprinkler mounted on the base and adapted to accumulate water from a water supply and to intermittently discharge the accumulated water in a stream over the field. Apparatus is provided for propelling the base in a back and forth movement traversing a field, and for generally reversing the water discharge direction each time the direction of travel is reversed. The sprinkler includes a resiliently expandable reservoir construction for accumulating relatively large volume, intermittent bursts, and a drive system which also provides relatively short range, continual irrigation. Separate sprinkler units can be used on a field concurrently, or a single unit can be moved over successive areas of a field until the whole field has been covered. The system may also be combined with a center pivot device to irrigate land that would otherwise be unused. (Sinha-OEIS)
W82-00561

RESEARCH AND DEVELOPMENT TO SERVICE A SUSTAINABLE AGRICULTURE,
University of New England, Armidale (Australia).
J. R. McWilliam.
Search, Vol 12, No 1/2, p 15-21, January/February, 1981. 5 Fig, 16 Ref.

Descriptors: *Research priorities, *Irrigation efficiency, *Dry farming, Irrigation, Water use efficiency, Water management, Water resources development, *Australia.

Important problems which threaten the stability of Australia's irrigated and dry-land cropping systems are considered and the most urgent research needs are identified. The originality and effectiveness of research depends upon the quality of students and the agricultural education available to them. A successful utilization of Australia's water and soil resources depends on efficient conservation and management practices. Research is needed in the area of irrigation. Most of the water resources are located in the north, where only about 5% of available water is utilized. In the south, where irrigation is used, there are problems with the buildup of salinity and the deterioration of structure in fine-textured soil under intensive cropping. Efficient water management is especially important in areas which employ dryland cropping. Research is needed on the effects of tillage, including no-till, minimum tillage, and various forms of stubble retention and mulching. Research is also needed in crop development, past and pathogen control, and the establishment of pastures. (Small-FRC)
W82-00669

OPERATIONAL EVALUATION OF VILLAGE LEVEL IRRIGATION CONVEYANCE SYSTEMS,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
T. J. Trout, and S. A. Bowers.
Transactions of the ASAE, Vol 24, No 3, p 636-642, May/June, 1981. 9 Fig, 5 Tab, 7 Ref.

Descriptors: *Conveyance structures, *Water loss, *Irrigation ditches, Water conveyance, Leakage, Irrigation operation, Mathematical studies, Design criteria, *Pakistan.

In a study of five village level watercourse systems in Pakistan, total operational conveyance losses were measured using an adaptation of the inflow-outflow method. The extents of transient losses were quantified, as were the types of watercourse losses, to aid in the evaluation of conveyance efficiencies. Flow rates were monitored continuously, and flow hydrographs were created. Operational losses were calculated as the difference between the volume of water entering the watercourse at the head and the volume entering the irrigated fields. Total losses varied from 37 to 56%, and averaged 45% on inflow. Fifty-five percent of the losses occurred on the primary channels. Less than 1% of the losses were attributed to evaporation, and loss rates decreased with distance. Seven percent of the inflow or 15% of the losses were due to transient phenomena such as wetting dry channels, dead storage, and short-term breaches. Steady-state seepage into channel wetted perimeters was much greater than would be expected from normal infiltration. (Small-FRC)
W82-00696

LAND FORMING EFFECTS ON DRYLAND SORGHUM PRODUCTION IN THE SOUTHERN GREAT PLAINS,
Science and Education Administration, Bushland, TX. Conservation and Production Research Lab.
O. R. Jones.
Soil Science Society of America Journal, Vol 45, No 3, p 606-611, May-June, 1981. 4 Fig, 5 Tab, 10 Ref.

Descriptors: *Crop yield, *Cultivation, Soil moisture retention, Soil water, Moisture availability, Agriculture, Erosion, Water conservation, *Sorghum, Runoff control, *Land forming.

Research was conducted to develop low-cost land forming systems for controlling or reducing storm runoff on drylands and to determine the effectiveness of selected land forming systems in preventing runoff, controlling erosion, storing water, and increasing grain sorghum yields. Various land forming treatments investigated included conventional graded furror, conventional contour furrow, wide furrow, Orthman, mini-bench, and conservation mini-bench. All plots were tandem-disked about 0.07 meters deep in early April each year to bury residue and allow volunteer sorghum to sprout. Furrow treatments were imposed in early May. Conventionally constructed contour furrows on large fields frequently overtop during heavy, high-intensity rainstorms. Overtopping and subsequent soil erosion from runoff results when the surface-water storage capacity of furrows or border dikes is exceeded. Orthman, wide furrow, mini-bench, and conservation mini-bench treatments did not overtop but retained all precipitation from this record rainstorm because their surface-water capacity was not exceeded. Thus level land forming systems can effectively conserve precipitation and prevent runoff on large, gently sloping field areas in the Southern Great Plains. Water is the limiting resource for crop production in the area. Approximately one half of the total water requirements for a dryland sorghum crop can be provided from soil water stored at seeding time. Land leveling is the most effective conservation practice for preventing runoff and increasing dryland crop yields. (Baker-FRC)
W82-00764

EFFECT OF SOIL WATER CONTENT AND A GROWING SEASON STRAW MULCH ON GRAIN SORGHUM,
Science and Education Administration, Bushland, TX. Conservation and Production Research Lab.
P. W. Unger, and O. R. Jones.
Soil Science Society of America Journal, Vol 45, No 1, p 129-134, 1981. 2 Fig, 1 Tab, 14 Ref.

Descriptors: *Mulching, *Sorghum, *Soil water, Straw, Mulches, Crop production, *Crop yield, Water use efficiency, Soil moisture retention.

A study was performed to evaluate the contribution of a growing season straw mulch to grain sorghum growth, yield, grain quality, water use, and water use efficiency. Plots of Pullman clay loam were given two irrigations, one irrigation, and no irrigation prior to planting in order to simulate high, medium, and low levels of water storage in soil during fallow. Zero, 2, 4, or 8 metric tons of wheat straw per hectare were placed on the surface after the sorghum emerged. Sorghum responses to the high and medium water storage levels were similar, since the second irrigation resulted in relatively little additional storage due to the slow permeability of the soil. However, sorghum on plots receiving one or two irrigations grew taller, yielded more, and used water more efficiently than water on unirrigated plots. In general, sorghum responded more to soil water content at planting than to mulch rate during the growing season. Over a three year period, application of 8 metric tons of straw per hectare during the growing season resulted in a 19 percent increase in water use efficiency over plots receiving no mulch. Shading from the plant canopy appeared to provide the beneficial effect of a mulch during the growing season. A major beneficial effect of using a mulch during both the fallow and the growing seasons, in terms of water conservation and crop production, is the enhancement of water storage in the soil during fallow periods. (Carroll-FRC)
W82-00765

LASER DRIP IRRIGATION.
World Farming, Vol 23, No 1, p 34, January/February, 1981.

Descriptors: *Irrigation engineering, *Trickle irrigation, *Lasers, Water conservation, Computers.

An experimental laser-guided traveling trickle irrigation system features a main tower which keeps field towers in alignment with the use of a laser plane. Laser receptors in each field tower activate changes in motor speed to adjust the alignment. Water is applied near the plant, wasting none between rows. Future plans include computer programming and solar power. This system can eliminate over-irrigation, uneven distribution of water in soil, and excessive labor costs. (Cassar-FRC)
W82-00771

EVALUATING IRRIGATION SYSTEMS,
For primary bibliographic entry see Field 6B.
W82-00772

WATER STRESS AND COLD HARDINESS IN FIELD-GROWN CITRUS,
Florida Univ., Gainesville. Dept. of Fruit Crops.
For primary bibliographic entry see Field 2I.
W82-00864

SIZING RICE IRRIGATION CANALS,
D. P. Spare, J-K. Wang, and R. E. Hagan.
Transactions of the ASAE, Vol 23, No 4, p 914-918, 923, July/August, 1980. 1 Fig, 3 Tab, 3 Ref.

Descriptors: *Rice, *Irrigation canals, *Design criteria, Flood irrigation, Cropland, Canals, Irrigation design, Mathematical studies, Mathematical equations.

The peak demand for irrigation water in a paddy rice production system, which occurs at the beginning of a production season when land soaking water is introduced, determines the sizes of irrigation canals needed. Three conflicting requirements must be suitably reconciled if this peak water demand is to be minimized. First, the system-wide water demand during the land soaking period should follow as closely as possible the theoretical minimum values proposed by Hagan and Wang (1977). Second, the minimum land area to be served by a given sublateral or farm-ditch during a rotational period should not be less than that determined by local circumstances. Third, the patterns of subdivision of the project area into command and service areas to be served by laterals and farm ditches which are dictated by topographical and sociological constraints should be respected. A procedure for the design of sublateral in-field irrigation water distribution systems for paddy rice production systems which reconciles these three requirements is presented. The procedure minimizes the peak water requirement of the produc-

tion system and gives a detailed irrigation schedule for the land soaking period. The procedure has been applied to the design of the Naga-Calabanga Integrated Agricultural Development Area project, a 7,000 hectare paddy rice production system in the Philippines. (Carroll-FRC)
W82-00895

WATER REQUIREMENT FOR SUGARCANE PRODUCTION,
Agricultural Research and Education Center, Belle Glade, FL.
S. F. Shih, and G. J. Gascho.
Transactions of the ASAE, Vol 23, No 4, p 934-937, July/August, 1980. 4 Fig, 3 Tab, 19 Ref.

Descriptors: *Crop production, *Water requirements, *Sugarcane, Sugar crops, Water use, Rainfall, Lysimeters, Soil water, Soil-water-plant relationships.

The only economically feasible strategy for increasing the longevity of the organic soils of the Everglades, which are subsiding at a rate of between 1.5 and 3.1 centimeters per year, is to maintain high water tables. However, available data on the effect of water table level on water requirement and production performance of sugarcane are not adequate for making precise recommendations as to optimum water table depth for sugarcane production and soil conservation. Six lysimeters were used to control water tables at 30, 60, and 90 centimeters below the muck soil surface for sugarcane production. The effective rainfall was found to be proportional to water table depth, with about 3.4 centimeters of rainfall stored in the soil for each 10-centimeter increment of water table depth. Water table depth had a significant effect on water requirement in both the dry and the grand growth periods. Each 10-centimeter increase in water table depth resulted in a reduction in the water requirement of about 3.7 centimeters for plant crop and 2.2 centimeters for ratoon crop during the dry season and about 3.4 and 1.3 centimeters, respectively, during the grand growth period. Maintaining a high water table will increase the requirements for water for irrigation and the need for pumping for drainage following heavy rainstorms. The water required to produce 1 kilogram of fresh cane varied from 89 kilograms in plant crops to 118 kilograms in the ratoon crop. Water requirements for production of 1 kilogram of sugar ranged from 884 kilograms in plant crop to 1115 kilograms in ratoon crop, indicating lower water use efficiency by ratoon crop. (Carroll-FRC)
W82-00899

DEPTHS OF FLOW IN LEVEL BASINS,
Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
A. J. Clemmens.
Transactions of the ASAE, Vol 23, No 4, p 910-913, July/August, 1980. 1 Fig, 1 Tab, 7 Ref.

Descriptors: *Water depth, *Basins, *Flow rates, Border irrigation, Irrigation, Infiltration, Mathematical studies, *Basin irrigation, Level basins.

The design of level basins is based on balancing the infiltration characteristics of the soil, the basin size, and the available irrigation stream (flow rate). Since the use of the largest possible stream available can cause excessive surface water depths in some cases, the design of level basins can also be dependent upon a practical limit on basin ridge or border height. A solution for the maximum surface water depth in level basins was developed from the zero-inertia border irrigation model developed by Strelkoff and Katopodes (1977). This model is based on continuity and momentum principles. The solution is applicable to rectangular basins irrigated from one end where the application time is less than the advance time to the end of the basin. A direct comparison of the solution results with the design charts in the Soil Conservation Service Border Irrigation Handbook demonstrates that the solutions presented in these charts can be in error by as much as 20 percent within a realistic range of field variables. (Carroll-FRC)
W82-00900

THE UNCERTAINTY OF CROP MODELS IN IRRIGATION OPTIMIZATION,
Oregon State Univ., Corvallis. Dept. of Agricultural Engineering.
M. J. English.
Transactions of the ASAE, Vol 24, No 4, p 917-921, July/August, 1981. 6 Fig, 2 Tab, 10 Ref.

Descriptors: *Model studies, *Irrigation practices, Crop yield, Simulation, Weather, *Optimization, Irrigation efficiency.

This paper is concerned with economic optimization of irrigation practices. Optimization is taken to mean maximizing the net benefit realized from the unit of water used. Crop production models are considered which relate applied water to crop yield. It is noted that the relationship between the water applied and crop yield is characterized by substantial and largely unavoidable uncertainty, which may be so great as to influence a farmer's irrigation practices. A case study is presented in which the uncertainty of yield predictions is simulated for a situation involving irrigation of beans and sugar beets in southern Idaho. The consequences of that uncertainty are evaluated through the use of decision theory. A need for a probabilistic approach to crop modelling is demonstrated. Weather conditions are unpredictable. Irrigation efficiency is another source of considerable uncertainty. Crop models are needed which not only predict most probable yields, but also quantify the uncertainty in yield predictions. New models will need to emphasize statistical simulation techniques, and since statistical simulation usually involves large blocks of computer time, these models should be designed with computational efficiency in mind. The related research in agronomy, meteorology, soil science and engineering should be as concerned with variability of results as with central tendencies. Researchers concerned with water use and crop yield models need to develop an understanding of the practical applications of the variability and uncertainty of such models. (Baker-FRC)
W82-00940

LATERAL SIZES FOR EFFICIENT LEVEL-BASIN IRRIGATION,
Agricultural Research Service, Fort Collins, CO.
E. G. Kruse.
Transactions of the ASAE, Vol 24, No 4, p 961-967, 969, July/August, 1981. 3 Fig, 4 Tab, 2 Ref.

Descriptors: *Irrigation practices, *Computer programs, Irrigation efficiency, Level basins, Irrigation programs, Irrigation canals, *Grand Valley, Colorado.

A procedure is described whereby a computerized data base of irrigated fields in a section of the Grand Valley was sorted to determine those fields with deep enough soils and mild enough slopes for practical basin leveling. Level-basin irrigation is an old technique for applying water to the land for the benefit of crops. There is no runoff in such a situation, and crops such as rice are easily kept inundated. Pilot studies demonstrated that with proper management, irrigation water can be applied efficiently and good crop production obtained. The computer screens data on physical characteristics of irrigated fields and then uses Soil Conservation Service design procedures to predict the necessary irrigation flows for efficient level-basin applications. The United States Water and Power Resources Service is formulating designs for improved canals, laterals, and turnouts in a pilot area of the Grand Valley. The computer program compared required delivery rates for level-basin irrigation with turnout capacities, based on existing WPRS criteria. Those turnouts which need enlargement were thus identified. Arrangements were negotiated with WPRS to increase the sizing on critical turnouts. If level-basin procedures continue to show promise of increased irrigation efficiencies and if they are adopted widely on the pilot area, this procedure will receive widespread use in planning for the remainder of the Grand Valley and other irrigated areas in the upper Colorado River Basin. (Baker-FRC)
W82-00942

WATERTABLE MANAGEMENT SAVES WATER AND ENERGY,
Science and Education Administration, Mandan, ND. Northern Great Plains Research Center.
L. C. Benz, E. J. Doring, and G. A. Reichman.
Transactions of the ASAE, Vol 24, No 4, p 995-1001, July/August, 1981. 4 Fig, 7 Tab, 15 Ref.

Descriptors: *Irrigation efficiency, *Water table, Crop yield, Water table fluctuations, Water level fluctuations, Lysimeters, Groundwater movement, Farming, Corn, Sugarbeets, Water conservation, *North Dakota.

Water and energy savings possible by maintaining shallow watertables were investigated. The field expriment was conducted near Oakes, North Dakota, on soils of the Hecla-Arveson-Fossum Association. Soil textures range from sandy loams to loamy sands in the surface but have uniformly sandy subsoils. Corn and sugarbeets were grown for 3 years with four applied water treatments, three imposed water tables, and four replications. As it was impossible to maintain the watertable at prescribed depths in the field experiment, twelve nonweighing lysimeters were constructed near the field plot experiment. In the field plot studies where the growing season 3-year average watertables were 1.5, 2.1, and 2.4 meters deep, yields of corn grain, corn total dry matter, sugarbeet roots, and sugarbeet sucrose were higher with the 1.5 meter watertable than with the deeper watertables irrespective of irrigation water applied. Thus irrigation water and energy were wasted where the shallow watertable existed. For the 2.1 and 2.4 meter watertable depths, irrigation increased yields, but maximum yields never exceeded yields obtained with the shallow watertables. The lysimeter studies included a wider range of watertable depths than field plot experiments. At the shallowest watertable, crop yields were depressed. Regression analyses of normalized field and lysimeter data indicated that maximum yields were obtained with much less irrigation water when the watertable depth was about 1.3 meters than with deeper watertables. It was concluded that a managed shallow watertable is a valuable agricultural resource that can save significant amounts of irrigation water and energy. (Baker-FRC)
W82-00943

DRYLAND CROPPING STRATEGIES FOR EFFICIENT WATER-USE TO CONTROL SALINE SEEPS IN THE NORTHERN GREAT PLAINS, U.S.A.,
Science and Education Administration, Mandan, ND. Northern Great Plains Research Center.
A. L. Black, P. L. Brown, A. D. Halvorson, and F. H. Siddoway.
Agricultural Water Management, Vol 4, No 1/3, p 295-311, 1981. 5 Tab, 41 Ref.

Descriptors: *Water supply development, *Cropland, *Salinity, Farming, Wheat, Sunflower, Alfalfa, Water quality, Groundwater, Water resources development, Soil water, *Seepage control, *Soil-water-plant relationships.

Soil, water, and crop management strategies needed for the control of saline seeps are identified. These strategies are based on the specific water requirements and rooting depths of crops, soil water conservation and storage, crop residue management, disease and weed control and proper fertilization. Specific strategies considered include water conservation, cropping systems, weed control and residue management. Several conclusions were reached. The practice of summer fallowing a given field every other year restricts a farmer to a fixed cropping system with limited flexibility for adjusting cropping patterns to fit available water supplies. Summer fallow should be used judiciously instead of as a regular practice. Of great importance is an understanding of the quantity and depth of available water stored within the effective rooting zone in the recharge area to be cropped. Once the quantity and depth of available soil water are known, the crop best suited to a given supply of water can be selected. On deep soils, alfalfa can remove more soil water than any other adaptable crop in a 3 to 5 year period to depths of 6 meters if no root restricting factors are present. Second in

soil water use is biennial sweet clover. Of annual crops, safflower uses the most, followed in order by sunflower, winter wheat, rapeseed, spring wheat, spring barley, and corn. After available soil water is depleted to the maximum depth possible, a flexible cropping system can be employed. Methods of weed control plus provisions for snow management, leaving crop stubble standing or establishing tall wheatgrass barrier systems to trap and hold snow, all augment available water supplies. (Baker-FRC)
W82-01023

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

SUBMERSIBLE PUMPS HELP QUELL DAMAGE FROM MOUNT ST. HELENS MUDFLOW.
For primary bibliographic entry see Field 4D.
W82-00509

AQUATIC WEED CUTTING APPARATUS,
J. R. McClure.
U.S. Patent No 4,205,507, 13 p, 8 Fig, 13 Ref; Official Gazette of the United States Patent Office, Vol 995, No 1, p 44, June 3, 1980.

Descriptors: *Patents, *Aquatic weed control, *Equipment, *Channel improvement, Floating, Water quality control, Weed cutter.

A floating aquatic weed cutting apparatus is disclosed which is highly maneuverable and particularly useful for cutting along banks and around obstacles. The cutter bar is entirely outward of one of the lateral sides of a flotation device. The cutter bar may be moved about an axis parallel to the central axis of the flotation device to change the angular disposition of it for cutting along submerged banks and around obstacles in the water. The entire cutter may be elevated with respect to the flotation device to raise or lower it from or into the water. (Sinha-OEIS)
W82-00624

THE CASPIAN SEA PROBLEM,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
D. Ya. Ratkovich.
Water Resources (English Translation), Vol 7, No 5, p 393-402, September/October, 1980. 4 Tab, 20 Ref. Translated from Vodnye Resursy, No 5, p 5-20, September/October, 1980.

Descriptors: *Caspian Sea, *Water resources development, *Resources management, Water management, Planning, Management planning, River basin development, Irrigation, Hydroelectric power, Salinity, Fisheries, Hydrologic budget, Mathematical studies, Interbasin transfers.

The Caspian Sea is the world's largest closed water body, collecting water from an area of about 3 million square kilometers. The Volga River accounts for about 75% of the total natural inflow to the sea. Although the average salinity of the sea is stable, that of the North Caspian, which is freshened by the runoff from the Volga, varies considerably. The various branches of the economy place conflicting demands on the regime of the Caspian and of the rivers flowing into it. Planned irrigation projects will decrease the runoff of the Volga, Kura, and Ural rivers, reducing the energy produced by hydroelectric stations and the depth of navigation channels. Efforts to maintain the water flow for these purposes necessitates reduction of the height and duration of floods, which will adversely affect spawning conditions of sturgeon. Reduction of the inflow into the sea results in increased salinity and may induce a drop in the water level. The water management balance of rivers of the Caspian basin is already under stress. The planned diversion of waters to the Volga from rivers and lakes of the northern European U.S.S.R. should be correlated with the rate of development of irrigation in order to preserve the unique biological productivity of the sea, to prevent the unfavorable effect of drying of the North Caspian on the climate, and to reduce losses which would result from a drop in the water level of the sea. Diversion of small amounts of water from the Volga to the Ural river would have favorable effects on the North Caspian, freshening its waters and enriching its biogenic substances. Changes which will occur in the natural conditions in zones from which water is withdrawn, and problems which may result from these changes, should be carefully considered when planning interbasin water transfer projects. (Carroll-FRC)
W82-00657

BACKFILL ALTERATION EFFECTS ON PIPE DRAINAGE OF A CLAY SOIL,
Ohio Agricultural Research and Development Center, Wooster.
G. S. Taylor, S. S. Hundal, N. R. Fausey, and G. O. Schwab.
Soil Science Society of America Journal, Vol 45, No 3, p 611-616, May-June, 1981. 5 Fig, 12 Ref.

Descriptors: *Subsurface drainage, *Backfill, Permeability, Clays, Infiltration, *Drainage, Effects, *Pipes, Drawdown.

A highly permeable region was created directly over drains installed a number of years earlier in a soil of high clay content in order to determine the effect of a highly permeable backfill on drain flow rates and to assess how long the backfill would remain highly conductive under continuous row cropping. Backfill treatments included unaltered backfill; gravel backfill, in which a trench excavated above the drain was filled with a band of crushed stone placed between plow layer and drain; or trenched and refilled, in which the trench excavated above the drain was refilled with excavated soil. The effects of backfill treatments on drain flow indicated that a permeable backfill may improve drainage for soils that have a slowly permeable subsoil. The addition of gravel increased drain flow rates by a factor of two to three during periods of ponding, but had no effect on flow rates under nonponded conditions nor on water table drawdown rates. The ponded flow rates for drains with gravel have not changed after 3 years. During the first year trenching and refilling had the same effect on drain flow rates as gravel. During the second year, the ponded flow rates declined to only 50 or 60% of those with gravel. The permeable backfill functioned as a hydraulic connector and permitted ponded water to bypass the relatively impermeable subsoil in flowing to the drain. Backfill alterations did not affect sediment concentrations in the drain water. (Baker-FRC)
W82-00763

MODELING HYDROLOGY AND EUTROPHICATION IN A LOUISIANA SWAMP FOREST ECOSYSTEM,
Louisiana State Univ., Baton Rouge. Coastal Ecology Lab.
C. S. Hopkinson Jr, and J. W. Day Jr.
Environmental Management, Vol 4, No 4, p 325-335, July, 1980. 5 Fig, 1 Tab, 16 Ref.

Descriptors: *Swamps, *Storm water, *Environmental effects, Model studies, Coastal marshes, *des Allemands, *Louisiana, *Eutrophication, Hydrology, Wetlands, Urbanization, Lakes, Drainage canals, Nutrients, Levees, Productivity, Estuaries, Swamp forest, Water management.

The EPA Storm Water Management Model was applied to the des Allemands swamp forest, Louisiana, to determine (1) the hydrologic changes that would result from removal of spoil banks and diversion of major agricultural canals and (2) the effects of overland flow on nutrient uptake in the ecosystem. At present, the swamp becomes impounded and discharge from the forest to he lake is slow. Simulations showed that hydraulic management could increase discharge rates to the lower estuary by 22%, increase productivity of the swamp forest by 100%, and decrease lake eutrophication by 43%. Contrary to commonly held beliefs, the results suggest that these changes can be accomplished by removing levees and upland drainage canals. This would allow upland runoff to pass through the backswamp, often as sheet flow, increasing water level fluctuations in the backswamp and decreasing fluctations in the bayous. (Cassar-FRC)
W82-00890

4B. Groundwater Management

PLAN OF STUDY FOR THE REGIONAL AQUIFER-SYSTEM ANALYSIS OF THE SNAKE RIVER PLAIN, IDAHO AND EASTERN OREGON,
Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 6A.
W82-00730

INTERSTATE CONFLICT OVER GROUND WATER: WISCONSIN-ILLINOIS,
Wisconsin Univ.-Oshkosh. Dept. of Geology.
For primary bibliographic entry see Field 6E.
W82-00818

THE DECLINING GROUND-WATER RESOURCES OF ALLUVIAL VALLEYS: A CASE STUDY,
Geological Survey, Lawrence, KS.
M. Sophocleous.
Ground Water, Vol 19, No 2, p 214-226, March/April, 1981. 15 Fig, 14 Ref.

Descriptors: *Groundwater depletion, *Groundwater budget, *Water conservation, Mathematical models, Depletion, Artificial recharge, Groundwater recharge, Case studies, *Kansas.

Present and future ground water withdrawals in the area of the Pawnee Valley, Kansas, were evaluated for their impact on water resources. The depletion of the water resource in the area is documented, and a preliminary hydrologic budget for the area is calculated. Also, a mathematical model is adapted and calibrated to simulate the operation of the hydrogeologic system in order to evaluate schemes for managing the ground water resource. The average natural recharge in the area was 0.5 inch/year, and the amount of appropriated ground water in the area exceeded the natural recharge figure by about 11 times. The simulations indicated that without any additional development or without very wet periods, water level declines will continue indefinitely. To reduce water depletion it will be necessary to reduce water waste, to impose a not more than 40% saturated-thickness depletion allowance for the next several years, to impose a freeze on the number of irrigation wells, and to engage in artificial recharge. (Small-FRC)
W82-00832

TAMPA BAY WATER GUARDED BY COMPUTER,
Camp, Dresser and McKee, Inc., Clearwater, FL.
R. N. Armstrong, and H. V. Aiken.
American City and County, Vol 96, No 6, p 33-35, June, 1981. 1 Fig.

Descriptors: *Water demand, *Water resources development, Wells, *Florida, Computers, Computer models, Computer programs, Drawdown, Water supply, Water supply development, Water distribution, Monitoring, *Groundwater management, Groundwater availability, *Tampa Bay region.

Use of a specialized, innovative computer management system has succeeded in maximizing the precious water resources on the west coast of Florida in the Tampa Bay region. The computer monitors, manages, and protects groundwater sources so that critical short-term and long-term water supply demands can be met. By quickly analyzing real-time information, the monitoring and control system developed for the Cross Bar Ranch well field greatly enhances the ability of the operator to

respond to real-time conditions in the well field. In the past it may have taken several days of trial adjustment to fine tune pumping rates to bring a well field into compliance with regulatory permits. With this system wells can be connected or disconnected rapidly as demand shifts. A model was also derived for surge analysis. While surge analysis is not new, the surge model for the Cross Bar ranch field is the most complex yet devised. This system makes possible an effective analysis of the complex system of 17, three mgd wells. It also enhanced the sizing of surge tanks throughout the well field to minimize pressure waves generated by the starting and stopping of pumps. Use of the surge model saves an estimated $70,000-$80,000. (Baker-FRC)
W82-00934

MANAGEMENT OF RECHARGE BASINS ON THE SOUTHERN HIGH PLAINS,
Science and Education Administration, Bushland, TX. Conservation and Production Research Lab.
O. R. Jones, D. W. Goss, and A. D. Schneider.
Transactions of the ASAE, Vol 24, No 4, p 977-980, 987, July/August, 1981. 2 Fig, 4 Tab, 8 Ref.

Descriptors: *Recharge basins, *Resources management, Recharge, Groundwater recharge, *Water management, Infiltration rate, Infiltration, Groundwater movement.

Management practices were developed for recharge basins which would prevent sealing, reduce suspended solids accumulated on the basin bottom, or permit rapid removal of the sealing layer without a drying period. These practices would increase total quantity of water infiltrated and thereby reduce the cost of artificial groundwater recharge. Six 9.1 meter square basins were excavated 1.1 meters deep with a backhoe to remove slowly permeable surface soil and expose permeable Pleistocene age pluvial sediments. These exposed sediments had a clay loam texture with moderately blocky structure and a high calcium carbonate content. Basin surface treatments and management practices for each basin included: check treatment, organic mat, flocculent, high head, variable head, and corrugated. Results showed that infiltration rates were controlled at or near the basin bottom. Suspended solids in the water supply accumulated on the basin bottom and reduced infiltration rates with time. Management practices that prevented or delayed clay-layer formation at the basin bottom were effective in maintaining high infiltration rates longer, which resulted in greater total infiltration per unit area of basin surface. Infiltration rates and total quantity of water infiltrated were highest with the high-head treatment. Application of cotton gin trash to the basin surface was another effective management practice. Total infiltration per unit area of basin surface was able to be more than doubled by using improved management pratices. The combination of high-head with either the organic mat or flocculent treatment could result in even greater recharge effectiveness than any of the treatments alone. (Baker-FRC)
W82-00938

WELL-FIELD DRAWDOWNS USING COUPLED AQUIFER MODEL,
Law Engineering Testing Co., Tampa, FL.
For primary bibliographic entry see Field 2F.
W82-00990

ROLE OF SOLUTE-TRANSPORT MODELS IN THE ANALYSIS OF GROUNDWATER SALINITY PROBLEMS IN AGRICULTURAL AREAS,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 5B.
W82-00993

ILLINOIS GROUNDWATER PROBLEMS AND NEEDS,
Illinois Environmental Protection Agency, Springfield. Div. of Land/Noise Pollution Control.
J. S. Moore.
In: Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, Cincinnati, April 28-29, 1981. Purdue University, Water Resources Research Center, West Lafayette, IN. p 13-14.

Descriptors: *Groundwater management, *Groundwater pollution, *Waste disposal, *Coal mining, Groundwater availability, Hazardous materials, Grants, Technology, Administrative agencies, Administrative regulations, Policy making, Public opinion, Public participation, *Illinois.

Use of underground water for public and private supplies, industrial use, and irrigation is increasing in Illinois. Approximately 38 percent of the total state population and 82 percent of the rural populaton relied on an underground water source for drinking water as of 1970. A wide variety of activities can lead to groundwater pollution, includng waste disposal sites; improper well construction; land application of potential pollutants such as fertilizers, pesticides, and road salt; mining and quarrying; individual sewer systems; and transportation of hazardous wastes. Various control strategies are possible. Illinois should (1) examine state agency jurisdiction to identify over laps or gaps in existing regulations; (2) examine the role of non-regulatory and scientific entities in the state to ensure coordination between such programs; (3) increase public awareness of the importance of groundwater as a valuable natural resource and identify existing public values and perceptions of underground water; (4) encourage public participation in program direction and development; (5) utilize the interagency groundwater task force to increase cooperation among involved state agencies on groundwater related strategies, determine the availability of data to decision-makers and identify technological practices; and (6) continue development of a comprehensive groundwater quality management program. Funds and technology-sharing must be sought from the federal government. (Garrison-Omniplan)
W82-01052

GROUNDWATER POLLUTION IN KENTUCKY: A STATUS REPORT,
Kentucky Dept. for Natural Resources, Frankfort.
J. C. Thornton.
In: Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, Cincinnati, April 28-29, 1981. Purdue University, Water Resources Research Center, West Lafayette, IN. p 17-21, 2 Fig, 5 Ref.

Descriptors: *Groundwater pollution, *Groundwater management, Water pollution, Karst, *Waste disposal, Hazardous materials, Poisons, Groundwater availability, Sinks, Septic tanks, Seepage pits, Underground streams, Drinking water, *Water pollution control, *Kentucky.

The Commonwealth of Kentucky has had a number or problems with contaminated groundwater, particularly related to improper waste disposal practices and to problems in oil and coal fields. Many of the existing major problem areas are located within the state's widespread areas of jointed, fractured limestone, which is very susceptible to the formation of solution channels and sinkholes. This kind of topography, known as karst, covers almost 50 percent of the state and is replete with underground streams and caves. Underground streams are particularly sensitive to contamination because they flow in channels that have a much higher velocity than normal groundwaters, and receive little or no filtration from the rock. If the contamination is stopped, these systems will flush out quickly, but in most cases the sources of contamination are relatively permanent. The major drinking water source throughout the largely rural karst area is groundwater. The Department for Natural Resources and Environmental Protection's Division of Water began assessing groundwater quality problems under the auspices of Section 208 of the Clean Water Act, and learned that one of the major causes of groundwater pollution in the state is improperly designed septic tanks and seepage pits. Other causes are sediment, agrichemicals, septic tank loadings, surface mining, oil and gas production, brine disposal, construction activity, and spills. Principal needs of the Division include quality research data for each aquifer, more trained personnel for groundwater management, and regulation for groundwater monitoring, well construction, and subsurface disposal. (Garrison-Omniplan)
W82-01053

GROUND WATER IN THE OHIO RIVER BASIN PORTION OF MARYLAND: PROBLEMS AND NEEDS,
Maryland Dept. of Natural Resources, Annapolis.
E. C. Rebuck.
In: Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, Cincinnati, April 28-29, 1981. Purdue University, Water Resources Research Center, West Lafayette, IN. P 22-26.

Descriptors: *Surface-groundwater relations, *Groundwater management, Federal jurisdiction, *Administrative regulations, State jurisdiction, *Aquifer management, Administrative agencies, Groundwater depletion, Groundwater level, Acid mine drainage, Mine acids, Hydrologic models, *Ohio River basin, *Maryland, Garrett County.

The Ohio River Basin portion of Maryland lies wholly within Garrett County, an area rich in minerals where the primary surface water resources are the Youghiogheny River and the Casselman River. While the two rivers have been shown to have good water quality, smaller tributaries do not meet stream water quality standards due to acid mine drainage pollution. Springs are important sources of domestic and municipal ground water supplies in the county. Hydraulic connection between the streams and ground waters is poorly understood. The U. S. Geological survey is pursuing a modeling study in the Casselman River Basin which will attempt to correlate base stream flow with ground water levels. On the state level, programs for ground water protection are administered by the Department of Water Resources and the Department of Health and Mental Hygiene. On the federal level, the Environmental Protection Agency is involved with activities covered by the Resources Conservation and Recovery Act of 1976, the Underground Injection Control program in the Safe Drinking Water Act (SDWA), and the sole source aquifer protection program of SDWA. Perhaps the most important technical need is the updating of the 1954 water resources reported by the USGS. Another need is better coordination among federal and state environmental regulatory efforts, especially now in times of tight economic conditions where environmental control budgets may be cut at both federal and state levels. (Garrison-Omniplan)
W82-01054

GROUNDWATER PROBLEMS AND NEEDS IN NEW YORK,
New York State Dept. of Environmental Conservation, Albany.
A. C. Tedrow.
In: Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, Cincinnati, April 28-29, 1981. Purdue University, Water Resources Research Center, West Lafayette, IN. p 27-29.

Descriptors: *Groundwater management, *Drinking water, *Groundwater availability, *Groundwater pollution, Research priorities, Administrative agencies, *Administrative regulations, Waste disposal, Water management, Reclaimed water, State jurisdiction, Local governments, Brine disposal, *New York.

A Groundwater Task Force convened in 1979 by the New York State Department of Environmental Conservation examined in-house groundwater management programs. Among its conclusions were that: (1) not enough is known about the resource itself, specifically with regard to current quality levels; (2) monitoring of changes in groundwater quality is adequate, so that violations of groundwater quality standards are often not discovered until they have created a problem; (3) oil and gas and mined land reclamation progrems in the Department are understaffed, so that groundwater impacts of the activities they regulate receive insufficient attention; (4) the Department should support local efforts in managing groundwater; (5) research is needed on groundwater reclamation and renovation; (6) Department personnel must be trained to be more sensitive to groundwater concerns, and technical staff must be developed to deal with groundwater questions; (7) a

classification system should be considered that includes fresh groundwater uses other than drinking water; (8) the possibility of utilizing wasteload allocations for discharges to groundwater should be explained; and additional groundwater management activities are required in the upstate area. Under the 208 program, projects are underway to investigate the technical, institutional, and financial aspects of changes in groundwater management, to develop better controls over underground storage of hazardous materials, and to investigate pesticide and fertilizer application practices in relation to groundwater quality. In the Ohio River Basin area, there are problems with high nitrate levels and brine disposal. (Garrison-Omniplan)
W82-01055

GROUNDWATER PROBLEMS IN NORTH CAROLINA,
North Carolina Dept. of Natural Resources and Community Development, Raleigh.
P. F. Nelson.
In: Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, Cincinnati, April 28-29, 1981. Purdue University, Water Resources Research Center, West Lafayette, IN. p 30-31.

Descriptors: *Groundwater management, Public opinion, *Deep wells, *Groundwater availability, *Legislation, State jurisdiction, Attitudes, Administrative agencies, Long-term planning, Multiobjective planning, Surface-groundwater relations, Boreholes, *North Carolina.

Planning for developing groundwater resources is not currently a very sophisticated process in North Carolina. Although much work has been done in the past to describe the hydrologic characteristics of the Coastal Plain aquifers, very little is known about the development potential in the Piedmont and mountain regions. Lack of knowledge of the availability of the resource, and widespread misunderstanding of groundwater on the part of the public, has resulted in its under-utilization in many areas. A hesitancy to drill deep wells prevails, although there is mounting evidence that contrary to public opinion, 600- and 700-foot wells are often extremely more productive than the borehole drilled to 175 feet. North Carolina's needs with respect to groundwater protection and wise management are: (1) recognition of the need for a comprehensive groundwater program; (2) prompt statewide implementation of the Groundwater Classification and Quality Standards; (3) an effective Water Well Contractors Licensing Board to examine and approve operators as well as contractors; (4) improved groundwater management legislation, as the existing Act is cumbersome to employ and has the potential of creating a 'patchwork quilt' of water management areas. The need to become more involved in groundwater research in the fractured rock terrain is becoming more and more critical as Piedmont cities exhaust their available surface water resource. (Garrison-Omniplan)
W82-01056

OHIO'S GROUND WATER RESOURCES AND PROBLEM AREAS,
Ohio Environmental Protection Agency, Columbus. Groundwater Div.
R. B. Stein.
In: Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, Cincinnati, April 28-29, 1981. Purdue University, Water Resources Research Center, West Lafayette, IN. p 32-33.

Descriptors: *Groundwater availability, *Groundwater management, *Groundwater pollution, Water pollution, Wells, Waste disposal, Poisons, Multiobjective planning, Water use, Competing use, Long-term planning, Legislation, State jurisdiction, Administrative regulations, Public policy, *Ohio.

Ohio's ground water reserves, while abundant, are unequally distributed. Ground water quantity problems can be attributed to cyclic drought conditions. Conflicts between groundwater users have been noted in a number of areas and are usually the result of well interference between two or more large users or one large user affecting water levels in nearby shallow wells. For the most part, the problems have been resolved voluntarily by adjusting pumping rates and schedules, or by developing additional production wells beyond the area of pumping interference. Ohio, being a densely populated and highly industrial state, generates large volumes of both liquid and solid wastes. Based upon groundwater complaint investigations conducted by the Ohio EPA over the past eight years, the most prevalent ground water contamination problems are from domestic on-lot sources affecting private individual wells. Contamination has most often been the direct result of poor well construction and maintenance, or improper well abandonment. Other leading causes of contamination have been salt water effects related to oil and gas production or improperly plugged oil wells, and coal leaching effects. Ohio's major concerns in ground water program planning are to define agency roles and coordinaton, determine staff capability and training, develop public education and awareness, and increase data collection and regulatory practices. (Garrison-Omniplan)
W82-01057

PENNSYLVANIA GROUND WATER PROBLEMS AND NEEDS,
Pennsylvania Dept. of Environmental Resources, Harrisburg.
R. T. Weston.
In: Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, Cincinnati, April 28-29, 1981. Purdue University, Water Resources Research Center, West Lafayette, IN. p 34-40.

Descriptors: *Groundwater management, *Long-term planning, *Groundwater availability, *Groundwater pollution, Water pollution, Coal mining, Data collection, Administrative regulation, *Legislation, Public policy, State jurisdiction, Drinking water, Multiobjective planning, *Pennsylvania.

Over half of Pennsylvania' public water supply systems obtain all their water from ground water aquifers, and another 13 percent meet part of their demands with ground water. Potentials for conflict among competing water users are growing. As water needs grow, ground water will fill an increasing part of the demand. Ground water planning is hampered by limited use data and incomplete hydrogeologic information, but several problem areas have been identified. Some Triassic basins are extremely susceptible to drought, and recharge slowly after heavy withdrawal. Interference between public and private withdrawals, such as overlapping cones of depression between neighboring wells or pumping operations, is another problem area. Mining operations frequently dewater large areas. In water quality preservation, problem areas include malfunctioning on-lot sewage systems, inadequately designed or operated waste disposal facilities, leaking storage tanks and pipelines, transportation accidents, poorly operated agricultural activities, roadways and parking lots where runoff infiltrates the ground, past or current mining, and oil and gas recovery operations. Acid drainage from bituminous coal mining is a problem in some areas. Pennsylvania has no comprehensive legal or institutional approach to water allocation. Common law often operates contrary to hydrologic fact, treating interrelated ground and surface water resources under separate and inconsistent rules. State authority to regulate water allocation is extremely narrow. A reform of State water management policy is proposed, and fourteen major goals are outlined. (Mantius-Omniplan)
W82-01058

GROUND WATER PROBLEMS VIRGINIA PORTION OHIO RIVER BASIN,
Virginia State Water Control Board, Richmond.
A. H. Giles.
In: Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, Cincinnati, April 28-29, 1981. Purdue University, Water Resources Research Center, West Lafayette, IN. p 42-62. 16 Fig.

Descriptors: *Groundwater management, River basins, Geohydrology, *Groundwater pollution, Water pollution, *State jurisdiction, Rivers, Groundwater availability, Underground stream, Coal mining, Aquifers, Aquifer management, Aquifer characteristics, *Ohio River basin, *Virginia.

The area drained by the headwaters of several Ohio River tributaries in southwestern Virginia covers three geologic/physiological provinces with somewhat rugged terrain, some broad valleys and moderate climate and rainfall. Generally ground water is abundant and of good quality but hard in the limestone aquifers of the Valley and Ridge Province. In the flood plain alluvium of the Valley and Ridge and Piedmont it is moderately abundant, and in the Piedmont, Valley and Ridge and cumberland Plateau's soils and rocks other than limestone it is of relatively small yield. Faulting and fraction enhances production. Some surface pollution has been reported in limestone aquifers in the Valley and Ridge, which are especially susceptible to pollution. In the Cumberland Plateau, ground water pollution and loss of supply potentially are associated with natural gas and coal extraction activities, and most deeper aquifers are naturally salty. Metal mining elsewhere threatens ground water quality. The most serious pollution problems throughout the area are from petroleum product storage tank leaks and spills, waste facilities, and local urbanization. Effects of salt water and gas invasion have been observed in the Cumberland Plateau. The State Water Control Board has been effective in local pollution response, waste facility evaluation and well site evaluation. For most of the area, ground water information is minimal, but in some areas, county-wide ground water reports are being published. (Garrison-Omniplan)
W82-01059

GROUND WATER PROBLEMS IN WEST VIRGINIA,
West Virginia Dept. of Natural Resources, Charleston. Div. of Water Resources.
J. Northeimer.
In: Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, Cincinnati, April 28-29, 1981. Purdue University, Water Resources Research Center, West Lafayette, IN. p 63-75. 1 Fig, 2 Tab, 2 Append.

Descriptors: *Groundwater management, *Groundwater pollution, Water pollution, State jurisdiction, *Administrative regulations, Public policy, Drinking water, *Legislation, Federal jurisdiction, Groundwater availability, Long-term planning, Multiobjective planning, *West Virginia.

Approximately 53 percent of the population of West Virginia obtains drinking water from ground water sources; however, historically there has been very little effort devoted to its protection and maintenance. Although the state ground water protection program is still in the developmental stage, participation in the various federal programs addressing ground water is providing the necessary resources for an effective regulatory framework. As the state assumes authorization for implementing these programs, the proper management of ground water will become a reality. Major limiting factors in the development of an adequate ground water management program at the state level are poorly developed control programs authorized under state statute, no central or coordinating regulatory approach or strategy, lack of initiative under the 106 program, no comprehensive monitoring network, no regulatory control over ground water development, and lack of adequate state-level funding. Statutory changes are currently being pursued at the state level to allow state implementation of federal programs which address ground water protection and maintenance, such as the Hazardous Waste Management Program under the Resource Conservation and Recovery Act, and the Underground Injection Control Program under the Safe Drinking Water Act. (Garrison-Omniplan)
W82-01060

MATHEMATICAL MODELING TECHNIQUES FOR GROUNDWATER MANAGEMENT,
Prickett (Thomas A.) and Associates, Urbana, IL.
T. A. Prickett.
In: Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, Cincinnati, April 28-29, 1981. Purdue University, Water Resources Research Center, West Lafayette, IN. p 97-104. 170 Ref.

Descriptors: *Mathematical models, *Groundwater management, *Data collections, *Model studies, Hydrologic models, Hydrologic data collections, Digital computers, Computers, Multiobjective planning, Long-term planning, Decision making, Data acquisition, Numerical analysis.

Mathematical modeling has served an important role in groundwater management. Mathematical groundwater models provide a broad range of techniques for analysis of groundwater problems, including not only sophisticated numerical techniques solved with digital computers but analytical formulas worked out with desk calculators, type curves, and a table of well functions. Despite the dominance of numerical model development in the 1970s, new analytical formulas continue to be found in the recent literature. Numerical and analytical models developed to date are impressive. Also, computational devices are readily available in all ranges of price and capability. However, progress is needed that involves (1) making present and future models more useful by adequately documenting codes and procedures for their application (2) developing a large group of models aimed at solving problems in the range of simple to moderate complexity; and (3) developing models and techniques that produce results that managers can understand. Based on a survey on modeling inadequacies conducted by Bachmat (1978), the major problem with existing groundwater models was that few are documented sufficiently to be useful. The development of more simple and moderately complex models should also be keyed to quick evaluation of many alternatives. A group of educational materials is needed to help managers understand the purposes, capabilities, and results of mathematical models. (Garrison-Omniplan)
W82-01062

4C. Effects On Water Of Man's Non-Water Activities

SESTON DYNAMICS IN SOUTHERN APPALACHIAN STREAMS: EFFECTS OF CLEAR-CUTTING,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
M. E. Gurtz, J. R. Webster, and J. B. Wallace.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 4, p 624-631, April, 1980. 7 Fig, 4 Tab, 28 Ref.

Descriptors: *Clear-cutting, *Logging, *Seston, *Forest watersheds, Forest management, Road construction, *Streams, Suspended sediments, Suspended solids, Sediment transport, Seasonal variation, Storm runoff, Litter, Organic matter, Particle size, Particulate matter, Southern Appalachian streams.

Two second order streams of the southern Appalachian Mountains where heavy logging activities are practiced were studied for suspended particulate matter (seston) from July 1977 to July 1978. In the stream, which drains an undisturbed hardwood forest watershed, seston levels varied with storm flows and were lowest during winter high flows. In this stream, the majority of the organic and inorganic particles were less than 105 microns in diameter. In the stream draining a forest watershed that was clearcut in 1977, increased levels of both organic and inorganic seston were found. Most of the inorganic seston of this stream was made up of particles greater than 235 microns in diameter. These increases were attributed to sediments deposited during the building of logging roads and debris entering the stream during logging activities. The rate of stream recovery will probably depend on the rate of recovery of the surrounding terrain. (Geiger-FRC)
W82-00543

THE INFLUENCE OF PLANT COMMUNITIES UPON THE HYDROLOGY OF CATCHMENTS,
Flinders Univ. of South Australia, Bedford Park. School of Earth Sciences.
For primary bibliographic entry see Field 2D.
W82-00931

4D. Watershed Protection

SUBMERSIBLE PUMPS HELP QUELL DAMAGE FROM MOUNT ST. HELENS MUDFLOW.
Public Works, Vol 112, No 7, p 62-64, July, 1981. 3 Fig.

Descriptors: *Damage, *Flooding, *Volcanoes, *Submersible pumps, Dredging, *Mt. St. Helens, *Mudflows, Disasters, Pumps, Wastewater treatment, Water treatment facilities, *Castle Rock, Washington, Storm water.

The eruption of Mount St. Helens caused damage to the water supply and wastewater treatment works in the town of Castle Rock, 40 miles from the volcano at the confluence of the Cowlitz and Toutle Rivers. The water supply intake was plugged with ash and debris, as were all sewage and stormwater discharge outfalls. Piping was rearranged to pump the effluent over the levee into the river. Submersible pumps were used to drain the equipment and the land behind the dikes and to pump storm water from a collection point and from a street manhole. Submersible pumps were also used to return water from dredged silt piles to the river. This pump arrangement will help protect the town from serious flooding. (Cassar-FRC)
W82-00509

LAND FORMING EFFECTS ON DRYLAND SORGHUM PRODUCTION IN THE SOUTHERN GREAT PLAINS,
Science and Education Administration, Bushland, TX. Conservation and Production Research Lab.
For primary bibliographic entry see Field 3F.
W82-00764

COORDINATED EFFORT STEMS SEDIMENT AND EROSION,
Anne Arundel County Dept. of Public Works, Annapolis, MD.
D. L. Kaiser.
Public Works, Vol 112, No 7, p 54-55. July, 1981. 3 Fig.

Descriptors: *Soil conservation, *Erosion control, *Sedimentation, Conservation, *Anne Arundel County, *Maryland, Regulations, Legal aspects, Inspection, Chesapeake Bay, Soil stabilization, Permits, Grading.

Soil conservation policies are carried out in Anne Arundel County, Maryland, by the Department of Inspection and Permits, the Soil Conservation District, and the Department of Public Works. Prior to construction, a grading permit must be obtained and all plans approved. A bond or similar security is required for projects disturbing more than 15,000 sq ft of surface area. Inspections are made on site, and over 95% of violations are corrected before any notice needs to be issued. However, the mandated program review of the conservation program in 1974 and 1978 showed some inadequacies. This resulted in guidelines suggesting greater interagency communications, a new procedures manual, stricter enforcement of sediment control, and preconstruction conferences. More recently, stabilization for projects lasting over 45 days has been required. (Cassar-FRC)
W82-00766

COSTS OF ALTERNATIVE POLICIES FOR CONTROLLING AGRICULTURAL SOIL LOSS AND ASSOCIATED STREAM SEDIMENTATION,
Idaho Univ., Moscow. Dept. of Agricultural Economics.
D. J. Walker, and J. F. Timmons.
Journal of Soil and Water Conservation, Vol 35, No 3, p 177-183, July/August, 1980. 1 Fig, 5 Tab, 20 Ref.

Descriptors: *Farm management, *Soil conservation, *Sedimentation, *Erosion control, Soil erosion, Nishnabotna River, Iowa, Regulations, Cost-benefit analysis, Agricultural watersheds, Taxes, Land use, Economic aspects, Subsidies.

Soil erosion and sediment discharge reduction programs in agricultural land (study area Nishnabotna River basin, Iowa) were evaluated by linear programming. The most cost-effective policy among the 141 individuals solutions was the dual ban on fall plowing and straight row cultivation on slopes. Several strategies were effective in reducing soil losses by 50%--a ban on fall plowing, a soil loss tax of 10-20 cents per ton, and a subsidy for minimum tillage. These three alternatives entailed income penalties of 2-3%. More restrictive policies were capable of reducing soil loss up to 90%--a dual ban on fall plowing and straight row cultivation on slopes, an annual soil loss limit of 5 tons per acre, and a soil loss tax of $0.50-1.50 per ton. Income penalties on these schemes were less than 14%. (Cassar-FRC)
W82-00869

ANSWERS: A MODEL FOR WATERSHED PLANNING,
Purdue Univ., Lafayette, IN. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 6A.
W82-00898

TRACTIVE FORCE DESIGN OF VEGETATED CHANNELS,
Science and Education Administration, Stillwater, OK. Water Conservation Structures Lab.
D. M. Temple.
Transactions of the ASAE, Vol 23, No 4, p 884-890, July/August, 1980. 2 Fig, 4 Tab, 12 Ref.

Descriptors: *Tractive forces, *Vegetation effects, *Channel flow, Mathematical studies, Design criteria, Turbulent flow, Flow resistance, Open channels, *Erosion control, Mathematical models.

Previous research designed to evaluate the value of a vegetal channel lining as an erosion control measure has established a relatively large data base for use in the development of semi-empirical design procedures. This report updates these design procedures by presenting a method for the application of tractive force principles to the design of vegetated channels. The allowable velocity approach currently used is related not only to soil properties, but also to the vegetal and geometric properties of the channel, requiring tabulation of each possible combination of channel slope, soil, and vegetal cover through separate consideration of the properties of soil and of vegetation. The proposed tractive force design procedure substantially simplified the investigation and tabulation of critical or allowable conditions by permitting separate consideration of the properties of soil and those of the vegetation. The protective value of vegetal channel lining is considered to be derived from two related interactions of the vegetation with the flow field: the generation of turbulent eddies at a significant distance from the soil boundary, creating an increase in flow resistance, and a change in the structure of the turbulent eddies in immediate proximity to the boundary. Two indices believed to relate directly to these interactions are used to classify the vegetation. Guidelines for the selection of these indices according to type and quality of cover are presented. Existing flow resistance curves are put into equational form as a single curve family. The design procedure is directly adaptable to programmed calculation, allowing the incorporation of optimization routines at little additional expense. (Carroll-FRC)
W82-00901

USDA, SEA, S. & W. R. RESEARCH

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

GAS CHROMATOGRAPHIC DETERMINATION OF TRIALKYL/ARYL PHOSPHATES IN DRINKING WATER, FOLLOWING ISOLATION USING MACRORETICULAR RESIN,
Health and Welfare Canada, Ottawa (Ontario). Monitoring and Criteria Div.
G. L. LeBel, D. T. Williams, and F. M. Benoit.
Journal of the Association of Official Analytical Chemists, Vol 64, No 4, p 991-998, July, 1981. 4 Fig, 5 Tab, 12 Ref.

Descriptors: *Ion exchange, *Organophosphorus compounds, *Water analysis, Phosphates, Pesticides, Drinking water, Gas chromatography, Phosphorus compounds, *Pollutant identification.

An XAD-2 screening method developed for organophosphorus pesticides was applied to the determination of trialkyl and triaryl phosphates in drinking water at the ng per liter level. Recovery studies at levels of 1, 10, and 100 ng per liter were carried out by fortification onto XAD-2 resin and by direct on-stream fortification of drinking water. Recoveries for several phosphates using direct fortification were as follows: trialkyl, 19.9-28.9%; tributyl, 88.2-101.2%; tris(2-chloroethyl), 82.9-95.5%; tri(2-ethylhexyl), 61.7-78.8%; tributoxyethyl, 104.5-125.6%; triphenyl, 95.0-107.4%; and tricresyl, 95.0-98.1%. Recoveries by continuous fortification were on the same order, with some exceptions. Drinking water samples from 6 Ontario water treatment plants contained several trialkyl and triaryl phosphates at 0.2 to 75 mg per liter levels, uncorrected for incomplete recoveries. (Cassar-FRC)
W82-00502

THIN LAYER CHROMATOGRAPHIC AND ATOMIC ABSORPTION SPECTROPHOTOMETRIC DETERMINATION OF METHYL MERCURY,
California Univ., Los Angeles. School of Public Health.
L. W. Margler, and R. A. Mah.
Journal of the Association of Official Analytical Chemists, Vol 64, No 4, p 1017-1020, July, 1981. 1 Fig, 1 Tab, 11 Ref.

Descriptors: *Methylmercury, Mercury compounds, *Pollutant identification, Thin layer chromatography, Atomic absorption spectrophotometry, Sludge, Fish.

Methyl mercury was determined by a combination of thin layer chromatography and atomic absorption spectrophotometry at 253.7 nm. The samples were first distilled with hydrochloric acid and copper sulfate and extracted twice with dithizone-chloroform, followed by chloroform. Dehydration and concentration preceded the chromatography procedure. Samples of tuna, trout, and anaerobically digested sewage sludge were analyzed; methyl mercury contents were 0.056 micrograms per g, 5.26 micrograms per g, and 0.012 micrograms per ml, respectively. Spiking showed that 90% of the methyl mercury was recovered from tuna and 73% from sewage sludge. The method was sensitive to 0.7 ng in the total Hg determination and 0.009 micrograms Hg per g in 100 g samples. (Cassar-FRC)
W82-00503

ENVIRONMENTAL VIROLOGY AND ITS PROBLEMS,
Severn-Trent Water Authority (England).
R. Morris, and W. M. Waite.
Journal of the Institution of Water Engineers and Scientists, Vol 35, No 3, p 232-244, May, 1981. 9 Ref.

Descriptors: *Viruses, *Water supply, *Public health, Culturing techniques, Potable water, Drinking water, Pollutant identification, Enteroviruses, Diseases, Microbiological studies, Water treatment, Severn-Trent Water Authority, *Great Britain.

Virus assays of waters in the Severn-Trent Water Authority jurisdiction showed that 135 (49%) of 276 surface water samples were positive, the highest level being detected being 337 pfu per liter from the River Tame. Heavily polluted rivers were 88% positive, and stored river water samples were 21% positive. Virus was present in 55% of 132 wastewater effluent samples: the highest recovery value was 5800 pfu per liter. A monkey kidney cell line, designated BGM, was the most suitable cell line tested for virus detection. The suspended cell technique gave higher recoveries than tube culture or the monolayer technique. No direct correlation was found between numbers of viruses in water and any of the bacterial indicator organisms or coliphages. Although there have been no reports of viral infections transmitted through public water supplies in the United Kingdom for many years, the Virology Unit has been established at the water authority to monitor drinking water, abstracted surface waters, and waste water effluents, and to develop more efficient and sensitive techniques for isolating and enumerating viruses. This paper includes background information on the history, character, growth, recovery and identification techniques, classification, diseases, vaccines, and survival in the water system. (Cassar-FRC)
W82-00505

R FACTORS IN COLIFORM-FECAL COLIFORM SEWAGE FLORA OF THE PRAIRIES AND NORTHWEST TERRITORIES OF CANADA,
Environmental Protection Service, Edmonton (Alberta). Microbiology Lab.
J. B. Bell, W. R. Macrae, and G. E. Elliot.
Applied and Environmental Microbiology, Vol 42, No 2, p 204-210, August, 1981. 6 Tab, 23 Ref.

Descriptors: *Coliforms, *Drugs, *Sewage bacteria, Bacteria, Escherichia coli, Public health, Canada, Raw water, Treated water.

The comparative antibiotic resistance and R factors were assessed in the coliform and fecal coliform populations found in raw and treated sewage. Results showed that 8.91% of the total coliform and 10.80% of the fecal coliform populations carried R factors. The following numbers of combinations of R determinants were found: 39 in Escherichia coli, 6 in Citrobacter, 20 in Enterobacter, 10 in Klebsiella, and 11 in Aeromonas. Seven was the maximum number of R determinants transferable simultaneously, and organisms with R factors containing determinants for chloramphenicol ususally contained determinants for ampicillin. From 2 to 4% of the coliforms and fecal coliforms were resistant to chloramphenicol, and from 17 to 30% of the populations were resistant to three or more antibiotics. Final effluent discharges to the environment contained R factor carrying coliform populations of 3.1 times 10 to the 4th power/100 ml and fecal populations of 5.8 times 10 to the 2nd power/100 ml. The maximum removal of R positive bacteria from sewage before its discharge into the environment is desirable, as this may be a factor in the reduced effectiveness of antibiotics. (Small-FRC)
W82-00508

MONITORING TRACE AMOUNTS OF CADMIUM IN NATURAL WATERS,
Brandon Univ. (Manitoba). Dept. of Chemistry.
K. Srikameswaran, H. D. Gesser, and M. Venkateswaran.
Journal of Environmental Science and Health, Part A, Vol 15, No 4, p 323-337, 1980. 2 Fig, 4 Tab, 5 Ref.

Descriptors: *Cadmium, *Trace metals, Natural waters, Water analysis, *Pollutant identification, Chelating agents, Heavy metals, Monitoring.

Cadmium may be determined semiquantitatively in trace amounts in water by using 1-(2-pyridylazo-2) naphthol loaded polyester foams. This chemical is a good complexing agent in the pH 7-8 range, forming a visible orange complex with Cd. The apparatus is operated by squeezing a piece of prepared foam with a piston in a tank of water. Cd concentrations of 3.7, 7.9, 18.6 and 55.9 micrograms per liter were used to determine the amount of Cd extracted by the chemically treated foams in a given number of squeezes (250-1500). Results varied from 5 micrograms Cd from water at 3.7 micrograms per liter concentration and 250 squeezes to 200 micrograms Cd from water at 55.9 micrograms per liter concentration and 1500 squeezes. A plot of Cd extracted per squeeze vs. number of squeezes produced a straight line for each concentration tested. The concentration of Cd in unknown waters may be estimated from a graph plotting Cd concentration against micrograms Cd extracted per squeeze. Other heavy metal ions (Zn, Pb, Cu, and Fe at 100 microgram per liter levels) had no significant effect on the results. (Cassar-FRC)
W82-00516

INDUSTRIAL EFFLUENT MONITORING INCORPORATING A RECENT AUTOMATED FISH BIOMONITORING SYSTEM,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
D. Gruber, and J. Cairns, Jr.
Water, Air, and Soil Pollution, Vol 15, No 4, p 471-481, May, 1981. 4 Fig, 38 Ref.

Descriptors: *Bioindicators, *Effluents, *Industrial wastes, *Pollutant identification, Fish, Fishkill, Water quality control, Monitoring, *Munitions wastes, Respiration, Water pollution effects, Toxicity, Ammunition plant, Radford, Virginia.

A series of experiments is described which implies that the present concept of automated and continuous biological monitoring is capable of detecting an industrial spill from an ammunition manufacturing plant. The sampling facility is located on site at a US Army Ammunition Plant in Radford, Virginia. Bluegill sunfish, Lepomis macrochirus Raf., served as sensors. Each fish is monitored within individual 6 liter monitor tanks. Twenty-four similar monitor tanks are housed within a compartmentalized module. A minicomputer system converts analog signals into digital information and uses a modified peak-picking program to quantify the frequency of ventilation for each fish over time. Chemical and physical parameters of the effluent are also continuously monitored and interfaced with the computer system. The alarm system consists of a display panel with lights and a bell system within the computer's keyboard. In a 48 hr static bioassay test, the concentration of roll powder effluent which killed half the fish was 25%. However, during a subsequent exposure, all fish survived in 100% effluent. All exposed animals significantly altered their ventilatory behavior within 30 minutes after the initial introduction of the effluent. All which survived had ventilatory rates return to normal within several hours after the effluent exposure ceased. Nitroglycerin was detected at 1.2 ppm in monitor tanks in a water sample taken during a specific time period. Concentrations of DEP and lead were also determined. (Baker-FRC)
W82-00530

A STUDY OF SAMPLES OF WELL WATER COLLECTED FROM SELECTED AREAS IN CALIFORNIA TO DETERMINE THE PRESENCE OF DBCP AND CERTAIN OTHER PESTICIDE RESIDUES,
California Dept. of Food and Agriculture, Sacramento.
S. A. Peoples, K. T. Maddy, W. Cusick, T. Jackson, and C. Cooper.
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 4, p 611-618, 1980. 3 Tab.

Descriptors: *Agriculture, *Agricultural chemicals, *Organic compounds, *Pesticide residues, *Water sampling, *Irrigation, Carcinogens, Wells, *Well water, Water pollution, Toxicity, Chemical analysis, Crop production, Well data, Soil contamination, Soil analysis.

A survey of possible soil and well-water contamination with DBCP and other pesticide residues

was conducted in selected California counties in 1979. Liquid 1,2-dibromo-3-chloropropane was used as a soil nematicide in California until 1977, when it was banned as a potential carcinogen. In Yolo County all well-water samples were negative. In Ventura and Riverside County wells, samples were also negative. Samples from the east of San Joaquin Valley exhibited contamination in 50% of the wells, primarily those less than 100 feet deep. The route by which DBCP contaminates water supplies is not known. (Titus-FRC)
W82-00532

DETERMINATION OF TERBUTRYN AND ITS DEGRADATION PRODUCTS IN WATER, SEDIMENTS, AQUATIC PLANTS, AND FISH,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
D. C. G. Muir.
Journal of Agricultural and Food Chemistry, Vol 28, No 4, p 714-719, July/August, 1980. 4 Fig, 4 Tab, 18 Ref.

Descriptors: *Chemical analysis, *Water, *Terbutryn, Chromatography, Agricultural chemicals, *Herbicides, Ponds, Aquatic plants, Degradation, Farm ponds.

A method for the determination of terbutryn and several of its degradation products, N-deethylated terbutryn (DET), hydroxyterbutryn (HT), N-deethylated hydroxyterbutryn (DEHT), 2-(tert-butylamino)-4-(ethylamino)-s-triazine (EBT), and 2-(tert-butylamino)-4-amino-s-triazine (ABT), is reported. Water samples were extracted with dichloromethane. Sediment, aquatic plant, and fish tissue samples were extracted with aqueous acetonitrile. The hydroxytriazines were isolated by chromatography on a cation-exchange resin and cleanup on alumina and by high-pressure liquid chromatography. Recoveries of terbutryn, DET, HT, DEHT, ABT, and EBT from water (0.5 - 50 micrograms/liter) ranged from 76 to 120%. Terbutryn and DET recoveries from sediment, plants, and fish tissues (0.05 - 0.9 micrograms/gram) ranged from 74 to 106%. HT and DEHT recoveries from sediment, plant material, and fish tissue (0.1 to 1.23 micrograms/gram) ranged from 62 to 124%. (Baker-FRC)
W82-00567

SEARCH FOR LINURON RESIDUES IN TRIBUTARIES OF THE CHESAPEAKE BAY,
Du Pont de Nemours (E. I.) and Co., Wilmington, DE. Dept. of Biochemicals.
E. W. Zahnow, and J. D. Riggleman.
Journal of Agricultural and Food Chemistry, Vol 28, No 5, p 974-978, September/October, 1980. 6 Fig, 4 Tab, 14 Ref.

Descriptors: *Agricultural chemicals, *Aquatic plants, Bays, *Herbicides, *Chesapeake Bay, Tributaries, *Linuron, Leaching.

The possible transfer of linuron from farm fields into the Chesapeake Bay was examined using extraction with acetonitrile followed by liquid chromatography. In the sampling area the principal usage of linuron is on soybeans at 0.55 kg/ha. Treatment is made between mid-May and early July. The first sampling followed the first major rain at the end of the treatment season. The second sample was taken 2 months later. Mud, soil and water samples were taken. The analysis of mud and water samples taken during the two successive summers showed no evidence of linuron accumulation. Samples from drainage basins receiving up to 45,000 kg of linuron annually showed no linuron residue, i.e., less than 10 ppbw in the mud and less than 0.2 ppb, w/v in the water. On this basis it was concluded that linuron usage on fields bordering Chesapeake Bay waters and its tributaries is not a contributing factor to the recent declines in the abundance of aquatic plants in the area. (Baker-FRC)
W82-00569

EVALUATION OF VARIOUS SOIL WATER SAMPLERS FOR VIROLOGICAL SAMPLING,
Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
D-S. Wang, J. C. Lance, and C. P. Gerba.
Applied and Environmental Microbiology, Vol 39, No 3, p 662-664, March, 1980. 2 Fig, 1 Tab, 12 Ref.

Descriptors: *Sampling, *Viruses, Water quality, Drinking water, Wastewater, Effluent, *Soil water, Water analysis.

Various types of ceramic soil water samplers were evaluated for virus sampling. Both tap water and sewage effluent were used in the study. Secondary sewage was collected from the effluent of an activated sludge treatment plant before chlorination. The tap water was dechlorinated with sodium thiosulfate before use. Poliovirus 1 (strain LSc), echovirus 1 (strain V239), bacteriophage T2, and bacteriophage MS-2 were added to water samples for the experiments. Before sampling, 500 ml of water was seeded with virus to obtain a concentration of 100,000-1,000,000 plaque-forming units per ml. The percentage recoveries of viruses in water samples after passage through the three samplers was determined. To test the possibility that particulate matter present in the water sample could influence the passage of virus through the samplers, the recovery of virus from both unfiltered and filtered water samples was compared. In general, no significant difference in virus recovery was observed between unfiltered and filtered samples. Soil water samples obtained from both the ceramic cup soil water sampler and the porous ceramic tube exhibited low recoveries of poliovirus and bacteriophage T2. Recoveries of MS-2 and echovirus 1 were substantially higher. The ceramic sampler constructed in the laboratory performing the investigation was consistently superior to the two commercially available soil water samplers tested. (Baker-FRC)
W82-00572

SIMULTANEOUS CONCENTRATION OF SALMONELLA AND ENTEROVIRUS FROM SURFACE WATER BY USING MICRO-FIBER GLASS FILTERS,
Nancy-1 Univ. (France). Lab. d'Hygiene et de Recherche de la Sante Publique.
D. Rolland, and J. C. Block.
Applied and Environmental Microbiology, Vol 39, No 3, p 659-661, March, 1980. 2 Tab, 6 Ref.

Descriptors: *Bacteria, *Surface water, *Salmonella, *Enteroviruses, Filters, Viruses, Monitoring, Recreation facilities, Water quality, Bacterial analysis.

Surface waters were sampled at weekly intervals in January 1979 from the Meurthe River, 8 km south from the city of Nancy, France. Salmonella testing was conducted using a micro-fiber glass filter of 8 micrometers porosity, at pH 3.5. Simultaneous concentrations of Salmonella and enterovirus were determined. Quantitative analysis indicated that Salmonella and viruses are effectively retained or adsorbed or both at pH 3.5 on micro-fiber glass filters. The viral concentrations ranged from 0 to 2.3 MPNCU/liter and the Salmonella concentrations ranged from 1 to 80 bacteria/liter. For Salmonella, as for viruses, a concentration step was required. The water tested was of poor quality due to the presence of a wastewater treatment plant output of the city located 8 km upstream. It was concluded that adsorption at pH 3.5 to microfiber glass filters offers a rapid, effective, quantitative, and relatively inexpensive method for simultaneous concentration of Salmonella and enterovirus. Recreational water quality can then be monitored for two parameters from a single concentration. (Baker-FRC)
W82-00573

RELATIONSHIPS BETWEEN ENVIRONMENTAL FACTORS, BACTERIAL INDICATORS, AND THE OCCURRENCE OF ENTERIC VIRUSES IN ESTUARINE SEDIMENTS,
Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
R. L. LaBelle, C. P. Gerba, S. M. Goyal, J. L. Melnick, and I. Cech.
Applied and Environmental Microbiology, Vol 39, No 3, p 588-596, March, 1980. 3 Fig, 3 Tab, 41 Ref.

Descriptors: *Estuarine environment, *Viruses, Bacteria, *Sediments, Enteric bacteria, Enteroviruses, Indicators, Bioindicators, Recreation, Recreation facilities, Public health, Epidemiology, Shellfish farming.

The occurrence of enteric viruses in estuarine sediments was examined in efforts to find a possible relationship between the presence of viruses in seawater or sediment or both and various biological and physiochemical characteristics of the environment. Sediment was found to contain greater numbers of viruses than overlying seawater on a volume basis. Several types of enteroviruses were isolated, including coxsackievirus types A16, B1, and B5, echovirus type 1, and poliovirus type 2. On several occasions, viruses were isolated from sediments when overlying waters met bacteriological water quality standards for recreational use. Only one significant association was noted in the statistical analysis of a possible relationship between viruses in seawater or in sediment and other variables. This association indicated that the number of viruses in sediment was positively correlated with the number of fecal coliforms in the sediment. No other statistically significant associations were found. Bacterial indicators and viruses in the overlying waters did not appear to be correlated. The evaluation of the presence of bacteria and viruses in sediment may give additional insight into long-term water quality conditions. It is noted that indicator bacteria in water are not reflective of the concentration of enteric viruses in marine waters. (Baker-FRC)
W82-00574

EFFECTS OF WASTEWATER SLUDGE AND ITS DETERGENTS ON THE STABILITY OF ROTAVIRUS,
Sandia Labs., Albuquerque, NM.
R. L. Ward, and C. S. Ashley.
Applied and Environmental Microbiology, Vol 39, No 6, p 1154-1158, June, 1980. 3 Fig, 4 Tab, 12 Ref.

Descriptors: *Sludge, *Viruses, *Detergents, Growth, Rotavirus, Wastewater, Reovirus.

A series of inactivation experiments in wastewater sludge were performed with SA-11, a rotavirus strain isolated from a vervet monkey. Wastewater sludge reduced the heat needed to inactivate rotavirus SA-11, and ionic detergents were identified as the sludge components which were responsible for this effect. This is similar to an effect that had been found earlier with reovirus. The quantitative effects of individual ionic detergents on rotavirus and reovirus were very different, and rotavirus was extremely sensitive to several of the detergents. However, neither virus was destabilized by nonionic detergents. On the contrary, rotavirus was stabilized by a nonionic detergent against the potent destabilizing effects of the ionic detergent sodium dodecyl sulfate. The destabilizing effects of both cationic and anionic detergents on rotavirus were greatly altered by changes in the pH of the medium. Although there may be a number of compounds in sludge that can stabilize rotavirus, nonionic detergents, which are known ingredients of sewage, were shown here to have this stabilizing effect. It is possible that removal of nonionic detergents from sludge caused the destabilizing effects of ionic detergents to be better expressed after their separation from other sludge components. (Baker-FRC)
W82-00576

GROWTH OF AEROMONAS HYDROPHILA AT LOW CONCENTRATIONS OF SUBSTRATES ADDED TO TAP WATER,
Netherlands Waterworks, Rijswijk. Testing and Research Inst.
D. Van der Kooij, A. Visser, and W. A. M. Hijnen.
Applied and Environmental Microbiology, Vol 39, No 6, p 1198-1204, June, 1980. 3 Fig, 4 Tab, 29 Ref.

Descriptors: *Drinking water, *Bacteria, Growth, Water pollution, *Aeromonas, Microorganisms, Bioassay, Water treatment, Water quality, Substrates, Biodegradation.

The growth of Aeromonas hydrophila at low substrate concentrations was investigated as part of an investigation on the behavior of different types of bacteria in tap water. Batch experiments were conducted using tap water supplied with low concentrations of substrates. Growth was assessed by colony count determinations. The isolate only multiplied in the used tap water after the addition of a small amount of an assimilable carbon compound. d-Glucose especially caused growth of the organism even at initial concentrations below 10 micrograms C per liter. At initial glucose concentrations below the substrate concentration value (12 micrograms C per liter), generation times and yield were nonlinear with 1/initial glucose concentrations and initial glucose concentrations respectively. The maintenance coefficient m was calculated from these observations. At initial concentrations below the substrate concentration value of starch, no growth was noted, but complete use of starch occurred in these situations after the addition of 10 micrograms of glucose-C per liter. The results of this study demonstrated that information of ecological significance may be obtained by very simple batch experiments. Moreover, the isolate studied may be used in growth experiments to assess the maximum concentration of glucose present in water, particularly tap water, initially or after various treatment stages. (Baker-FRC)
W82-00578

ISOLATION AND IDENTIFICATION OF PATHOGENIC MICROORGANISMS AT WASTEWATER-IRRIGATED FIELDS: RATIOS IN AIR AND WASTEWATER,
Hebrew Univ., Jerusalem (Israel). Environmental Health Lab.
B. Teltsch, S. Kedmi, L. Bonnet, Y. Borenzstajn-Rotem, and E. Katzenelson.
Applied and Environmental Microbiology, Vol 39, No 6, p 1183-1190, June, 1980. 1 Fig, 8 Tab, 31 Ref.

Descriptors: *Wastewater irrigation, *Pathogens, Microorganisms, Salmonella, Enteroviruses, Bacteria, Viruses, Coliforms, Poliovirus, Spray irrigation, Sprinkler irrigation.

The occurrence of Salmonella bacteria and animal enteroviruses in aerosol emissions from wastewater irrigation sites was determined by direct assay. An evaluation was made of the suitability of coliforms as indicators of airborne contaminations. Throughout this study different types of sprinklers were used, and consequently different discharge rates, particle numbers, and aerosol volumes were generated in the experimental fields. The frequency of positive Salmonella samples was 78% in the wastewater and 18% in the airborne emissions. For enteroviruses, the frequency of positive samples was 71% in the wastewater and 44% in aerosol emissions, indicating higher frequency of enteroviruses in aerosol emissions in comparison to Salmonella. The results indicate that enteroviruses and Salmonella bacteria survive in the air better than coliform bacteria. In addition it appears that the enteroviruses are more hardy than Salmonella in wastewater aerosols. Although coliforms were present in all air samples, their use as indicators of the microbial contamination of air may result in an inaccurate assessment of the true presence or survival of pathogens. (Baker-FRC)
W82-00579

DESTRUCTION BY ANAEROBIC MESOPHILIC AND THERMOPHILIC DIGESTION OF VIRUSES AND INDICATOR BACTERIA INDIGENOUS TO DOMESTIC SLUDGES,
Environmental Protection Agency, Cincinnati, OH. Office of Research and Development.
G. Berg, and D. Berman.
Applied and Environmental Microbiology, Vol 39, No 2, p 361-368, February, 1980. 3 Fig, 4 Tab, 9 Ref.

Descriptors: *Bacteria, *Sludges, *Bioindicators, Indicators, Temperature effects, Digestion, *Viruses, Water treatment facilities, Wastewater treatment.

The usefulness of fecal coliforms, total coliforms, and fecal streptococci as indicators of viruses in raw and digested sludges is demonstrated. The extent to which indicator bacteria and some viruses are destroyed by anaerobic mesophilic and thermophilic digestion of domestic wastewater sludges as these sludge stabilization processes are currently practiced is also examined. Large variations were found in the numbers of viruses occurring over narrow ranges of numbers of fecal coliforms, total coliforms, and fecal streptococci in raw sludges and in mesophilically and thermophilically digested anaerobic sludges. This finding suggests that the bacteria were poor quantitative reflectors of the numbers of the viruses detected. All three indicator bacteria were destroyed more rapidly than were the viruses by mesophilic and thermophilic digestion of the anaerobic sludges. The relative rates for the destruction of viruses, fecal coliforms, and fecal streptococci in the digested sludges were consistent over the 17 month study. Fecal coliforms were 7 to 8 times more sensitive than the viruses to mesophilic digestion and 9 to 10 times more sensitive to thermophilic digestion. Even more sensitivity was noted among the total coliforms. The rates at which fecal streptococci were destroyed by mesophilic and thermophilic digestion of anaerobic sludges approached those at which the viruses were destroyed by those processes. This suggests that rates of fecal streptococci destruction may be used as indicators for the rates at which viruses in sludges are destroyed by these processes. (Baker-FRC)
W82-00580

MONITORING RIVER PERIPHYTON WITH ARTIFICIAL BENTHIC SUBSTRATES,
Bowling Green State Univ., OH. Dept. of Biological Sciences.
R. L. Lowe, and W. F. Gale.
Hydrobiologia, Vol 69, No 3, p 235-244, March, 1980. 2 Fig, 4 Tab, 17 Ref.

Descriptors: *Periphyton, *Substrates, *Algal growth, Algae, Rivers, *Benthic environment, *River beds, Monitoring, Susquehanna River, Species composition, Water quality analysis, Pennsylvania.

Frosted acrylic was the most satisfactory artificial substrate for studying periphyton colonization on a river bottom. Other substrates tested at the bottom of the Susquehanna River, near Falls, Pennsylvania, were smooth glass, frosted glass, Vermont slate, and sandy slate (flagstone). Natural river stones were collected for comparison. The most abundant algae on the substrates were diatoms, with Nitzschia and navicula most often dominating. The genera Cocconeis, Synedra, Asterionella, Gomphonema, Meridion, Cymbella, Fragilaria, Stephanodiscus, Cyclotella, and Melosira were also well represented. A 1-month exposure time showed very little colonization in December through April, but from May through November, communities from 1,000 to 10,000 units per sq mm were found. The densest communities were accumulated in October. The long-term, or cumulative, substrates had the densest periphyton communities in winter, with decreasing densities in June-October. The greatest periphyton density was found on a river stone in February (21,850 units per sq mm). Any of the substrates would be satisfactory to determine the dominant genera in the periphyton. The number of genera on artificial substrates tended to be higher than the numbers on river stones. It is suggested that 1-month colonization periods are not enough; substrates should be collected after several month's submergence. (Cassar-FRC)
W82-00581

CATION CHROMATOGRAPHY WITH A CONDUCTIVITY DETECTOR,
Ames Lab., IA.
J. S. Fritz, D. T. Gjerde, and R. M. Becker.
Analytical Chemistry, Vol 52, No 9, p 1519-1522, August, 1980. 6 Fig, 5 Ref.

Descriptors: *Chromatography, *Cations, *Cation exchange, *Conductivity, Drinking water, Water analysis, Hardness, Ammonium, Calcium, Manganese.

A system for cation analysis which successfully separates inorganic and amine cations was developed. Using this cation chromatography system metal and ammonium cations are separated on a cation-exchange column of low capacity and are detected with a conductivity detector. There is no need for a suppressor column. Mixtures of alkali metal and ammonium ions are separated using a nitric acid eluent, while an eluent containing an ethylene-ammonium salt is used to separate magnesium, calcium, strontium, and barium ions. The procedure requires 5 to 10 min. In experiments with drinking water, the method was used to determine alkali metal ions, ammonium, magnesium(II), and calcium(II). This procedure is similar in speed and convenience to atomic spectrometry methods, and has the advantage that ammonium ions can be determined simultaneously. Cation chromatography is a promising method for water hardness analysis, as it gives both magnesium and calcium hardness. (Small-FRC)
W82-00582

ENUMERATION OF BACTERIOPHAGES AND HOST BACTERIA IN SEWAGE AND THE ACTIVATED-SLUDGE TREATMENT PROCESS,
Clemson Univ., SC. Dept. of Microbiology.
D. L. Ewert, and M. J. B. Paynter.
Applied and Environmental Microbiology, Vol 39, No 3, p 576-583, March, 1980. 6 Tab, 26 Ref.

Descriptors: *Bacteria, *Wastewater, Bacteriophage, Viruses, *Wastewater treatment, Water treatment facilities, Effluents, Influent water, Activated sludge, Sludge.

Enumeration was made of bacteriophage populations in an activated-sludge sewage treatment plant. A newly developed assay for quantitation of total phases, employing direct electron microscopic counts, was used in conjunction with the plaque assay. The total concentration of phages was significantly higher in reactor mixed liquor and effluent than in influent sewage, indicating a net production of phages within the reactor. Maximum total phage concentrations in the fluid phase of sewage, activated-sludge mixed liquor, and reactor effluent, were 2.2 times 10 to the seventh power, 9.5 times 10 to the seventh power, and 8.4 times 10 to the seventh power, respectively. In general, specific phage titers were lower in mixed liquor than in sewage, indicating that these hosts were not responsible for the net production of phages in the reactor. This study emphasizes the limitations of the plaque assay for ecological studies of phages, and suggests that bacteria responsible for phage production in activated-sludge mixed liquor either mirror components of the heterotrophic population, floc-producing strains, or members of other physiological groups. (Baker-FRC)
W82-00584

METAL SPECIATION. EFFECTS ON AQUATIC TOXICITY,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
H. E. Allen, R. H. Hall, and T. D. Brisbin.
Environmental Science and Technology, Vol 14, No 4, p 441-443, April, 1980. 2 Fig, 1 Tab, 24 Ref.

Descriptors: *Aquatic life, *Metals, Metal complexes, *Chelating agents, Toxicity, Metal-finishing wastes, Industrial wastes, Heavy metals, Algae, *Algal growth, Natural waters.

The effect of chelation in aquatic environments has been investigated. Experiments were conducted to demonstrate that algal toxicity is related to the free metal ion and not to the total soluble metal concentration. A series of algal bioassays was conducted in which zinc and various chelators were added. To relate algal growth to the chemical forms of zinc present, stability constants for the reaction of each of the chelators with hydrogen, calcium, and magnesium ions, as well as with zinc ions, were required. For all cultures in which there was an increased number of algae after 5 days, the logarithm of the number of cells was plotted vs. the calculated concentration of free zinc. In addition, data were included for a series of controls in which no additional chelator was added to the media, but

in which the concentration of added zinc was varied. The results demonstrated that the toxicity of trace metals to algae is directly dependent on the concentration of free metal ion rather than the total metal concentration. This method of predicting biological toxicity could be extended to natural waters provided adequate information on organism response to and equilibrium relations for the metal are available. An understanding of the relationship of an organism's response to the specific chemical form of a toxicant in the environment rather than to its total concentration is an important consideration in the development of water quality criteria. (Baker-FRC)
W82-00610

ADSORPTION AS A CONTROL OF METAL CONCENTRATIONS IN SEDIMENT EXTRACTS,
Australian Atomic Energy Commission Research Establishment, Lucas Heights.
P. S. Rendell, G. E. Batley, and A. J. Cameron.
Environmental Science and Technology, Vol 14, No 3, p 314-318, March, 1980. 3 Fig, 5 Tab, 16 Ref.

Descriptors: *Metals, *Water analysis, Chemical analysis, *Sediments, Copper, Lead, Cadmium, Heavy metals, *Adsorption, Extraction, Sediment concentration.

Extractants spiked with copper, lead, or cadmium were shaken overnight with river sediment, and the solution metal concentrations were compared before and after the overnight extraction. To give an indication of the range of extraction reagents that might be affected, adsorption was investigated as a function of pH and in the presence of reducing agents, strong and weak complexiang agents, a weak acid, an oxidizing agent, and a cation exchanger. The adsorption of added metal in these experiments was assumed to constitute evidence for the readsorption of metal released during sediment extractions. Significant adsorption of added metal occurred during overnight extraction with dilute hydrochloric acid with a pH of more than 1.5, 0.1 M hydroxylamine hydrochloride with a pH of 2, 0.1 M sodium citrate with a pH of 4.6, 1 M ammonium acetate, 10% sodium citrate-1% sodium dithionite, and 25% acetic acid. Adsorption also occurred during a hydrogen peroxide digestion procedure. The inability of reagents to prevent losses of soluble metal in these experiments strongly suggests that a proportion of the metal actually released from a sediment sample during an extraction will be readsorbed. This may lead to serious misinterpretation of extraction data, because the metal concentrations determined in the extract do not represent metal levels in the sediment fractions attacked. (Baker-FRC)
W82-00614

AN ENVIRONMENTAL SAFETY ASSESSMENT OF BUTYL BENZYL PHTHALATE,
Monsanto Co., St. Louis, MO.
W. E. Gledhill, R. G. Kaley, W. J. Adams, O. Hicks, and P. R. Michael.
Environmental Science and Technology, Vol 14, No 3, p 301-305, March, 1980. 4 Tab, 26 Ref.

Descriptors: *Chemical industry, *Environmental protection, Phthalates, Safety, Environmental effects, Assessments, Water quality, Algal growth, Toxicity, Fish, *Butyl benzyl phthalate, Biodegration.

The environmental safety of butyl benzyl phthalate (BBP) was evaluated through both laboratory and field studies. BBP itself is relatively insoluble in water and tends to partition to soil, sediment, and biota in the aqueous environment. Biodegradation, the rate controlling process for environmental degradation of BBP, is rapid and extensive in natural water and sewage systems. Environmental levels of BBP averaged less than 1 microgram/liter in water and less than 100 ng/g in sediment. BBP is acutely toxic to a variety of algae, invertebrates, and fish in the 0.5 to 5 mg/liter range and chronically toxic to Daphnia and fathead minnows in the 0.1-0.8 mg/liter range. A bioconcentration study indicated that BBP was not an accumulative or persistent chemical in fish. Comparison of mean environmental water concentrations of BBP to laboratory chronic toxicity values for Daphnia and fathead minnows showed an average safety margin of about three orders of magnitude. This current safety assessment concludes that BBP under present use and disposal patterns does not constitute a hazard to the safety and well being of the aquatic environment. (Baker-FRC)
W82-00615

VOLTAMMETRIC CHARACTERIZATION AND CHEMICAL BEHAVIOR OF INORGANIC TIN IN NATURAL WATERS,
Istituto di Ricerca sulle Acque, Rome (Italy).
G. Macchi, and M. Pettine.
Environmental Science and Technology, Vol 14, No 7, p 815-818, July, 1980. 8 Fig, 28 Ref.

Descriptors: *Natural waters, *Tin, Seawater, Chemical analysis, Water analysis, Measuring instruments, *Volumetric analysis, Comparison studies.

Differential pulse anodic stripping voltammetry was used to test a solution containing 16 ppb of Sn(IV) in 0.04 M sodium nitrate and in artificial seawater as a function of pH. At a pH value below 7, a peak of anodic redissolution due to the oxidation of Sn(0) to Sn(II) became apparent. The peak potential shifted as a function of pH and indicated the formation of Sn(OH)(+) in the stripping process. The height of the peak decreases markedly with time in acid solution near pH 4 to 6. The results suggest that the stable forms of Sn(IV) are a function of pH. The differential pulse anodic stripping voltammetry analysis of surface seawater and samples collected at depth of 100 meters at the mouth of the Tiber River indicate the existence of Sn. The measured Sn peak was stable for at least six months. The findings indicate that soluble tin is present in natural waters in the form of Sn0(OH)3(-) when the pH is about 8. At lower values of pH, Sn may polymerize from Sn0(OH)2. (Baker-FRC)
W82-00627

DETERMINING VOLATILE ORGANICS IN WATER,
Monsanto Industrial Chemicals Co., St. Louis, MO.
J. P. Mieure.
Environmental Science and Technology, Vol 14, No 8, p 930-935, August, 1980. 4 Fig, 5 Tab, 19 Ref.

Descriptors: *Pollutant identification, *Organic compounds, Water analysis, Chemical analysis, Isolation.

Six techniques for low-level, multicomponent analysis of volatile organics in water are described. The key to analytical techniques for volatile organic determinations lies in the isolation step. This step determines the types of compounds to be measured, the expected accuracy and precision, and the potential interferences. Once the isolation and concentration steps have been achieved, the spectroscopic or chromatographic measurement of the analyte is usually straightforward. Static headspace sampling has detection limits ranging from sub- to mid-microgram/liter concentrations, depending on the compound and the detector. Purge and trap sampling has greater sensitivity than static headspace sampling, but foaming may be a problem. Solid sorbents have been shown effective for selected compounds, but the general usage for concentrations less than 50 micrograms/liter needs verification. Liquid/liquid extraction is useful for compounds for which specific detectors are available. Precision is better than with purge and trap technique. Sample cleanup is minimal, so removal of interferences is unlikely. Distillation is effective in concentrating water-soluble volatile organics. Semipermeable membranes are not widely used for isolation of volatiles; however, rapid analyses are possible when they are used as a selective introduction device for a mass spectrometer. (Baker-FRC)
W82-00630

ACCURATE AND EFFICIENT ESTIMATION OF BENTHIC POPULATIONS: A COMPARISON BETWEEN REMOVAL ESTIMATION AND CONVENTIONAL SAMPLING TECHNIQUES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Entomology.
F. L. Carle, and O. E. Maughan.
Hydrobiologia, Vol 71, No 1/2, p 181-187, May 27, 1980. 2 Fig, 1 Tab, 5 Ref.

Descriptors: *Sampling, *Benthos, *Species diversity, Invertebrates, Biological samples, Water quality, *Bioindicators, Circular Depletion Sampler, Benthic populations.

The continuing use of benthic communities as indicators of water quality requires use of accurate and efficient quantitative sampling techniques. The removal method using the Circular Depletion Sampler (CDS) was developed to collect consecutive subsamples from the same location, increasing the probability of capture. Average probability of capture, using three subsamples, from 270 CDS samples ranged from 0.19 for Antocha to 0.96 for Chironomidae. These population estimates were higher and less variable than single removal catches, Surber catches, or kick-net catches. Although sampling time was nearly equal for all three methods, the CDS method required less than half the time to separate the benthos from the substrate. Catchability varied with species, person collecting the samples, and sampling conditions. (Cassar-FRC)
W82-00633

IDENTIFICATION OF ORGANIC COMPOUNDS,
NUS Corp., Pittsburgh, PA., Analytical Services Lab.
G. D. Burns.
Industrial Wastes, Vol 26, No 4, p 23-25, July/August, 1980. 6 Fig.

Descriptors: *Organic compounds, *Measuring instruments, *Chemical analysis, Wastewater analysis, Wastewater composition, *Pollutant identification.

A large increase in the usefulness of gas chromatographic/mass spectrometric analytical methods is forecast as a result of increasing demands for certain standards to be met in wastewater discharging. The basis of the identification of an unknown compound is the retention time, that is, the length of time required for the compound to elute from a specific GC column under controlled conditions of column temperature and carrier gas flow rate. Mass spectrometry offers information concerning a compound's molecular weight and structure which is not available from conventional GC detectors. Computer technology has vastly increased the capabilities of a moden GC/MS system. The cost of a GC/MS with a data system varies from bench top models for about $60,000 to a complete data system for about $250,000. (Baker-FRC)
W82-00635

EVALUATION OF STANDARD AND MODIFIED M-FC, MACCONKEY, AND TEEPOL MEDIA FOR MEMBRANE FILTRATION COUNTING OF FECAL COLIFORMS IN WATER,
National Inst. for Water Research Pretoria (South Africa).
W. O. K. Grabow, C. A. Hilner, and P. Coubrough.
Applied and Enviromental Microbiology, Vol 42, No 2, p 192-199, August, 1981. 13 Tab, 31 Ref.

Descriptors: *Coliforms, *Culture media, *Water analysis, Bacteria, Agars, *Fecal coliform, Microbiological studies, Rivers, Activated sludge, Performance evaluation, Pollutant identification.

Counts obtained by means of different growth media recommended for membrane filtration counting of fecal coliforms were compared and isolates were identified to establish the composition of fecal coliforms in various water environments. Media included M-FC agar, modified M-FC agar which contains no rosolic acid, Teepol media, and MacConkey agar. Comparative tests were per-

formed on 312 samples including chlorinated effluents. M-FC agar without rosolic acid generally yielded the highest counts, was readily obtainable, was easy to prepare and handle, and yielded clearly recognizable fecal coliform colonies. Fecal coliform tests cannot be used to determine E. coli levels because in these tests the incidence of E. coli among fecal colonies varies from 51% for river water to 93% for activated sludge effluent. Klebsiella pneumoniae averaged 4% for sludge effluent and 32% for river water. The standard membrane filtration procedure using M-FC agar without rosolic acid gave clear advantages. (Small-FRC)
W82-00644

MODIFICATION OF THE STANDARD MOST-PROBABLE-NUMBER PROCEDURE FOR FECAL COLIFORM BACTERIA IN SEAWATER AND SHELLFISH,
Food and Drug Administration, Davisville, RI. Construction Batallion Center.
F. Dexter.
Applied and Environmental Microbiology, Vol 42, No 1, p 184-185, July, 1981. 1 Tab, 2 Ref.

Descriptors: *Coliforms, *Water analysis, *Seawater, Bacterial analysis, Bacteria, Brackish water, Saline water, Shellfish.

A total of 572 seawater and shellfish samples were collected and used in a study to determine whether or not presumptive tubes which take 48 hr to become positive need to be transferred to EC medium during the fecal coliform multitube most-probable-number procedure. It appeared that incorrect dilution data would be rare when the 24 hour positive tubes alone were transferred to EC. It is suggested that when the fecal coliform multitube most-probable-number procedure is performed, the presumptive test could be discontinued after 24 hr. An exception could be made for those situations in which either extreme accuracy or a high recovery rate is necessary, for example, in a comparative study of media or techniques or both. (Baker-FRC)
W82-00646

EFFECT OF OZONATION AND CHLORINATION ON THE MUTAGENIC POTENTIAL OF DRINKING WATER,
Florence Univ. (Italy). Inst. of Pharmacology.
P. Dolara, V. Ricci, D. Burrini, and O. Griffini.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 1, p 1-6, 1981. 2 Fig, 12 Ref.

Descriptors: *Chlorination, *Ozonation, *Toxicity, Water treatment, Drinking water, Water quality, Public health, Mutagenic chemicals, *Florence, Italy.

Water from a treatment plant in Florence, Italy, was tested for mutagenic activity using the Salmonella/microsomes test. The plant treats water from the Arno River with the following treatment scheme: prechlorination, addition of powdered activated carbon, coagulation and flocculation, decanting, rapid sand filtration, ozonation, and final chlorination. Dose response curves, with and without metabolic activation, were obtained by plating different amounts of DMSO concentrates. Untreated water had a negligible mutagenic activity, whereas significant, although low, mutagenic activity was introduced by chlorination. After ozone treatment, the water showed more mutagenic activity but less than after chlorination. Ozone treatment may be an alternative to chlorination for disinfection and odor removal in water treatment. Mutagenic chemicals were produced by chlorination, while ozonation could minimize the exposure to mutagenic chemicals in drinking water. The effect of ozonation on heavily contaminated waters is not known. (Small-FRC)
W82-00649

NEW WATERBORNE BACTERIOPHAGES ACTIVE ON YERSINIA ENTEROCOLITICA,
Granada Univ. (Spain). Dept. of Microbiology.
C. Calvo, J. Brault, J. M. Alonso, and H. H. Mollaret.
Applied and Environmental Microbiology, Vol 42, No 1, p 35-38, July, 1981. 5 Tab, 8 Ref.

Descriptors: *Bacteriophage, *Isolation, *Bacterial analysis, Water analysis, Viruses, Surface water, Enterobacter, Bacteria, Enteric bacteria, *Granada, Spain.

A phage typing scheme for Yersinia enterocolitica (YE) was investigated using bacteriophages isolated from surface waters. Seven bacteriophages active on YE were isolated from surface water samples collected in Granada, Spain. A comparison of the respective host ranges of these new phages and of reference phages used for YE phage typing showed that YE strains belonging to various phage types, grown at either 37 or 25 degrees C, expressed susceptibility to reference sewage water phages, whereas susceptibility to new waterborne phages, as well as to reference phages from lysogenic YE, was only demonstrated in YE strains grown at 25 degrees C. A YE strain isolated by stool culture from a pig was lysogenic for a bacteriophage which behaved like waterborne phages and reference phages from lysogenic YE strains. The possibility that the isolation of waterborne bacteriophages might, in certain circumstances, reflect the presence of lysogenic YE was raised. (Baker-FRC)
W82-00662

OCCURRENCE OF CYTOPHAGAS IN SEWAGE PLANTS,
Gesellschaft fuer Biotechnologische Forschung, m.b.H., Stockheim (Germany, F.R.).
H. Gude.
Applied and Environmental Microbiology, Vol 39, No 4, p 756-763, April, 1980. 3 Fig, 5 Tab, 27 Ref.

Descriptors: *Bacteria, *Activated sludge processes, *Cytophagas, Activated sludge, Microbiological studies, Biological treatment, Wastewater treatment.

In order to better understand biological sewage purification processes, the occurrence of bacteria belonging to the Cytophaga group in activated sludge from a treatment works was investigated. Plate count methods and the KOH-flexirubin test were used to determine Cytophagas. In the inflow sewage water, the percentage of Cytophaga colonies was generally low when compared with values for activated sludge, trickling filters, and effluent samples. Over a period of 16 months, the highest percentages of cytophagas were found in activated sludge and trickling filter samples collected during the winter. Also, cytophagas were found to have high percentages of the bacteria lytic to polymeric substrates such as cellulose, chitin, dextran, pectin, xylan, and gelatin. Polymer breakdown may be the way cytophagas contribute to sewage purification, especially at low temperatures. Isolated strains of Cytophaga had gliding motility, flexirubin pigmentation, and a low guanine plus cytosine base ratio. (Small-FRC)
W82-00682

ORGANOCHLORINE RESIDUES IN KENYA'S RIFT VALLEY LAKES,
National Wildlife Federation, Washington, DC.
J. L. Lincer, D. Zalkind, L. H. Brown, and J. Hopcraft.
Journal of Applied Ecology, Vol 18, No 1, p 157-171, April, 1981. 1 Fig, 6 Tab, 29 Ref.

Descriptors: *Pesticide residues, *Aquatic life, *Lakes, Wildlife, Pollutant identification, Chlorinated hydrocarbons, Fish, Birds, Water birds, Insects, Invertebrates, Vegetation, Algae, Eggs, Africa, Rift Valley, Lake Nakuru, *Kenya, Fate of pollutants, DDT, DDE.

Organochlorine pesticide residues were determined in aquatic life in four Rift Valley lakes in Kenya-Naivasha, Nakuru, Baringo, and Elmenteita. These lakes are closed basin systems with no external outlet. Pesticides used in the L. Nakuru catchment basin include DDT, dieldrin, toxaphene, dioxathion, and abate (temephos). The only organochlorine detected in samples was DDE, a DDT metabolite. DDE residues in vegetation, insects, fish, amphibians, mammals, bird eggs, and bird muscle are reported for each lake. Lake Elmenteita is probably the most pesticide-contaminated of the four lakes, but the small sample sizes did not permit a definite conclusion. L. Nakuru had the highest DDE levels, with L. Naivasha and Baringo, lesser levels. Some of the higher mean levels of DDE (in mg per liter oven dry weight) were: ferns in L. Naivasha, 0.107; fish in L. Baringo, 0.43-2.13; insects in L. Baringo, 0.90; and an otter from L. Nakuru, 0.35. Residues in eggs from fish eating birds were as high as 5.75 mg per liter DDE oven dry weight in the African darter from L. Nakuru. The highest residue of DDE in avian muscle tissue was 1.09 mg per liter oven dry weight in maribou stork from L. Nakuru. (Cassar-FRC)
W82-00690

TOXICS IN MUNICIPAL AND INDUSTRIAL WASTEWATERS,
Municipal Environmental Research Lab., Cincinnati, OH. Wastewater Research Div.
D. F. Bishop.
In: 1980 Annual Report - A Perspective on the Problem of Hazardous Substances in the Great Lakes Basin Ecosystem, Appendix D, November, 1980. 98 p. 1 Fig, 32 Tab, 29 Ref, 3 Append. International Joint Commission, Windsor, Ontario.

Descriptors: *Hazardous materials, *Pollutant identification, Organic compounds, Waste disposal, Waste management, Waste load, Organic loading, *Industrial wastewater, Technology, Waste characteristics, Pretreatment of water, *Toxins, *Municipal wastewater, Great Lakes.

Legislative and court actions are forcing the evolution of systematic toxic management approaches to limit environmental exposure to toxics in both Canada and the United States. This report, as background to a discussion on toxic loading estimates in the Great Lakes, reviews legislative actions in the U.S. and various treatment processes studied in a 25-city survey. Approaches evaluated for the treatment of 129 'primary pollutant' compounds included removal systems, pretreatment, toxics loads, treatability, and removability. Not unexpectedly, there was a wide variation found among industrial plants for compounds identified and concentrations recorded. Similarly, removal of specific compounds varied from zero to almost 100 percent. Of the 87 compounds detected, 24 organics and 13 metals were found in all of the plants. Chlorination for disinfection generally increased the concentrations of certain compounds. The report recommends that the following issues related to municipal and industrial wastes in the Great Lakes area be studied: updating and reliability of the estimated toxics loads, municipal and industrial sources of toxics, monitoring issues, wastewater chlorination, land treatment vs. conventional wastewater treatment, and pre-treatment vs. centralized municipal treatment. (Garrison-Omniplan)
W82-00712

NEW LIQUID CHROMATOGRAPHIC DETECTION SYSTEM FOR ENVIRONMENTAL POLLUTANTS,
Georgia Univ., Athens.
L. A. Carreira, and L. B. Rogers.
Environmental Protection Agency Report EPA-600/4-80-015, February 1980. 71 p, 30 Fig, 3 Tab, 29 Ref.

Descriptors: *Water analysis, *Liquid chromatography, *Polychlorinated biphenyls, *Hydrocarbons, Spectrometers, Solvents, Computers, Automation, *Pollutant identification.

Resonance enhanced coherent anti-Stokes Raman spectrometry (CARS) has been demonstrated as a specific identification system for liquid chromatography. To achieve this, liquid chromatographic preconcentration and separation and computer control of the liquid chromatograph/ultraviolet-visible/CARS were undertaken. Under the optimum resonance condition, spectra were obtained on 5 microliter volumes with detection limits of 1 micromolar or less under favorable conditions. Excellent fluorescence rejection and ultraviolet

CARS were also shown. A number of different species (polynuclear aromatic hydrocarbons and polychlorinated biphenyls) were surveyed by liquid chromatography with the selectivity of different stationary phases and special solvent effects examined. Observations useful in relating experimental variables in the preconcentration step to the recovery of given species were made. A system consisting of a liquid chromatograph, a scanning ultraviolet-visible spectrometer and the CARS was automated using a mini-computer. Column selection, flow rate, and solvent composition were monitored and controlled. The ultraviolet-visible spectrometer was used at a fixed wavelenth until a species was detected. The flow was stopped, the absorption spectrum was scanned, and flow was resumed. The optimum laser frequencies for resonance CARS were set from the absorption spectrum. The Raman spectra were then scanned under control of the computer with on-line signal averaging and data smoothing. (Author's abstract)
W82-00740

INTERIM METHOD FOR DETERMINING ASBESTOS IN WATER,
Environmental Research Lab., Athens, GA.
C. H. Anderson, and J. M. Long.
Environmental Protection Agency Report EPA-600/4-80-005, January 1980. 43 p, 2 Fig, 2 Tab, 13 Ref.

Descriptors: *Water analysis, *Microscopic analysis, *Asbestos, *Electron microscopy, Drinking water, Filtration, Hazardous materials, Water pollution, Pollutants.

This revised interim method for asbestos in drinking water and water supplies reflects the improvements that have been made in asbestos analytical methodology since the initial procedure was drafted. A variable, known volume of water sample is filtered through a 0.1 micrometer polycarbonate membrane filter and the filter is then carbon coated. A small portion of the filter is placed on an electron microscope grid and the filter material is removed by solution in chloroform. The material remaining on the grid is examined in a transmission electron microscope at 20,000 magnification. Chrysotile asbestos can be differentiated from amphibole by their morphologies and electron diffraction patterns. The number of fibers in a known area examined in the microscope is converted to number of fibers per liter, and the mass per liter can be calculated from the assumed density and volume of the fibers. The method can detect 0.01 million fibers per liter or 0.1 ng/1, under favorable circumstances. (Brambley-SRC)
W82-00741

SAMPLE INTAKE POSITION AND LOADING RATES FROM NONPOINT SOURCE POLLUTION,
National Forest Service, Challis, ID.
P. E. McGuire, T. C. Daniel, D. Stoffel, and B. Andraski.
Environmental Management, Vol 4, No 1, p 73-77, January, 1980. 2 Fig, 1 Tab, 4 Ref.

Descriptors: *Nonpoint pollution sources, *Runoff, *Sampling, Water quality, Monitoring, Bed load, Suspended solids, Phosphorus compounds, Nitrogen compounds, Pollutant identification, Water sampling.

Paired water samples were taken simultaneously at two different vertical positions in a flow control structure designed for monitoring nonpoint source pollution. It was determined that easily transported pollutants and those with more potential for immediate impact on water quality should be sampled at the midstage level. If total transport of contaminants from a particular land use is required, then bed load sampling must be used. Suspended solids, total phosphorus, and organic plus exchangeable N were consistently higher when sampled at the floor of the apparatus than those sampled at midstage. Dissolved molybdate reactive phosphorus and ammonium concentrations were not significantly affected by intake position. Concentrations of nitrate-nitrite were much higher when sampled at the midstage level. Levels produced by midstage sampling, expressed as a percent of bed load (floor) sampling, were as follows: suspended solids, 44; total phpsphorus, 39; organic plus exchangeable N, 35; dissolved molybdate reactive phosphorus, 80; ammonium, 71; and nitrate-nitrite, 181. (Cassar-FRC)
W82-00778

SIMULTANEOUS DETERMINATION OF IRON, CADMIUM, ZINC, COPPER, NICKEL, LEAD, AND URANIUM IN SEAWATER BY STABLE ISOTOPE DILUTION SPARK SOURCE MASS SPECTROMETRY,
National Research Council of Canada (Ontario). Div. of Chemistry.
A. P. Mykytiuk, D. S. Russell, and R. E. Sturgeon.
Analytical Chemistry, Vol 52, No 8, p 1281-1283, July, 1980. 2 Tab, 19 Ref.

Descriptors: *Seawater, *Trace elements, *Water analysis, Mass spectrometry, Chemical analysis, Copper, Iron, Zinc, Cadmium, Nickel, Lead, Uranium, Cobalt.

Seawater samples have been analyzed at trace concentration levels by stable isotope dilution spark source mass spectrometry for iron, cadmium, zinc, copper, nickel, lead, uranium, and cobalt. The samples were preconcentrated on the ion exchanger Chelex-100 and the concentrate was evaporated on a graphite or silver electrode. The results are compared with those obtained by graphite furnace atomic absorption spectrometry and inductively coupled plasma emission spectrometry. The technique avoids the use of calibration standards and is capable of producing results in cases where the analyte is only partly recovered. (Baker-FRC)
W82-00786

AQUATIC MOSSES AS MONITORS OF HEAVY METAL CONTAMINATION IN THE RIVER ETHEROW, GREAT BRITAIN,
Durham Univ. (England). Dept. of Botany.
P. J. Say, J. P. C. Harding, and B. A. Whitton.
Environmental Pollution, Series B, Vol 2, No 4, p 295-307, 1981. 3 Fig, 9 Tab, 13 Ref.

Descriptors: *Mosses, *Bioindicators, *Zinc, Heavy metals, Metals, Chromium, Aquatic plants, Rivers, Pollutant identification, Sediments, Water analysis, Monitoring, Etherow River, *Great Britain.

Zinc concentrations in two aquatic mosses, Fontinalis squamosa and Rhynchostegium riparioides, showed significant positive correlation, suggesting that these species may be useful bioindicators for Zn contamination of river water. Samples of water, sediments, and moss were collected on 5 occasions at 9 sites during 1979 and 1980 in the River Etherow, Great Britain, and analyzed for heavy metals. Levels of metals in sediments and water showed a similar pattern with the exception of proportionately higher lvels of Cr in sediments at 3 sites. Zn levels were 0.22 to 14.6 mg per liter in water, 73.7-4960 micrograms per g in sediments, and 64.1-6705 micrograms per g in mosses. Although Cr was not detected in water, it was present in mosses from some sites, indicating previous contamination. Data obtained for Amblystegium riparium and Fontinalis antipyretica were not sufficient to assess their value as monitors. (Cassar-FRC)
W82-00787

FORMATION OF N-NITROSODIETHANOLAMINE FROM DIETHANOLAMINE IN LAKE WATER AND SEWAGE,
Cornell Univ., Ithaca, NY. Dept. of Agronomy.
J. R. Yordy, and M. Alexander.
Journal of Environmental Quality, Vol 10, No 3, p 266-270, July/September, 1981. 5 Fig, 20 Ref.

Descriptors: *Wastewater, *Lakes, *Nitrosamines *Diethanolamine, Carcinogens, Nitrogen compounds, Toxins, Pollutants, Nitrite, Pollutant identification, Chromatography.

Diethanolamine (DEIA) is a compound of potential environmental concern due to its presence in a number of industrial and consumer products which result in the dicharge of large amounts of the unchanged chemical into wastewater and sewage. The N-niroso derivative of DEIA, N-nitrosodiethanolamine (NDEIA), is a proven carcinogen. This study used a thin-layer chromatographic technique with a carbon-14 labeled secondary amine to measure the possible formation of nitrosamines in samples of natural waters and sewage. The loer limit of sensitivity was 1 nanogram of nitrosamine per milliliter. The formation of NDEIA from DEIA in both lake waters and sewage was demonstrated. A combination of gas chromatography and mass spectrometry was used to verify the ientity of the product. Sewage produced the greatest amount of the carcinogenic NDEIA, while water from Cayuga Lake produced considerably less. The least amount of NDEIA was produced by water from an acid lake. The amount of DEIA added and the nitrite level in samples of the environment were found to be related to the amount of the nitrosamine formed. When samples of sewage and water from Cayuga Lake were autoclaved, NDEIA was either not formed or formed at rates much lower than in nonsterile environments. These results indicate that microorganisms or some other heat-labile factor may play a role in the formation of the nitroso compound. Although the nitrosamine could be netabolized in all three environments investigated, it persisted in lake water samples taken in the winter. (Carroll-FRC)
W82-00796

MEASUREMENT OF IN SITU RATES OF NITRIFICATION IN SEDIMENT,
Aarhus Univ. (Denmark). Inst. of Ecology and Genetics.
K. Henriksen.
Microbial Ecology, Vol 6, No 4, p 329-337, 1980. 4 Fig, 2 Tab, 14 Ref.

Descriptors: *Nitrification, *Sediments, *Chemical reactions, Ammonium, Sediment sampler, Inhibitors, In situ tests, Oxygen, Bacteria, Chemical analyses, *Marine sediments.

High numbers of nitrifying bacteria occur below the zone of oxygen penetration in marine sediments and can almost immediately oxidize ammonium when supplied with oxygen. As a result, sampling methods which introduce oxygen into anoxic parts of the sediment can be expected to give potential rather than actual nitrification rates. This paper reports the development of a method for the measurement of nitrification rates in intact sediment cores without disturbing the concentration gradients of oxygen and ammonium. N-serve (2-chloro-6-trichloromethyl-pyridine) is a specific inhibitor of the nitrifying bacteria Nitrosomonas in oxidizing ammonium to hydroxylamine, the first step in the nitrification process. Injection of 20 parts per million (ppm) of N-serve into a 0-2 centimeter surface layer of the sediment and addition of 5 ppm N-serve to the water column of sediment cores was sufficient to inhibit nitrification, but did not change the rate of ammonium production or incorporation in sediment suspensions. The sediments were incubated aerobically and anaerobically. The ammonium accumulation in sediment cores injected with N-serve was equal to the amount of ammonium which was oxidized to nitrate in the control cores. Nitrification rates measured by this method were in the range of 0 to 3 millimolecules of nitrogen per square meter per day. The agreement of this finding with the findings of previous studies substantiates the conclusion that this method gives near in situ nitrification rates. (Carroll-FRC)
W82-00798

URANIUM CONCENTRATION IN THE GROUND WATERS OF THE PULLMAN-MOSCOW BASIN, WHITMAN COUNTY, WASHINGTON, AND LATAH COUNTY, IDAHO,
Washington State Univ., Pullman. R. L. Albrook Hydraulic Lab.
For primary bibliographic entry see Field 5B.
W82-00809

Group 5A—Identification Of Pollutants

SAMPLING GROUND WATER FOR ORGANIC CONTAMINANTS,
Oklahoma State Univ., Stillwater. Dept. of Geology.
W. A. Pettyjohn, W. J. Dunlap, R. Cosby, and J. W. Keeley.
Ground Water, Vol 19, No 2, p 180-189, March/April, 1981. 8 Fig, 7 Ref.

Descriptors: *Water sampling, *Groundwater pollution, *Laboratory equipment, Water quality, Wells, Sampling, Sample preparation, Pollutant identification.

Current preferred methods for the sampling of organic pollutants in groundwater are described which are used at the Ground Water Research Branch of the Robert S. Kerr Environmental Research Laboratory. For an effective sampling program, sampling equipment must be constructed of materials that have the least potential for affecting the sample, including glass and Teflon. Wells used to sample groundwater should be drilled and completed using techniques that minimize potential contamination of the aquifer. Teflon tubing can be used to case that portion of the well that extends from a few feet above the water table to the bottom of the borehole. Grab samples can be withdrawn through a sterile 6 mm Teflon tube and discharged into a sterile, calibrated one-liter heavy-wall Erlenmeyer flask with a peristaltic pump. For sampling at greater depths, a noncontaminating submersible high-lift pump can be used. Continuous sampling can utilize a system in which the water is pumped directly from the well through 6 mm Teflon tubing to two columns of adsorbent in series. Sampling systems are installed in specially constructed housings and form self-contained, easily transported units. (Small-FRC)
W82-00820

A REDUCTION-SPECTROPHOTOMETRIC METHOD FOR THE DETERMINATION OF SULPHATE IN WATERS,
Sydney Univ. (Australia). Dept. of Inorganic Chemistry.
Rama S. Bhat, J. M. Echert, and N. A. Gibson.
Analytica Chimica Acta, Vol. 128, p 263-267, 1981. 2 Tab, 7 Ref.

Descriptors: *Water analysis, *Sulfates, Estuarine environment, Seawater, Natural waters, Chemical analysis, *Spectrophotometry.

The reduction spectrophotometric method presented for the determination of sulfate in waters is based on the reduction of the sulfate by tin(II) chloride in hydriodic acid to hydrogen sulfide, which is then swept by nitrogen into a buffered solution of bis(2,9-dimethyl-1,10-phenanthroline)copper(II) ion. The resulting copper(I) complex is measured spectrophotometrically. With sample volumes between 10 and 1000 microliters, the limit of detection is 0.5 micrograms of sulfate. Formation of the stable complex is immediate and the reduction system can be used repeatedly. The method is applicable to fresh, estuarine, and marine waters. The common inorganic sulfur containing anions such as sulfide, sulfite, thiosulfate, tetrathionate and dithionate interfere quantitatively with the proposed method, as they are all reduced by hydrogen sulfide with the same efficiency as sulfate. No interference was present from linear alkylbenzene sulfonates. The major ions of sea water do not intefere seriously, and the method may be used without modification for the determination of sulfate in marine and estuarine waters. (Baker-FRC)
W82-00850

EVALUATION OF AN AUTOMATIC SYSTEM FOR DETECTION OF TOXIC SUBSTANCES IN SURFACE WATER USING TROUT,
Antwerpse Waterwerken (Belgium).
F. Van Hoof.
Bulletin of Environmental Contamination and Toxicology, Vol 25, No 2, p 221-225, 1980. 2 Tab, 10 Ref.

Descriptors: *Toxicity, *Bioindicators, *Monitoring, *Trout, Fish physiology, Water pollution, Experimental design, Chemical analysis, *Surface water, Streams, Sewage treatment, Environmental effects, Metabolism, Sewage effluent.

An automatic system for detection of toxic substances in surface water is evaluated. The system uses rainbow trout as test organisms, since toxicity data on fish can be more easily extrapolated to mammals than results obtained with organisms having a lower level of bioorganization. Fish in aquaria were exposed to eight chemicals representing widely used pesticides and other polluting discharges. Avoidance reactions, loss of condition or death were monitored by a set of photoelectric cells placed at the downstream end of the flow-through aquarium. No conclusive evidence of toxicity was observed for cadmium, zinc, and ethyl-parathion. Potassium cyanide was the only product to elicit a clear avoidance response. Carbaryl, malathion, dinitroorthocresol, and captan caused death. These results are used in calculations of lethal dose concentrations; however, they do not take into account any safety margin. The biomonitoring parameters, i.e., positive rheotaxis and opercular rhythm in fish, oxygen production and oxygen consumption in bacteria, and mobility inhibition in daphnia may be useful when results from flow-through monitoring are inadequate. (Titus-FRC)
W82-00855

DETECTION OF VOLATILE NITROSAMINES IN WASTE WATER FROM CHEMICAL PLANTS BY COMBINED CAPILLARY GAS CHROMATOGRAPHY-MASS SPECTROMETRY,
Mainz Univ. (Germany, F.R.). Hygiene Inst.
G. Hartmetz, and J. Slemrova.
Bulletin of Environmental Contamination and Toxicology, Vol 25, No 1, p 106-112, 1980. 4 Fig, 2 Tab, 10 Ref.

Descriptors: *Volatility, *Waste water, *Chemical wastes, *Mass spectrometry, *Gas Chromatography, Industrial wastes, Carcinogens, Drinking water, Potable water, Water treatment, Water sampling, Chemical analysis, Sea water, Brackish water, Chemical wastewater, Pharmaceutical wastewater.

Seven samples of crude water from different wastewater treatment facilities and the purified waste water from a chemical-pharmaceutical plant were examined for carcinogenic materials. Concentrations of nitrosamines in the purification works effluent varied considerably with time. Findings show that volatile nitrosamines are introduced into the surface water through the waste water of chemical plants. The nitrosamine concentrations in the waste water are of the same order of magnitude as in various foodstuffs. Concentrations are so dilute in rivers as to be undetectable. (Titus-FRC)
W82-00856

SERUM ENZYMES IN RAINBOW TROUT AS TOOLS IN THE DIAGNOSIS OF WATER QUALITY,
Innsbruck Univ. (Austria). Inst. fuer Zoophysiologie.
W. Wieser, and S. Hinterleitner.
Bulletin of Environmental Contamination and Toxicology, Vol 25, No 2, p 188-193, 1980. 1 Tab, 15 Ref.

Descriptors: *Fish physiology, *Blood, *Toxicity, *Bioindicators, Water pollution, Experimental design, Chemical analysis, Trout, Streams, Sewage treatment, Environmental effects, Enzymes, Metabolism, Ammonia, Nitrate, Nitrite, *Sewage effluent, Water pollution effects.

Stress responses of trout (Salmo gairdneri) brought about by deterioration of water quality are investigated. The activities of two transaminases in the trout serum were measured and the quality of the river water was analyzed at areas where the fish were caught. Samples were obtained at various distances from a sewage outfall. The transaminase activity was found to be a function of distance from the sewageplant and to be correlated with the nitrogen content of the river water. The behavior and appearance of liver and gills of fish showed no variation from normal. Specimens caught within the plume had high values of serum glutamic oxalacetate transaminase (SGOT) and glutamic pyruvate transaminase (GPT) activity. The levels of SGOT and SGPT activity in S. gairdneri appear to be good indicators of certain types of water pollution, at least within a range characterized by total ammonia concentrations of approximately 0.5 to 12 mg/liter. Trout in natural waters, in contrast to laboratory conditions, appear to tolerate surprisingly high local pollutant concentrations. (Titus-FRC)
W82-00857

METHODS OF INVESTIGATING THE STATE OF METAL IONS IN NATURAL WATERS,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
P. N. Linnik, and B. I. Nabivanets.
Water Resources (English Translation), Vol 7, No 5, p 463-477, September/October, 1980. 3 Fig, 1 Tab, 162 Ref. Translated from Vodnye Resursy, No 5, p 148-170, September/October, 1980.

Descriptors: *Metals, *Water analysis, *Measurement techniques, *Ions, Colloids, Suspended solids, Dissolved solids, Chemical analysis, Physical analysis, Separation techniques, Ionization, Hydrolysis, Oxidation.

Information concerning the forms of metal ions in natural waters is needed for developing an understanding of mechanisms for the assimilation of metals by aquatic organisms, for developing hydrochemical methods of prospecting for mineral resources, and for developing effective water treatment processes. This state-of-the-art review describes methods being used for the investigation and quantification of the forms of migration of metals in natural waters, including the distribution of metal between suspended, colloidal, and truly dissolved forms; the concentration of free noncomplexed ions of the investigated metals; the sign of the charge of the metal ions; the molecular (ionic) weight of complex or polynuclear compounds; complexation of metal ions in natural waters (kinetics of complexation, degree of complexation, strength of binding the metal into complex compounds, and complexing capacity of natural waters); and degree of oxidation (Valency) of the metal. The possibilities and limitations of each of the measurement techniques described are discussed. It is now possible to create general schemes for a systematic study of forms of migration of metal in complex natural waters. Three such general schemes are discussed. One of these schemes, developed by the authors of the article, permits the development of information on the state of metal ions in natural waters which is sufficiently complete to satisfy the needs of various specialists engaged in the problems of the study and use of natural waters. This scheme includes the successive use of various methods of investigation, permitting a quantitative determination of the portion of individual forms of the investigated element. (Carroll-FRC)
W82-00859

EFFECT OF TURBIDITY ON CHLORINATION EFFICIENCY AND BACTERIAL PERSISTENCE IN DRINKING WATER,
Oregon State Univ., Corvallis. Dept. of Microbiology.
M. W. LeChevallier, T. M. Evans, and R. J. Seidler.
Applied and Environmental Microbiology, Vol. 42, No. 1, p 159-167, July, 1981. 7 Fig, 1 Tab, 29 Ref.

Descriptors: *Drinking water, *Turbidity, *Chlorination, Disinfection, *Bacteria, Water quality, Potable water.

The influence of turbidity on drinking water quality was examined in six watersheds where turbidities at entry points to distribution lines ranged from 0.2 to 15.0 nephelometric turbidity units (NTU). Coliforms densities in raw water ranged from 11 to 500 coliforms per 100 ml, and were reduced 10- to

1,000-fold by chlorination. Coliforms in high-turbidity water (13 NTU) were reduced to only 20% of the initial count, whereas coliforms in low turbidity water (1.5 NTU) were undetectable even when large volumes were sampled, indicating a 1,000-fold or greater decrease. Disinfection efficiency was found to be negatively correlated with turbidity. Turbid water samples were examined in an attempt to determine factors which aid bacteria in surviving exposure to chlorine. Some bacteria particles were either embedded in trubidity particles or appeared to be coated with amorphous material or both. Blending of chlorinated turbid water increased the number of standard plate count bacteria as much as five times, indicating the physical separation of cells attached to common particles. The chlorine demand of the surfce water supplies was positively correlated with both the turbidity and total organic carbon content of the water, but not with other chemical parameters. It was concluded that turbidity is a useful indicator of potential problems in drinking water. (Baker-FRC)
W82-00865

GOOD LOOKS, LOW MAINTENANCE GUIDE WATER TANK CHOICE,
K. Grover.
American City and County, Vol. 95, No. 12, p 19-22, December, 1980.

Descriptors: *Water tanks, *Water storage, *Maintenance costs, *Design criteria, *Concrete construction, Storage tanks, Pipes, Materials engineering, Cost analysis, Economic aspects, Design standards, Pumps, Pumpage, Construction, Construction costs.

The design and cost of various water tanks is discussed, and examples of tanks currently in operation are cited. The three basic types of tanks used today are ground storage reservoirs, standpipes, and elevated tanks. Steel and concrete are the standard construction materials. For utilities and districts with storage needs in excess of 1.5 million gallons, tanks are constructed of welded steel or prestressed concrete, while bolted steel is appropriate for smaller tanks. Topography of the service area, availability and cost of land, and the type of water system are the prime factors influencing the choice of design. Elevated tanks assure constant pressure, accommodate variable demand, and can reduce pumpage costs. Standpipes are useful where there is some need for pressure equalization. Ground storage often offers lowest first cost and maintenance costs. It is safer and more convenient, and avoids aesthetic problems. However, land acquisition and excavation costs may be high. The newest innovation in design is the multi-use elevated tank which provides space inside for offices, pumps, controls, and storage. These are in operation in over 100 towns in the United States. (Titus-FRC)
W82-00868

DETERMINATION OF LOW NG/L LEVELS OF POLYCHLORINATED BIPHENYLS IN DRINKING WATER BY EXTRACTION WITH MACRORETICULAR RESIN AND ANALYSIS USING A CAPILLARY COLUMN,
Environmental Health Directorate, Ottawa (Ontario).
G. L. LeBel, and D. T. Williams.
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 3, p 397-403, 1980. 3 Fig, 2 Tab, 14 Ref.

Descriptors: *Drinking water, *Phenols, *Organic compounds, Water pollution, Contamination, Potable water, Streams, Groundwater, Chlorination, Chlorine, Gas chromatography, Water sampling, Monitoring, Experimental design, *Pollutant identification, *Polychlorinated biphenyls.

The application of the XAD-2 macroreticular method to analyze large volumes of potable water for low volumes of polychlorinated biphenyls was investigated. Contributions to the procedural blank value and the interference from other organic materials in a water sample were examined. Quantitation of recovery runs was achieved by comparing peak heights of selected peaks from the sample extracts with the corresponding peaks from standard polychlorinated biphenyl solutions. Results of tests run on well samples indicate that the detection limits are affected by the interference from other organics in the water sample but are typically in the 1 to 10 microgram per liter range for potable water from a river source. (Titus-FRC)
W82-00875

OCCURRENCE OF TETRAALKYLEAD COMPOUNDS IN THE AQUATIC ENVIRONMENT,
Canada Centre for Inland Waters, Burlington (Ontario).
Y. K. Chau, P. T. S. Wong, O. Kramar, G. A. Bengert, and R. B. Cruz.
Bulletin of Environmental Contamination and Toxicology, Vol. 24, No 2, p 265-269, 1980. 1 Tab, 10 Ref.

Descriptors: *Aquatic environment, *Fish physiology, Fish populations, *Water pollution, *Toxicity, Microorganisms, *Lead, Organic compounds, Primary productivity, Environmental effects, Ecosystems, Gas chromatography, Spectrophotometry, Sediment, Lakes, *Tetraalkylead compounds.

Results of an extensive survey of fish, vegetation, sediment, and water for the presence of tetraalkylead compounds are presented. The samples were taken from various lakes and rivers in Ontario. Only fish samples were found to contain these compounds. The source of these compounds is thought to be antiknock gasoline additives or related commercial products. The fish containing tetraalkylead also contained high total and extractable lead. No relationship between species and size of fish and concentration of pollutant was detected. The type of tetraalkylead varied in different locations. Concentrations of the tetraalkylead were generally low, comprising less than 10 per cent of the total lead. (titus-FRC)
W82-00878

DETERMINATION OF POLYHALOGENATED PHENOLIC COMPOUNDS IN DRINKING WATER, HUMAN BLOOD SERUM AND ADIPOSE TISSUE,
Miami Univ., FL. School of Medicine.
C. Morgade, A. Barquet, and C. D. Pfaffenberger.
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 2, p 257-264, 1980. 5 Tab, 8 Ref.

Descriptors: *Phenols, *Drinking water, *Halogens, *Tissue analysis, *Water sampling, Potable water, Organic compounds, Blood, Experimental design, Water pollution, Gas chromatography, Sensitivity analysis, Public health.

The blood serum of 58 women in Florida was analyzed for the presence of eight halogenated phenols, and the drinking water source for each woman was recorded. Chlorinated municipal water and nonchlorinated well water were the two sources of drinking water. Additionally, 10 samples of human adipose tissue, taken at autopsy, were analyzed. Results showed that blood serum levels of PCP were not dramatically different for the two groups of women. The concentrations in both groups were significantly below those reported for citizens in Hawaii. Tissue analyses indicate that PCP (pentachlorophenol) does not bioconcentrate in human adipose tissue to the same extent as DDT and DDE. The level of PCP in adipose tissue ranged from 0.01 to 0.08 parts per million. (Titus-FRC)
W82-00879

ALUMINUM SHADOWING-DIRECT PROJECTION PHOTOMICROSCOPY OF DIATOM FRUSTULES,
Weyerhaeuser Co., Longview, WA.
D. W. Quackenbush, and M. L. Bothwell.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 7, p 1160-1166, July, 1980. 3 Fig, 24 Ref.

Descriptors: *Diatoms, *Microscopy, Bacteria, Phytoplankton, *Photography, Water analysis, *Environmental gradient, *Ecology.

Accurate identification of diatom genera and species represents an important means of studying present and past environmental conditions in freshwater and marine ecosystems. The aluminum shadowing-direct projection method produced high resolution photomicrographic reproductions of diatom preparations in the 200 x 800 magnification range. This technique, which allows size determination in three dimensions, provides a simple and inexpensive alternative to low magnification scanning electron micrographs. Among the details revealed are valve surface contours, ridges and depressions, raised and depressed central areas of Cyclotella valves, external and internal valve views of pennate forms, and puncta of Stauroneis. A shadowing angle of 20 degrees gave the best results. By multiplying the measured length of shadows by tan 20 degrees, the depth of specimens or length of spines can be determined. Diatom identification and enumeration can be done directly from photographic prints, which are a permanent record. Another potential use of the method is in preparing permanent mounts for total free-living bacteria counts of water samples. (Cassar-FRC)
W82-00884

THE IMPACT OF AN INDUSTRIALLY CONTAMINATED LAKE ON HEAVY METAL LEVELS IN IT'S EFFLUENT STREAM,
Purdue Univ., Lafayette, IN. Dept. of Bionucleonics.
For primary bibliographic entry see Field 5B.
W82-00886

GRAB VERSUS COMPOSITE SAMPLING: A PRIMER FOR THE MANAGER AND ENGINEER,
Illinois Environmental Protection Agency, Springfield.
D. J. Schaeffer, H. W. Kerster, and K. G. Janardan.
Environmental Management, Vol 4, No 2, p 157-163, March, 1980. 1 Tab, 7 Ref.

Descriptors: Sampling, *Water sampling, Water quality management, Effluents, Wastewater treatment, Monitoring, Regulations, Pollutant identification, Water analysis, Water pollution prevention, Simulation analysis, *Wastewater analysis, *Comparison analysis, Sampling techniques.

Effluent samples are usually aggregated into 24-hr composite samples for measuring compliance. This paper shows by simulation analysis that random grab samples are as effective as composite samples for monitoring purposes and provide more information on plant variability. In addition, by using a constant volume compositing regime, a single composite of n subsamples provides as much information as do n grab samples. Monthly average performance measured by M composites is the same as that measured by M random grabs taken over the same period. M grab samples are equally or more informative than the monthly average derived from flow proportional composites. For judging average plant performance, composites are better than grabs; for long term performance, grabs and composites provide the same real information. Process extremes, particularly high values, are more readily revealed by grab samples than by composite samples. This allows earlier corrective measures for out-of-control plant operations and warnings on releases of momentarily high concentrations of toxic or high BOD effluents. (Cassar-FRC)
W82-00891

PREFERENCE-AVOIDANCE REACTIONS OF CRAYFISH TO SUBLETHAL CONCENTRATIONS OF CADMIUM,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
A. F. Maciorowski, E. F. Benfield, and J. Cairns, Jr.
Hydrobiologia, Vol 74, No 2, p 105-112, September, 1980. 1 Fig, 4 Tab, 36 Ref.

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Descriptors: *Cadmium, *Bioindicators, *Behavior, *Crayfish, Invertebrates, Monitoring, Water quality, Metals, Animal behavior, Water pollution effects, Aquatic environment, Pollutant identification.

Crayfish (Cambarus acuminatus) were able to detect sublethal concentrations of cadmium and respond by changing their locomotion patterns. This suggests a possible use of crayfish in continuous biomonitoring systems. The alterations in locomotor patterns included: activity without directed movement, momentary cessation of directed movement at the contaminated-uncontaminated interface, attempts to leave the test chamber, and leaving and reentering the Cd zone. Tests were conducted in tanks using Cd concentrations of 125.0, 12.5, and 1.25 micrograms per liter. The crayfish tended to avoid the Cd area in the tank with the highest concentration and appeared to prefer the Cd side in the lower two concentrations. A possible explanation for this is that the pollutant disrupts chemosensory behavior, blocking taste receptors and natural stimuli. (Cassar-FRC)
W82-00916

HEAVY METAL CONCENTRATIONS IN THE HOLSTON RIVER BASIN (TENNESSEE),
East Tennessee State Univ., Kingsport. Dept. of Chemistry.
G. J. Young, and R. D. Blevins.
Archives of Environmental Contamination and Toxicology, Vol 10, No 5, p 541-560, September, 1981. 1 Fig, 7 Tab, 71 Ref.

Descriptors: *Heavy metals, *Water analysis, *Fish, Monitoring, Pollutant identification, Metals, Cadmium, Lead, Manganese, Zinc, Copper, Mercury, *Holston River, *Tennessee, Water pollution sources, Toxicity, Water pollution effects.

Heavy metals (Zn, Cd, Hg, Cu, Pb, and Mn) were measured in water samples and fish muscle from the Holston River Basin in Eastern Tennessee. This basin, encompassing 12 counties, contains both natural, unpolluted streams and waters heavily polluted by industrial and domestic uses. Maximum levels (in ppb) in water samples were: Zn, 1143; Mn, 637; Pb, 18; Hg, 0.6; Cd, 4; Cu, 68. In fish muscle maximum levels (in ppm) were: Cd, 0.41; Pb, 1.3; Mn, 4.3; Cu, 0.8; and Zn, 24. Median levels of Cd, Cu, Pb, and Zn in the Holston River Basin were at or below median values found in fish throughout the world; Mn levels were much higher. Serious Hg pollution problems downstream of a chlor-alkali plant operated from 1950 to 1972 were not reflected in grab water samples because large amounts of Hg are adsorbed on sediment. Fish muscle is a better indicator of Hg pollution than water samples. (Cassar-FRC)
W82-00959

SEA URCHIN SPERM BIOASSAY FOR SEWAGE AND CHLORINATED SEAWATER AND ITS RELATION TO FISH BIOASSAYS,
Washington Univ., Seattle. Fisheries Research Inst.
P. A. Dinnel, Q. J. Stober, and D. H. DiJulio.
Marine Environmental Research, Vol 5, No 2, p 29-39, 1981. 3 Fig, 2 Tab, 30 Ref.

Descriptors: *Bioassay, *Wastewater, *Echinoderms, Chlorination, Toxicity, *Seawater, Eggs, Fertilization.

Sea urchin sperm bioassay was used to assess the toxicity of a complex municipal wastewater and chlorinated seawater, and these results were compared with previous results obtained with fish. Green sea urchin or sand dollar sperm and eggs were exposed to chlorinated or unchlorinated primary sewage effluent or chlorinated seawater before fertilization of eggs. With 5-minute exposures to chlorinated sewage, eggs remained viable in up to 25% sewage while sperm viability decreased to 29% in 5% sewage and 0% in more than 10% sewage. Fertilization was successful after 5-minute exposures of the sperm to as much as 30% freshwater in seawater with a salinity of about 20 ppt, while sperm lost viability in 20% sewage/seawater dilutions. Fertilization success was reduced by 50% by 2.2% chlorinated or 4.8% unchlorinated sewage in seawater. Sea urchin and sand dollar sperm were more sensitive than marine fish sperm to sewage and chlorinated seawater. Tests with sperm cells require only short exposure times under static conditions, thus this bioassay technique may be useful to researchers. (Small-FRC)
W82-00988

DETERMINATION OF PICOGRAM AMOUNTS OF TECHNETIUM-99 BY RESIN BEAD MASS SPECTROMETRIC ISOTOPE DILUTION,
DuPont de Nemours (E. I.) and Co., Aiken, SC. Savannah River Lab.
T. J. Anderson, and R. L. Walker.
Analytical Chemistry, Vol 52, No 4, p 709-713, April, 1980. 3 Fig, 3 Tab, 25 Ref.

Descriptors: *Nuclear powerplants, *Isotope studies, *Mass spectrometry, Resins, Radioisotopes, *Pollutant identification, Chemical analysis.

Accumulation of large amounts of technetium-99, which is produced in high yields from the fission of uranium-235 and plutonium-239, can be expected to occur concurrent with energy production by atomic fission. The volatility of technetium-99 and its aqueous mobility in soil systems create the potential for escape to the environment. This paper reports the development of an improved isotope dilution mass spectrometric technique for the analysis of technetium-99 in environmental samples. Sequential ion-exchange chromatography and ion-association solvent extraction are used to isolate technetium from a sample spiked with technetium-97. The isolated technetium is concentrated onto a pair of anion exchange beads having a diameter of about 0.3 millimeters, which are then individually analyzed on the rhenium 'V' filaments of a surface-ionization mass spectrometer. The resin bead source provides an enhanced ionization efficiency capable of permitting determination of as little as 1 picogram of technetium. This technique was used for the analysis of several environmental samples from the vicinity of the Savannah River Plant, a nuclear materials production complex. These analyses showed that technetium-99 has high mobility in water-saturated soil and that technetium-99 concentrations in the seepage basins can be expected to vary substantially with reprocessing parameters. The contribution of technetium-99 to the Savannah river was assessed by comparing upstream and downstream samples and gave an annualized instantaneous release rate to the aqueous environment of 0.05 Ci/yr. (Carroll-FRC)
W82-00999

A RAPID SIMPLE LONG-TERM TOXICITY ASSAY FOR AQUATIC CONTAMINANTS USING THE NEMATODE PANAGRELLUS REDIVIVUS,
Manitoba Univ., Winnipeg. Dept. of Zoology.
M. R. Samoiloff, S. Schulz, Y. Jordan, K. Denich, and E. Arnott.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 7, p 1167-1174, July, 1980. 6 Tab, 10 Ref.

Descriptors: *Bioassays, *Water pollution effects, *Nematodes, Carcinogens, Aquatic animals, *Heavy metals, Toxicity, Pesticide toxicity, Pesticides, Physiological ecology, Water pollution, Assay, Bioindicators.

Two bioassay methods (one developmental, the other mutagenic) for determining the effects of aquatic environmental contaminants to the nematode Panagrellus redivivus are presented. The nematodes were tested with 15 known carcinogens or mutagens, 6 suspect carcinogens, and 7 heavy metals at levels of 0.01 to 1,000 micromoles/liter. An assay based on frequency of completion of postembryonic molts showed that 24 of the 28 test agents caused an increased mortality to P. redivivus. Twelve of the known carcinogens and one heavy metal caused lethal mutations in nematode chromosome assays. These assays are recommended for the detection of toxic effects to aquatic organisms due to chronic exposure to environmental water pollutants. (Geiger-FRC)
W82-01017

RELATION BETWEEN TROPHIC POSITION AND MERCURY ACCUMULATION AMONG FISHES FROM THE TONGUE RIVER RESERVOIR, MONTANA,
Montana Cooperative Fishery Research Unit, Bozeman.
G. R. Phillips, T. E. Lenhart, and R. W. Gregory.
Environmental Research, Vol 22, No 1, p 73-80, June, 1980. 3 Fig, 30 Ref.

Descriptors: *Reservoirs, *Fish, *Mercury, Toxicity, Accumulation, *Bioaccumulation, Methylmercury, Organic compounds, Mining industry, *Tongue River Reservoir, *Montana.

Fish were collected from the Tongue River Reservoir during spring and summer 1978 using trap nets or gill nets. Total mercury in fish was determined using an atomic absorption spectrophotometer. Mercury concentrations in muscle tissue from all five species of fish increased with fish length. This increase in contamination with increasing length is primarily a result of the long biological half-time of methylmercury in fishes. Male northern pike contained higher mercury concentrations than did females of similar length. This trend was a result of the slower growth of males relative to females. Mercury concentrations in some individuals of all species analyzed exceeded the FDA guideline. Maximum mercury concentrations in microgram mercury/gram observed were as follows: Northern pike 1.53, sauger 1.40, walleye 1.30, black crappie 0.64, and white crappie 0.60. Mercury concentrations in northern pike were particularly high, with 29% of the fish analyzed exceeding the FDA guidelines. Northern pike and saugers accumulated mercury nearly twice as fast as did the two species of crappie. The rate for walleyes was intermediate. It was concluded that planktivores derive most of their methylmercury body burden from water, but that piscivores receive a significant amount from both diet and water. (Baker-FRC)
W82-01041

DISPERSAL OF SALMONELLA FROM A POLLUTED STREAM TO NEIGHBORING TERRESTRIAL HABITATS,
Elmhurst Coll., IL. Dept. of Biology.
F. C. Mittermeyer, D. Cramer, and R. Ransford.
Journal of Environmental Science and Health, Part A, Vol 15, No 3, p 269-281, 1980. 1 Fig, 1 Tab, 8 Ref.

Descriptors: *Human diseases, *Salmonella, *Bacterial analysis, Rivers, Surface waters, Sediments, Shores, Shoreline cover, Soil analysis, Bacteria, River water, Water pollution sources, Path of pollutants, *Illinois.

Environmental samples were collected from the Fox River and adjacent areas in Kane County, Illinois. Seven sampling sites were chosen from within the suburban municipalities of St. Charles, Geneva, Batavia, and North Aurora. During the first four months of the study the greatest efficiency of Salmonella recovery was achieved using BPW pre-enrichment followed by enrichment in BGTET and subsequent plating onto Brilliant Green Agar. This procedure was used exclusively thereafter. Twenty-three percent of grass samples taken from the river's edge were positive for Salmonella. Grass samples taken more than 2 meters from the river were all negative. Soil samples taken from the top 10 cm of the ground about 3 meters from shoreline were usually negative. Salmonella heidelberg was the only serotype found in the sediment samples. Attempts to isolate Salmonella from surface swabs of picnic tables, trees, poles, bridges, and other surfaces within 15 meters of the river were unsuccessful. Some animals associated with the polluted river were found to be infected with Salmonella. However, general findings lead to the conclusion that the river is not an intensive Salmonella threat to humans, except perhaps those who directly contact the water. (Baker-FRC)
W82-01043

GIARDIA PREVALENCE IN COMMERCIALLY TRAPPED MAMMALS,
Washington State Dept. of Social and Health Services, Olympia. Office of Environmental Programs.
F. Frost, B. Plan, and B. Liechty.
Journal of Environmental Health, Vol 42, No 5, p 245-249, March/April, 1980. 5 Tab, 13 Ref.

Descriptors: *Water quality, *Drinking water, Giardia, Watersheds, Parasites, Potable water, *Contamination, Public health, Water pollution sources, Mammals, Protozoa, Chlorination, Beaver, Epidemiology, *Municipal water, Animal parasites.

Several recent outbreaks of giardiasis have been linked to the presence of Giardia in municipal water supplies. In most cases human or animal contamination of drinking water has been implicated. Since chlorine may not be effective in inactivating cysts, the risk of human infection through contaminated drinking water may be significant. Commercial trappers were recruited to provide stool samples from kill-trapped animals. During the three years of the study 704 fecal samples were examined. Parasites were found in all species of animals; however, only the beaver and muskrat harbored Giardia. The percentage of Giardia-positive animals increased each year, due to the detection of infected animals in previously negative counties and to a higher prevalence of Giardia infections in animals from previously positive counties. In the second and third years, Giardia prevalence in muskrats was higher than in beavers. The finding of infected animals in the Jones Creek/Boulder Creek, Cedar River and Green River watersheds suggests that beavers can maintain the infection independent of human involvement. This indicates that human sewage is not necessary to maintain infections among wild beaver. It also suggests that protected watersheds will not insure pathogen-free water. (Baker-FRC)
W82-01046

BIOLOGICAL TESTING METHODS - COMPLIANCE WITH HAZARDOUS WASTE REGULATION CHAPTER 173-302 WAC.
Washington State Dept. of Ecology, Olympia.
Document DOE 80-12, October, 1980. 24 p, 1 Fig, 3 Tab.

Descriptors: *Fishkill, *Waste characteristics, *Hazardous materials, *Waste identification, *Fish toxins, Fish populations, Testing procedures, Toxicity, Test facilities, Poisons, Mortality, Lethal limit, Laboratory animals, *Washington.

The purpose of Washington's acute fish toxicity test is to provide a simple, reliable, low-cost method for testing the toxicity of a material against the requirements of the Hazardous Waste Regulation, Chapter 173-302 WAC. The test method developed, described in Part A of the report, is strictly a range-finding test and does not determine the actual median lethal concentration, which is defined as the concentration of material that kills 50 percent of the population (fish) within 96 hours. The method, incorporating test organisms in holding tanks in a constant-temperature room or recirculating water batch, follows the requirements of Chapter 173-302 WAC, which states that if the toxicity is not known, the waste must be tested at two concentrations: 100 mg/l and 1000 mg/l. Wastes that are highly toxic and kill fish at 100 mg/l are considered extremely hazardous, while wastes that kill fish at 1000 mg/l are considered dangerous wastes. Part B of the report describes oral rat testing whose purpose is to determine the relative biological risk of potentially hazardous waste to man and wildlife. Male albino rats weighing 200-300 grams are used for test and control animals. Wastes are introduced into the stomachs by a tube. Ten rats are used at each dosage level, and ten rats for each positive control test. Oral rat tests are used whenever a generator does not characterize the toxicity of a waste because of a lack of knowledge of the chemical composition and presence of toxic constituents, a lack of knowledge of the biological hazards of toxic constituents or the waste as a whole, and/or the inability to book-designate a waste's biological toxicity. (Garrison-Omniplan)
W82-01071

DETERMINATION OF ALKALINE EARTH AND DIVALENT TRANSITION METAL CATIONS BY ION CHROMATOGRAPHY WITH SULFATE-SUPPRESSED BARIUM AND LEAD ELUENTS,
Brigham Young Univ., Provo, UT. Dept. of Chemistry.
F. R. Nordmeye, L. D. Hansen, D. J. Eatough, D. K. Rollins, and J. D. Lamb.
Analytical Chemistry, Vol 52, No 6, p 852-856, May, 1980. 2 Fig, 5 Tab, 8 Ref.

Descriptors: *Water analysis, *Metals, Magnesium, Calcium, Strontium, Iron, Manganese, Cobalt, Nickel, Copper, Zinc, Cadmium, Lakes, Ponds, Measuring instruments, *Chromatography.

The development of simple eluent-suppressor systems is reported. These systems allow the simultaneous ion chromatographic determination of Mg(2+), Ca(2+), and Sr(2+), and individual determinations of Mn(2+), Fe(2+), Co(2+), Ni(2+), Cu(2+), Zn(2+), and Cd(2+). Aqueous Ba(2+) and Pb(2+) which serve as eluting ions are suppressed as insoluble sulfates in a suppressor column initially loaded with SO4(2-). An H(+)-exchange postcolumn is placed between the suppressor and detector, serving to minimize the effect of pH on the conductometric base line and amplify divalent cation peak heights by a factor of about 5, thus greatly increasing the sensitivity of the technique. The major advantage of the method is the wide range of eluent pH which becomes available. Thus transition metal cations can be eluted in acidic solution without being exposed to a neutral or alkaline environment at any point in the system. Use of the ion chromatographic technique described for the analysis of Mg(2+) and Ca(2+) in pond water samples is described. The samples were analyzed both by ion chromatography using the 1 mM Ba (NO3)2 eluent at pH 4 with the post-column in line and by atomic absorption spectrometry. The results from the two techniques never differed by more than 3%. (Baker-FRC)
W82-01082

WATER HARDNESS DETERMINATION BY THE CATALYTIC POLAROGRAPHIC WAVE OF MAGNESIUM ION,
Foxboro Co., MA.
M. C. Cheney, D. J. Curran, and K.S. Fletcher, III.
Analytical Chemistry, Vol 52, No 6, p 942-945, May, 1980. 2 Fig, 1 Tab, 18 Ref.

Descriptors: *Water analysis, *Magnesium, Chemical analysis, *Hardness, Measuring instruments, Polarographic analysis, Chemical properties.

A water hardness measurement technique is presented which is based on the stoichiometric displacement of magnesium from its relatively weak EDTA complex by most divalent metal ions. Subsequent determination of free Mg(2+) using the catalytic wave that results when it is reduced at the dropping mercury electrode provides a substantial amplification effect. Though the relationship between observed catalytic current and concentration of Mg(2+) is linear over a relatively narrow range of concentration, the technique offers a rapid and sensitive method for determination of water hardness. Samples of tap water, well water, and an artificially prepared hard water containing 25.0 ppm Ca(2+) and 20.0 ppm Mg (2+) were analyzed by this method and by the standard EDTA titration method. Results were accurate to within 1% of the titration values and precision was on the order of 1%. (Baker-FRC)
W82-01083

DETERMINATION OF CHROMIUM SPECIATION IN NATURAL WATERS BY ELECTRODEPOSITION ON GRAPHITE TUBES FOR ELECTROTHERMAL ATOMIZATION,
Australian Atomic Energy Commission Research Establishment, Lucas Heights.
G. E. Batley, and J. P. Matousek.
Analytical Chemistry, Vol 52, No 11., p 1570-1574, September, 1980. 6 Fig, 1 Tab, 22 Ref.

Descriptors: *Natural waters, *Chromium, *Water analysis, Chemical analysis, Electrothermal atomization, Electrochemistry.

Studies of the electrodeposition-atomization technique and its potential for the analysis of chromium species in seawater are described. Matrix interferences can be overcome and preconcentration achieved by the electrodeposition of chromium with mercury onto pyrolytic graphite-coated tubular furnaces, using a flow-through assembly. At pH 4.7, using a desposition potential of -1.8 V vs. SCE, both Cr(VI) and Cr(III) are reduced and accumulated as metallic chromium. At the same pH, but at -0.3 V vs. SCE, only Cr(VI) is selectively reduced to Cr(III), which accumulates by adsorption. Using the labile-bound discrimination of the electrodeposition technique combined with an ultraviolet irradiation step, Cr(VI) was found to be dominant in the samples studied, with most Cr(VI) present as labile forms. (Baker-FRC)
W82-01084

ORGANIC MATRIX MODIFIERS FOR DIRECT GRAPHITE FURNACE ATOMIC ABSORPTION DETERMINATION OF CADMIUM IN SEAWATER,
National Research Council of Canada, Halifax (Nova Scotia). Atlantic Regional Lab.
R. Guevremont.
Analytical Chemistry, Vol 52, No 11, p 1574-1578, September, 1980. 3 Fig, 4 Tab, 17 Ref.

Descriptors: *Seawater, *Cadmium, Water analysis, Chemical analysis, Spectral analysis, Atomic absorption spectrometry, Reagent.

The application of citric acid, lactic acid, aspartic acid, histidine, and EDTA to direct graphite furnace analysis of cadmium in seawater is described. The agreement between analyses performed using the different reagents was very good. The application of EDTA gave results in good agreement with APDC/MIBK solvent extraction followed by graphite furnace atomic absorption and with ion exchange on Chelex-100 resin followed by isotope dilution spark source mass spectrometry. Citric acid appeared to be the most promising reagent used thus far. The sensitivity possible with this reagent is higher and the background interferences were small and easily controlled. The major difficulty with this reagent is the shortness of the atomic absorption signal. The lowest standard deviation in the measurement of cadmium in seawater was obtained using aspartic acid. In seawater this reagent had excellent sensitivity and low background absorbance. In deionized water, however, it did not promote low temperature atom production to the extent possible using citric acid or lactic acid. (Baker-FRC)
W82-01085

COMPARISON OF METHODS FOR THE DETERMINATION OF TRACE ELEMENTS IN SEAWATER,
National Research Council of Canada, Ottawa (Ontario). Div. of Chemistry.
R. E. Sturgeon, S. S. Berman, J. A. H. Desaulniers, A. P. Mykytiuk, and J. W. McLaren.
Analytical Chemistry, Vol 52, No 11, p 1585-1588, September, 1980. 3 Tab, 16 Ref.

Descriptors: *Seawater, *Chemical analysis, *Trace elements, Water analysis, Metals, Cadmium, Zinc, Lead, Iron, Manganese, Copper, Nickel, Cobalt, Chromium, Atomic absorption spectrometry, Emission spectroscopy, Ion exchange.

The analysis of coastal seawater for Cd, Zn, Pb, Fe, Mn, Cu, Ni, Co, and Cr was carried out using isotope dilution spark source mass spectrometry (IDSSMS), graphite-furnace atomic absorption spectrometry (GFAAS), and inductively coupled plasma emission spectrometry (ICPES) following trace metal separation-preconcentration using ion-exchange and chelation-solvent extraction, and direct analysis by GFAAS. Cu, Ni, Pb, Cr, and Co could not be measured by direct GFAAS in the stored seawater samples because of their inherently low concentrations and/or pronounced physicochemical matrix interference effects. Manganese

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could not be determined by ICPES using a 25-fold preconcentration of the trace elements, as their levels in such concentrates remain below values at which reliable analysis can be performed. Overall good agreement was obtained between the elemental values in relation to the method of analysis. The precision of replicate determination between methods for all elements is comparable. Complete analysis of each sample by all the methods indicated usually required about two months. The results of this study give confidence in the ability of the individual methods to give accurate analytical data and in the effectiveness of the standard addition approach in compensating for physicochemical interferences arising during sample preconcentration and instrumental analysis. (Baker-FRC)
W82-01086

ENTERIC VIRUSES IN RENOVATED WATER IN MANITOBA,
Cadham Provincial Lab., Winnipeg (Manitoba).
L. Sekla, W. Stackiw, C. Kay, and L. VanBuckenhout.
Canadian Journal of Microbiology, Vol 26, No 4, p 518-523, 1980. 4 Tab, 31 Ref.

Descriptors: *Viruses, *Wastewater renovation, Water reuse, Water shortage, Wastewater treatment, Drinking water, Potable water, Effluents, Rivers, Water analysis, *Manitoba, Canada.

This paper reports on procedures used in, and the findings obtained from, recovering enteric viruses from a Manitoban waterway system consisting of a sewage treatment plant, a river, and a water treatment plant. Both the liquid and the solid (sludge) components of sewage were sampled. The viruses isolated from raw sludge, sewage, final effluent, river water, and drinking water are listed. Of the 57 poliovirus isolates from sewage, 22 were tested and found to be vaccine strains. All three viruses isolated from the river were obtained from the same sample, collected at the middle of the river near the outlet of the sewage treatment plant in October of 1978. Thirteen of the isolates from drinking water were found on samples taken 2 days apart. The first 14 isolates found were confirmed as vaccine strains. This study has demonstrated the presence of enteric viruses in sewage and drinking waters, thus confirming the hypothesis that viruses can be recycled. The presence of enteric viruses in 61.8% of the sewage samples was expected. The presence of enteric viruses in 20.5% of the final sewage effluent samples was also expected. The recovery of enteric viruses from 6.75% of the drinking water samples is a matter of concern. All viruses so recovered were polioviruses, and thos tested were found to be vaccine strains, a sequel to the extensive immunization program carried out in Manitoba since 1962. (Baker-FRC)
W82-01090

MULTIELEMENT PRECONCENTRATION OF TRACE HEAVY METALS IN WATER BY COPRECIPITATION AND FLOTATION WITH INDIUM HYDROXIDE FOR INDUCTIVELY COUPLED PLASMA-ATOMIC EMISSION SPECTROMETRY,
Nagoya Univ. (Japan).
M. Miraide, T. Ito, M. Baba, H. Kawaguchi, and A. Mizuike.
Analytical Chemistry, Vol 52, No 6, p 804-807, May, 1980. 2 Fig, 4 Tab, 3 Ref.

Descriptors: *Heavy metals, *Water analysis, Measuring instruments, Chemical analysis, Chromium, Manganese, Nickel, Cobalt, Cadmium, Lead, Spectrometers, Spectral analysis, Analytical techniques.

Microgram quantities of Cr(III), Mn(II), Co, Ni, Cu(II), Cd, and Pb in 1200-ml samples were quantitatively coprecipitated with indium hydroxide at a pH of 9.5. After adding ethanolic solutions of sodium oleate and dodecyl sulfate, the precipitates are floated with numerous tiny nitrogen bubbles to the solution surface, and then collected in a small sampling tube. The procedure is simple and rapid, and suitable for operation at sampling spots. The heavy metals in the dissolved precipitates are determined by inductively coupled plasma-atomic emission spectrometry. The concentrations of the heavy metals are increased 240-fold, and those of alkali and alkaline earth metals in artificial seawater are reduced to 1/50-1/20 for sodium and potassium, and about 1/2 for magnesium, calcium, and strontium. Heavy metals at the low microgram/liter level in water or artificial seawater were simultaneously preconcentrated and determined by this procedure. The time required for preconcentration was about 40 minutes. (Baker-FRC)
W82-01097

DETERMINATION OF MOLYBDENUM IN SEA AND ESTUARINE WATER WITH BETA-NAPHTHOIN OXIME AND NEUTRON ACTIVATION,
Dalhousie University, Halifax (Nova Scotia). Dept. of Chemistry.
A. I. Kulathilake, and A. Chatt.
Analytical Chemistry, Vol 52, No 6, p 828-833, May, 1980. 1 Fig, 9 Tab, 53 Ref.

Descriptors: *Water analysis, *Molybdenum, Chemical analysis, Seawater, Neutron activation analysis, Estuaries, Trace elements, Heavy metals.

An analytical method for the determination of trace quantities of molybdenum in sea and estuarine water employing neutron activation analysis preceded by preconcentration of the element using beta-naphthoin oxime is presented. Radioactive tracers were used to investigate the various factors which can influence the sensitivity of the method. Concentrations of sodium, chlorine, and bromine in untreated seawater and cocrystallized product have been compared for evaluating the ability of beta-naphthoin oxime to reduce interferences from these three elements. Selectivity of beta-naphthoin oxime in preconcentrating molybdenum was studied using two diverse matrices, seawater and steel, which are known to contain several elements at drastically different concentrations. Molybdenum concentrations in samples of sea and estuarine water were determined with good precision and accuracy by this method. Beta-naphthoin oxime was found to be superior to alpha-benzoin oxime in selectively cocrystallizing molybdenum quantiatively from water. Detection limits were such that small amounts of molybdenum could be measured in the presence of large quantities of interfering elements. (Baker-FRC)
W82-01098

AMMONIA ELECTRODE WITH IMMOBILIZED NITRIFYING BACTERIA,
Akinomoto Co., Inc., Kawasaki (Japan). Central Research Lab.
M. Hikuma, T. Kubo, T. Yasuda, I. Karube, and S. Suzuki.
Analytical Chemistry, Vol 52, No 7, p 1020-1024, June, 1980. 7 Fig, 5 Tab, 11 Ref.

Descriptors: *Wastewater analysis, *Ammonia, Water analysis, Measuring instruments, Industrial wastes, Electrodes, Chemical analysis.

Nitrifying bacteria were immobilized by being entrapped between two membranes, a porous acetylcellulose membrane and the Teflon membrane of an oxygen electrode. This microbial sensor was then applied to the determination of ammonia in wastewaters. When a sample solution was pumped into the flow system of the sensor, the electrode current decreased to a steady state after 8 minutes. Measurement could be also made with a 3-minute pumping period with little loss of sensitivity. The calibration plot of the current difference vs. concentration of ammonia was linear up to 1.3 mg/liter. The sensor was applied to the determination of ammonia in wastewaters of a fermentation factory. The concentration of ammonia and the biological oxygen demand (BOD) of the sample solutions were determined by the distillation acidimetry and Japanese Industrial Standard methods, respectively. Good agreement was obtained between the ammonia concentration determined by the conventional method and that obtained by the microbial sensor. The relative difference betweeb the two methods was less than 6%. The results were not affected by organic compounds. The microbial sensor could be used for more than two weeks and 1400 assays. The electrode current difference decreased gradually, necessitating occasional recalibration of the electrode. (Baker-FRC)
W82-01099

DETERMINATION OF NICKEL BY DIFFERENTIAL PULSE POLAROGRAPHY AT A DROPPING MERCURY ELECTRODE,
Laurentian Univ., Sudbury (Ontario). Dept. of Chemistry.
C. J. Flora, and E. Nieboer.
Analytical Chemistry, Vol 52, No 7, p 1013-1020, June, 1980. 4 Fig, 5 Tab, 49 Ref.

Descriptors: *Water analysis, *Nickel, Metals, Chemical analysis, Polarographic analysis, Lakes, Drinking water, Potable water, Pollutant identification.

The use of differential pulse polarography (DPP) in the analysis of nickel was examined. The detection limit of the method of 2 ppb with a confidence interval of 95% and observed standard deviations of the same magnitude for the DMG-sensitized procedure are all comparable to those possible with modern electrothermal AA of nickel. Detection limits and precision are virtually limited by the ability to avoid contamination. The proposed DPP methods are well suited to the routine analysis of water and other aqueous samples. Especially advantageous is the flexibility to extend the analytical concentration range from ng/ml. The advent of the laboratory minicomputer should also lead to many innovations and improved performances with this method. In an analysis of Sudbury Lake and tap water, agreement between DPP and AA results are excellent for the July 7, 1978 data and somewhat less satisfactory for the data from the remaining time of experimentation. The DPP analysis requires no pretreatment of the water samples and is an extremely rapid, sensitive, reproducible, and convenient method conducting water analyses. The high contents of nickel found in Sudbury tap and lake water may be related to nickel emissions associated with local smelting and refining of the metal. (Baker-FRC)
W82-01100

5B. Sources Of Pollution

ANTHROPOGENIC TRACE ELEMENTS AND POLYCYCLIC AROMATIC HYDROCARBON LEVELS IN SEDIMENT CORES FROM TWO LAKES IN THE ADIRONDACK ACID LAKE REGION,
Department of Energy, NY. Environmental Measurements Lab.
M. Heit, Y. Tan, C. Klusek, and J. C. Burke.
Water, Air, and Soil Pollution, Vol 15, No 4, p 441-464, May, 1981. 2 Fig, 11 Tab, 37 Ref.

Descriptors: *Sediments, *Lakes, *Pollution load, Metals, Aromatic compounds, Hydrocarbons, *Acid rain, Acidic water, *Adirondacks, Sagamore Lake, Woods Lake, *New York, Sivter, Aluminum, Arsenic, Beryllium, Cadmium, Chromium, Copper, Mercury, Nickel, Lead, Tin, Vanadium, Zinc, Selenium, Thallium, Perylene.

The degree to which anthropogenic trace elements and polycyclic aromatic hydrocarbons have been deposited in remote lakes known to be affected by acid rainfall was investigated. The lakes investigated are located in the Adirondack State Park on the western slope of the Adirondack Mountains. Sagamore Lake is a brown water lake due to high levels of humic materials, while Woods Lake is generally clear. Sediment cores were taken from each of the lakes during March 1978. Several conclusions were reached. Except for perylene, the prime source of all parental PAHs measured and the majority of trace elements appears to be combustion. All combustion products had primarily an anthropogenic origin. Levels of all parental PAHs except perylene and levels of several of the metals significantly increased in the surface sediments of both lakes compared to their background concentrations. PAH concentrations in Woods Lake were quite high, approaching levels reported for more heavily

populated and industrialized areas. Metals were present at 3-4 times higher concentrations in Woods Lake than in Sagamore Lake. Metals and PAH levels decreased in concentration with depth to background levels in both lakes. This baseline depth corresponded to about 30 years ago. Lead has increased to the greatest extent of any of the metals considered relative to their baseline quality. Long distance atmospheric transport and region-wide deposition of anthropogenically derived elements and PAHs into these remote lakes appears to be more significant than input from local sources. (Baker-FRC)
W82-00501

RELATIONSHIPS BETWEEN SULFATE AND NITRATE ION CONCENTRATIONS AND RAINFALL PH FOR USE IN MODELING APPLICATIONS,
Battelle Pacific Northwest Lab., Richland, WA. Atmospheric Sciences Dept.
D. J. McNaughton.
Atmospheric Environment, Vol 15, No 6, p 1075-1079, 1981. 4 Fig, 2 Tab, 8 Ref.

Descriptors: *Acid rain, *Sulfates, *Nitrates, Mathematical modeling, Hydrogen ion concentration, Acidity, Air pollution effects, Anions, Rainfall, Water pollution sources.

Precipitation chemistry data for the northeastern United States were analyzed to test relationships between anthropogenic sulfate and nitrate ion contributions and rainfall pH. The data set incorporated all observations, with complete measurements of all three ion concentrations being collected from September 1976 through December 1979. A relationship was found between sulfates and nitrates and rainfall acidity expressed in terms of pH, and this relationship can be applied to deposition predictions to predict pH from regional air pollutant transport models. Variance in the pH versus ion relationships can be explained by the sulfate ion concentration alone. Thus, rainfall acidity patterns could be approximated by sulfate deposition patterns alone in cases where relative levels of nitrate ions and sulfate ions in the atmosphere are the same as those that influence precipitation. The analysis was based on the assumption that the predominant anions are anthropogenic, and this assumption could lead to an overprediction of rainfall acidity. (Small-FRC)
W82-00507

THE BREAKDOWN OF POULTRY MANURE AGGREGATES BY RAINFALL IMPACT,
Science and Education Administration, Ithaca, NY.
R. E. Muck, and D. C. Ludington.
Journal of Environmental Quality, Vol 9, No 1, p 61-65, January-March, 1980. 6 Fig, 3 Tab, 12 Ref.

Descriptors: *Manure, *Rainfall impact, Rainfall rate, Land disposal, Simulated rainfall, *Poultry, Nitrogen, Phosphorus, *Leaching, Kinetic energy, Poultry manure.

The effects of rainfall characteristics on the breakdown of dry poultry manure aggregates were investigated, and the effects of aggregate breakdown on the leaching of N and P from poultry manure were demonstrated. Simulated rainfall was used to determine the effects of rainfall intensity, duration, drop velocity, and drop size. Aggregate breakdown was an exponential function of rainfall amount for a constant drop velocity and size. Rainfall energy and momentum both explained the aggregate breakdown results for a constant drop size. As drop size increased, aggregate breakdown seemed to increase, but these results were not statistically significant. Aggregate breakdown caused increases in the leaching of nitrogen and phosphorus from the manure. With a 4 hr, 5.08 cm/hr simulated rainfall, aggregate breakdown accounted for a 70% increase in leaching losses from the manure. Thus, the type of crop cover on which manure is spread may affect nutrient losses due to rainfall. For example, hay would intercept the rainfall before it hit the manure and thus would reduce aggregate breakdown by rainfall. (Small-FRC)
W82-00513

DYE-SENSITIZED PHOTOOXIDATION OF BROMACIL IN WATER,
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Div. of Soil Residues Chemistry.
A. J. Acher, and S. Saltzman.
Journal of Environmental Quality, Vol 9, No 2, p 190-194, April-June, 1980. 3 Fig, 2 Tab, 17 Ref.

Descriptors: *Bromacil, *Degradation, *Dyes, Pesticide residues, *Herbicides, Photodegradation, Chemical reactions, Solar radiation, Irradiation, *Fate of pollutants.

To study its fate in aquatic systems, the herbicide bromacil (3-sec-butyl-5-bromo-6-methyl uracil) in aqueous solution (250 ppm) was exposed to direct solar radiation in the presence of dye sensitizers at appropriate pH. The herbicide rapidly and completely photodegraded via a debromination mechanism to 3-sec-butyl-2-acetyl-2-hydroxy hydantoin, the major product (97-98%), and the 5,5'-dimer of 3-sec-butyl-6-methyl uracil, a minor product (1-2%). Unidentified polar compounds were formed upon continued degradation. The most effective dye sensitizers were riboflavin (10 ppm) and methylene blue (2-5 ppm). Less effective sensitizers were rose bengal (5 ppm), humic acids (20 ppm), and chlorophyll (20 ppm). The reaction proceeded more rapidly at alkaline pH. With sensitizers and a reaction time of 30 min, no degradation occurred at less than pH 5, 10% at pH 7, 20% at pH 8, and 80% at pH 10. The effects of suspended solids, often found in natural waters, were tested. An anion exchange resin partially inhibited degradation, and bentonite strongly inhibited degradation. Under optimal conditions (effective sensitizer, high pH, no suspended solids) photooxidation to the intermediate products was complete within 1 hour. (Cassar-FRC)
W82-00514

ACID RAIN AT KENNEDY SPACE CENTER, FLORIDA: RECENT OBSERVATIONS,
University of Central Florida, Orlando. Dept. of Chemistry.
B. C. Madsen.
Atmospheric Environment, Vol 15, No 5, p 853-862, May, 1981. 7 Fig, 6 Tab, 15 Ref.

Descriptors: *Acid rain, *Kennedy Space Center, *Florida, Rainfall, Air pollution, Fallout, Water pollution sources, Hydrochloric acid, Sulfuric acid, Nitric acid.

Precipitation samples were collected in automated samplers designed to prevent both dry deposition and evaporation. Determinations of major cation and anion concentrations were made within 10 days after sample collection. All sampling sites were on or near the Kennedy Space Center complex in Florida. In general, summertime acidity was greater than during other times of the year. Maximum free acidity was observed during July in both 1978 and 1979. The July rainfall accounted for 21 and 10% of the total amounts received during the respective years. Lowest acidities were noted in November 1977 and April 1979. No pattern was noted when rain composition from a specific month during the first year of the study was compared to the identical time in the following year. The presence of sulfate ion can be attributed primarily to non-marine sources. Monthly and annual deposition of components which will be important if changes in rain composition occur due to future SRM launches are presented. Free acidity, nitrate ion and excess sulfate ion deposition account for the present acid loading, while chloride ion deposition reflects the influence of the marine environment. Monthly weighted average chloride ion concentrations ranged from 20 to 240 micromole/liter. The chloride: sodium ion ratio was slightly lower than that present in sea water. (Baker-FRC)
W82-00533

AQUASOLS: THE BEHAVIOR OF SMALL PARTICLES IN AQUATIC SYSTEMS,
Johns Hopkins Univ., Baltimore, MD.
For primary bibliographic entry see Field 1B.
W82-00540

PARTITIONING OF NO. 2 FUEL OIL IN CONTROLLED ESTUARINE ECOSYSTEMS. SEDIMENTS AND SUSPENDED PARTICULATE MATTER,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
For primary bibliographic entry see Field 2L.
W82-00541

TRACE ELEMENT CONCENTRATIONS OVER MIDLAKE MICHIGAN AS A FUNCTION OF METEOROLOGY AND SOURCE REGION,
Governors State Univ., Park Forest South, IL. Coll. of Environmental and Applied Sciences.
H. Sievering, M. Dave, D. Dolske, and P. McCoy.
Atmospheric Environment, Vol 14, No 1, p 39-53, January, 1980. 7 Fig, 12 Tab, 21 Ref.

Descriptors: *Trace elements, *Air pollution, *Aerosols, Heavy metals, Metals, Lakes, *Lake Michigan, Water pollution sources, Path of pollutants, Wind, Air-water interfaces.

Aerosol samples were collected during May-September 1977 over southern Lake Michigan. This location, 87 degrees west and 42 degrees north, is in midlake, 40 to 100 km removed from any shoreline aerosol sources. The samples were analyzed for Pb, Zn, Mn, Mo, Fe, Ti, Al, Ca, and Mg. Micro- and meso-meteorological conditions were recorded. Several general conclusions were derived. Midlake metal concentration variabilities are linearly independent of wind speed and strongly and directly dependent on temperature stability of the surface layer, defined as the lowest few meters of air above the lake surface. Midlake mass concentration variability is more dependent on fine particulate aerosols with high Pb, Zn, and Mn content than on the coarse particulate fraction. Temperature stability of the surface air layer is more important than sedimentation and aerosol aging in terms of aerosol concentration variability within that layer. Midlake metal concentrations are more dependent on nearshore sources than on long range transport. The largest amount of Pb (95%), Zn and Mn (75%), and Fe (over 50%) present in the midlake atmospheric surface layer is probably anthropogenic in origin. (Cassar-FRC)
W82-00550

GROUNDWATER CONTAMINANT TRANSPORT WITH ADSORPTION AND ION EXCHANGE CHEMISTRY: METHOD OF CHARACTERISTICS FOR THE CASE WITHOUT DISPERSION,
Texas Univ. at Austin. Dept. of Civil Engineering.
R. J. Charbeneau.
Water Resources Research, Vol 17, No 3, p 705-713, June, 1981. 6 Fig, 2 Tab, 12 Ref.

Descriptors: *Solute transport, *Adsorption, *Ion exchange, *Leaching, Ion transport, Groundwater movement, Uranium, Mining engineering, Path of pollutants, Ammonia, Organic compounds.

Contaminant transport involves not only the movement of a pollutant away from a waste disposal site or the fate of constituents in recharge water, but also site restoration problems caused by emerging technologies such as in situ leach mining for uranium and in situ gasification of lignite. This paper concerns adsorption and ion exchange reactions in the absence of dispersion. The method of characteristics is used to formulate the solution for any adsorption isotherm and an arbitrary number of exchanging cations. It is applicable to linear flow systems and to nonlinear systems along streamlines in a nonuniform field. With 2 exchanging cations the complete solution may be obtained by graphical means; when there are more than 2, a computer is required to solve the problem. The first example illustrates migration of organics using the nonlinear Freundlich isotherm for adsorption of organics on lignite. The second concerns the volume of water required to restore a uranium mining site by sweeping out residual ammonia and other contaminants. (Cassar-FRC)
W82-00551

MODELING OF PROCESSES OF DECOMPOSITION OF ORGANIC MATTER IN BOTTOM SEDIMENTS,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
Ya. L. Fuksman.
Water Resources (English Translation), Vol 7, No 5, p 442-450, September/October, 1980. 6 Fig, 8 Ref. Translated from Vodnye Resursy, No 5, p 118-129, September/October, 1980.

Descriptors: *Mathematical models, *Decomposing organic matter, *Bottom sediments, Sediments, Organic matter, Decomposition, Mathematical equations, Mineralization, Fate of pollutants.

Although the decomposition of organic substances directly affects water quality, the mathematical description of this process is currently accomplished using rather simple models interpreting the general character of phenomena observed during the decomposition process. This paper discusses a more detailed mathematical model of biochemical processes of mineralization of organic matter with respect to bottom sediments. The systems of differential equations presented were developed on the basis of the energy balance in the heterotrophic population of bacteria. Nearly all of the parameters-constants used in the model have a definite thermodynamic or physiological significance. A flow of particles of detritus is produced by the dying phytoplankton. The amount of detritus is expressed by the weight of some biogenic element in the detritus, the cycle of which in the water body is being modeled. The biomasses of both aerobic and anaerobic bacteria are also phase variables in the model. Systems of differential equations for modeling anaerobic bacteria in an oxygen-free regime, anaerobic populations in the presence of oxygen, and populations of aerobic bacteria in the absence of anaerobic bacteria are presented. A model of the dynamics of an ecosystem with two populations is then developed which is composed of the model for the dynamics of the anaerobic population in the presence of oxygen and the model for the dynamics for the population of aerobes. (Carroll-FRC)
W82-00553

TRACE ELEMENT INPUTS FROM A COAL BURNING POWER PLANT TO ADJACENT TERRESTRIAL AND AQUATIC ENVIRONMENTS,
Savannah River Ecology Lab., Aiken, SC.
D. W. Evans, J. G. Wiener, and J. H. Horton.
Journal of the Air Pollution Control Association, Vol 30, No 5, p 567-573, May, 1980. 4 Fig, 4 Tab, 25 Ref.

Descriptors: *Powerplants, *Water pollution, *Trace elements, Coal, Plumes, Coal fuel, Fallout, Air pollution, Rainfall, Fly ash.

Levels of trace elements derived from coal ash were investigated in terrestrial and aquatic samples near an 83 MW coal burning power plant. Comparisons were made between the trace elements arising through aerial deposition during 23 years prior to the installation of electrostatic precipitators and aquatic inputs from ash disposal basins after installation. A guassian plume model was used to predict deposition patterns of 29 trace elements in coal ash around the power plant. Detectable increases were noted in Sr, As, Sb, and Be in surface soils within 3 km of the power plant. Concentrations measured in surface soils were largely consistent with the predictions. Measurements of aerial deposition of Cd, Pb, Cu, and Mn at a site 5.5 km distant were similar to those in other rural areas and indicated that little of the measured Cd, Cu, Mn, or Pb was derived from fly ash. Concentrations of 12 heavy metals in effluents from the basin receiving ash were comparable to those predicted in rainfall deposited nearest the plant. It was concluded that at other coal combustion facilities, basin disposal could be a more serious contamination threat to aquatic environments than aerial dispersal of ash. (Baker-FRC)
W82-00557

RESIDUES OF NONYLPHENOL IN SPRUCE FOLIAGE, FOREST SOIL, STREAM WATER AND SEDIMENT AFTER ITS AERIAL APPLICATION,
Forest Pest Management Inst., Sault Ste Marie (Ontario).
K. M. S. Sundaram, S. Szeto, R. Hindle, and D. MacTavish.
Journal of Environmental Science and Health, Part B, Vol 15, No 4, p 403-419, 1980. 1 Fig, 3 Tab, 9 Ref.

Descriptors: *Phenolic pesticides, *Pesticide residues, *Stream pollution, Insecticides, Water pollution, Spruce trees, Conifers, Trees, Forest soils, Sediments, Nonylphenol.

The residues of nonylphenol, a major component of the Matacil (aminocarb) formulation, were measured in a variety of natural features following aerial application of a mixture of this chemical and insecticide diluent 585 at a rate of 0.47 liters per hectare to a mixed coniferous forest in Ontario. Nonylphenol residues were found in water from the forest stream one hour after application of the insecticide to the forest and up to five days after application. The highest concentration, 9.1 ppb, which was detected one hour after spraying, decreased to trace levels of less than 2.0 ppb after 6 hours, indicating a half-life of about 2.5 hours. Water samples taken from a stagnant area of the stream showed concentrations of 1,100 ppb 4 hours after spraying, decreasing to 110 ppb in the next 2 hours, to 12 ppb within 24 hours, and to less than 1.0 ppb after 3 days. Dilution by water flow probably accounts for most of the rapid dissipation of nonylphenol residues in the stream water, while surface evaporation and co-distribution may also have been contributing factors. Residues in white spruce foliage decreased from 18.90 ppm 1 hour after spraying to about 11.34 ppm after 3 hours and to less than 0.20 ppm after 62 days. Analyses of forest soil samples collected after spraying resulted in no detections of residues. Trace levels of nonylphenol were found in only one sediment sample collected 4 hours after spraying. These data indicate that very little residue would be present in forest soil and that residues in foliage, stream water, and sediment would be non-persistent following application of nonylphenol at a rate equivalent to the seasonal allowable maximum. (Carroll-FRC)
W82-00559

ESTIMATION OF THE SALT BURDEN OF IRRIGATION DRAINAGE WATERS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
W. A. Jury, and P. F. Pratt.
Journal of Environmental Quality, Vol 9, No 1, p 141-146, January-March, 1980. 5 Fig, 5 Tab, 10 Ref.

Descriptors: *Mathematical models, *Salts, *Irrigation water, Irrigation effects, Water pollution sources, Mathematical studies, Water analysis, Path of pollutants.

The effectiveness of several different models for the prediction of important interactions which govern the salt movement process through soil was evaluated. The three models used to predict salt concentration and mass emissions below irrigated fields included a proportional model, a steady-state model, and a dynamic model. The proportional model overestimated the salt burden for waters which tend to precipitate calcium salts and underestimated the salt burden of waters which tend to dissolve soil CaCO3. The steady-state model predicted a greater tendency toward mineral dissolution than occurs when ion exchange is considered, but it calculated a more accurate salt balance than did the proportional model. The proportional model characterized irrigation management in terms of an average ratio of drainage volume to irrigation volume (leaching fraction, LF). When the saline irrigation water had LF=0.1, the steady-state model mass emission prediction was 22% less and the transient model prediction was 36% less than the estimates of the proportional model. When the irrigation water was of high quality (LF=0.4), the predictions of the two models were 198 and 201% higher, respectively, than the predictions of the proportional model. (Small-FRC)
W82-00563

DISTRIBUTION OF SILVEX, 2,4-D, AND TCDD APPLIED TO TURF IN CHAMBERS AND FIELD PLOTS,
Science and Education Administration, Beltsville, MD. Pesticide Degradation Lab.
R. G. Nash, and M. L. Beall, Jr.
Journal of Agricultural and Food Chemistry, Vol 28, No 3, p 614-623, May/June, 1980. 3 Fig, 10 Tab, 18 Ref.

Descriptors: *Leachates, *Organic compounds, Leaching, Infiltration, Percolation, *Path of pollutants, *Agricultural chemicals, Pesticides, Herbicides, Silvex, 2,4-D, Dioxins, TCDD, Residues, Water pollution.

The fate of 2,4-D, silvex, and TCDD applied to bluegrass turf was examined in four components, soil, grass, water, and air, of microagroecosystem chambers. Concentrations employed were as follows: 1.3 kg of granular 2,4-D per hectare, 2.8 kg granular and 2.0 kg emulsifiable silvex per hectare. A high-activity radiolabeled preparation of the possible toxic trace contaminant of silvex, TCDD, was added. Residue half-times for silvex on soil were 35 days for both formulations and 10 days for granular 2,4-D. TCDD concentrations in leachate water were less than 10 to the minus 16th power and 10 to the minus 13th power g/g water after silvex applications containing 44 ppb and 7.5 ppm TCDD, respectively. Silvex and 2,4-D concentrations were in the microgram/liter range as leachates and decreased with time. TCDD concentrations were less than 0.1 pg/liter. The TCDD concentration in the leachate seemed to increase with time, peaked on day 126, and then decreased to less than 10 pg/liter by day 275. The half-life values for leachate water, with high correlation coefficients, were about 10 days for both formulations of silvex and 6.5 days for the granular 2,4-D. After day 126, the half-life values for TCDD were 65 and 57 days for the emulsifiable concentrate and granular formulations, respectively. (Baker-FRC)
W82-00568

RESIDUES OF ISOBORNYL THIOCYANOACETATE (THANITE) AND A METABOLITE IN FISH AND TREATED PONDS,
National Fishery Research Lab., La Crosse, WI.
J. L. Allen, J. B. Sills, V. K. Dawson, and R. T. Amel.
Journal of Agricultural and Food Chemistry, Vol 29, No 3, p 634-636, 1981. 3 Tab, 9 Ref.

Descriptors: *Ponds, *Fish, *Insecticides, Carp, Bass, Metabolites, Sublethal effects, Thanite, Pesticide residues, Fate of pollutants.

The insecticide isobornyl thiocyanoacetate (Thanite) induces a surfacing response in fish, which may permit live collection of fish. However, there are no data on residues of the insecticide in fish exposed to the chemical nor on the persistence of Thanite in the aquatic environment. Only a trace of the parent compound was found in carp and largemouth bass exposed to Thanite at 1 mg/liter in the laboratory. A metabolite, isobornyl alpha-(methylthio)-acetate, was isolated and identified by gas chromatography-mass spectroscopy, and a reference standard for the metabolite was synthesized. Residues of the metabolite were found in the muscle tissue of largemouth bass and in the muscle tissue, blood plasma, and bile of carp within one hour after exposure to Thanite. Residues of the metabolite decreased to undetectable levels within 24 hours of withdrawal from water containing Thanite for the bass and within 48 hours for the carp. Residues of Thanite were detectable in water and soil samples from experimental ponds up to 14 days after treatment at 0.4 mg/liter, but not at 21 days after treatment, while algae samples contained detectable levels of Thanite in the 21-day samples but not at 28 days. The metabolite found in the bass and carp was not found in samples of water, soil, or algae. The results demonstrate that Thanite is rapidly metabolized and eliminated by fish and does not persist in a pond environment beyond 3 weeks. (Carroll-FRC)
W82-00570

WATER-TO-AIR FRACTIONATION OF BACTERIA,

Florida State Univ., Tallahassee. Oceanography Dept.
T. W. Hejkal, P. A. LaRock, and J. W. Winchester.
Applied and Environmental Microbiology, Vol 39, No 2, p 335-338, February, 1980. 4 Fig, 17 Ref.

Descriptors: *Bacteria, *Air-water interfaces, Interfaces, Escherichia coli, Serratia marinorubra, Micrococcus euryhalis, Pseudomonas bathycetes, Bacillus subtilis, Water treatment facilities, Wastewater treatment, Spray irrigation, Human disease, *Path of pollutants.

An attempt was made to determine the quantitative differences among several bacterial species in their abilities to be ejected into the atmosphere by bubbles rising through water and bursting at the air-water interface. Three species of marine bacteria, Serratia marinorubra, Pseudomonas bathycetes, and Micrococcus euryhalis, were tested for their ability to be aerosolized. Bubbles were generated in suspensions of mixed bacterial cultures, and the concentration was measured for each species in the top jet drop ejected. This concentration, divided by the concentration in the bulk menstruum, is the concentration factor (CF). Bubbles were generated 2 cm below the liquid surface, and jet drops with diameters from 34 to 136 micrometers were studied. S. marinorubra and M. euryhalis had CFs which were generally 10 to 100 times greater than those of Escherichia coli, P. bathycetes, and spores of Bacillus subtilis. P. bathycetes never had a CF significantly greater than 1 at any drop size, and spores of B. subtilis had a maximum CF of 4. E. coli had a maximum CF of 6 to 1- or 2-day old cultures, but this increased to 80 when a 5 day old culture was used. This change in the CF with age of the cells indicates that composition of the cell may be a factor influencing its ability to concentrate in jet drops. (Baker-FRC)
W82-00575

UTILIZATION OF DICHLOROMETHANE BY SUSPENDED AND FIXED-FILM BACTERIA,
Stanford Univ., CA. Dept. of Civil Engineering.
B. E. Rittmann, and P. L. McCarty.
Applied and Environmental Microbiology, Vol 39, No 6, p 1225-1226, June, 1980. 2 Fig, 8 Ref.

Descriptors: *Bacteria, *Effluents, *Dichloromethane, Biodegradation, Industrial wastes, Wastewater, Growth, Organic compounds, Fate of pollutants.

The biodegradation of dichloromethane, a commonly used solvent ubiquitous in aqueous environments, is described and evidence that the chemical will support bacterial growth is offered. Bacterial cultures were enriched from a seed of primary sewage effluent over a 12 month period. Several enrichment cultures, having different bacterial densities, were developed. It was noted that culture turbidity changes and dichloromethane utilization were not significant if bicarbonate was omitted from the mineral medium. The enriched bacteria were predominately gram-negative, motile rods. Batch, suspended-growth and biofilm experiments were performed to demonstrate dichloromethane utilization. The biological utilization of dichloromethane at 1-25 mg/liter by suspended bacteria was readily apparent. Since neither carbon dioxide evolution nor intermediates were measured, it was not possible to state whether dichloromethane was completely mineralized or by what pathway it was metabolized. Even so the study shows that dichloromethane can be used as an energy source without serving as a cometabolite. Although not conclusive, the fact that suspended growth was reduced when bicarbonate was omitted from the mineral medium suggest that the autotrophic pathway was used. (Baker-FRC)
W82-00577

MICROBIAL METABOLISM OF N-NITROSODIETHANOLAMINE IN LAKE WATER AND SEWAGE,
Cornell Univ., Ithaca, NY. Soil Microbiology Lab.
For primary bibliographic entry see Field 2H.
W82-00585

MOVEMENT OF ENDOTOXIN THROUGH SOIL COLUMNS,
Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
S. M. Goyal, C. P. Gerba, and J. C. Lance.
Applied and Environmental Microbiology, Vol 39, No 3, p 544-547, March, 1980. 1 Fig, 2 Tab, 18 Ref.

Descriptors: *Endotoxin, *Groundwater pollution, Rainfall, Percolation, *Land disposal, *Bacteria, Wastewater disposal, Waste disposal, Adsorption, Toxins, Soil contamination.

The possible removal of endotoxin during land treatment and the chance that endotoxin can reach groundwater after land application of wastewater were investigated. The movement of endotoxin through soil columns was studied under laboratory conditions. A 10 cm diameter polyvinyl chloride pipe was packed with loamy sand from the dry Salt River bed located near Phoenix, Arizona. Either 100 or 250-cm long soil columns were employed. While it was determined that endotoxin is removed by the soil, it was noted that endotoxin-containing sewage must travel longer distances than virus-containing sewage before any appreciable removal occurs. Free endotoxin is refractory to adsorption by granulated activated-carbon columns, whereas 83% of bound endotoxin is removed by passage through two granulated activated-carbon columns in series. Thus, there is a potential for some endotoxin contamination of groundwater if the aquifer is shallow. When a simulated rainfall was applied to the columns in which the endotoxin had been adsorbed, the endotoxin concentration moved through the soil as a concentrated band. Thus it appears that rainwater can desorb endotoxin from soil and that travel of endotoxin to groundwater is a distinct possibility. In field studies, two land treatment sites were sampled to compare the amount of endotoxin in the sewage being applied and that present in groundwater samples. At Lubbock, Texas, 600 to 6000 ng of endotoxin per ml was found in the sewage, and 0.6 to 480 ng/ml in the groundwater. At Fort Devens, 300 ng of endotoxin per ml was in the sewage, and 0.3 to 30 ng/ml in the groundwater. (Baker-FRC)
W82-00586

DYNAMICS OF SELENIUM IN MERCURY-CONTAMINATED EXPERIMENTAL FRESHWATER ECOSYSTEMS,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
J. W. M. Rudd, M. A. Turner, B. E. Townsend, A. Swick, and A. Furutani.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 5, p 848-857, May, 1980. 8 Fig, 3 Tab, 32 Ref.

Descriptors: *Path of pollutants, *Aquatic animals, *Ecosystems, *Selenium, *Mercury, Bioaccumulation, Fate of pollutants, Herbicides, Fish toxins, Heavy metals, Water pollution effects, Water pollution sources, Lakes, Sulfate, Benthos, Crayfish, Bottom sediments.

The movement of selenium (Se) and mercury (Hg) through experimental aquatic ecosystems in a lake contaminated with mercury (Hg) was studied. Stable Se or sulfate water concentrations were increased while aquatic herbicides (Velpar or terbutryne) were added to the model system. Part of the water column was isolated from contact with the sediments. Radioactively labeled Se and Hg did not move simultaneously through the ecosystem either geochemically or biologically. Se was rapidly bioaccumulated in fish, crayfish, and haptobenthos, an effect which was enhanced by increased sulfate levels in the absence of exposure to bottom sediments and decreased by aquatic herbicides. Se levels of 0.1 mg/l did not affect Hg movement out of the water column, but stabilized Hg movement among different compartments of the water column. Hg bioaccumulation by fish, crayfish and haptobenthos was inhibited by elevated Se levels. Se toxicity to several aquatic species was investigated. The possible use of Se as an ameliorating agent for freshwater systems polluted by heavy metals is considered. (Geiger-FRC)
W82-00595

BIODEGRADABILITY OF HALOGEN-SUBSTITUTED DIPHENYLMETHANES,
Monsanto Co., St. Louis, MO.
V. W. Saeger, and Q. E. Thompson.
Environmental Science and Technology, Vol 14, No 6, p 705-709, June, 1980. 2 Tab, 18 Ref.

Descriptors: *Biodegradation, *Organic compounds, Molecular structure, Hydrocarbons, Halogens, *Diphenylmethanes, Activated sludge, River water, Microorganisms, Rivers.

Primary and ultimate biodegradation test procedures were used to determine the biodegradability of 32 halogenated diphenylmethanes exposed to activated sludge and river water microorganisms. Generally, diphenylmethanes having one unsubstituted phenyl ring exhibited high primary degradation rates. Those substituted on both rings were slow to degrade. Ultimate biodegradation measurements on materials with high primary degradation rates indicate that the cleavage rate of the second phenyl ring decreases, in general, with increasing levels of substitution on the ring. The data point out, however, the inherent difficulties in predicting whether a specific synthetic molecule will be biodegradable. In keeping with other facets of biological behavior, minor changes in structure can lead to drastic changes in biodegradability. (Baker-FRC)
W82-00599

THE NONFUEL MINERALS INDUSTRY: REGULATORY IMPACTS,
Mitre Corp., McLean, VA. METREK Div.
A. Hershaft, and W. Lacy.
Environmental Science and Technology, Vol 14, No 4, p 404-408, 410-412, April, 1980. 6 Tab.

Descriptors: *Mineral industry, *Metal-finishing wastes, Metallurgy, Industrial plants, Industrial wastes, Effluents, Mine wastes, Mine drainage, Drainage, Water quality, Regulations, Standards.

Water pollutants are generated at every step of metal mining and processing. Runoff from exposed ore bodies and overburden and tailing piles carries suspended solids, acid sulfate, heavy metals, and other dissolved salts. Some of these pollutants find their way into the groundwater. The slurry contains additional suspended solids, as well as chemicals used in the ore concentration process. Smelting and refining effluents contain heavy metals and other substances, sometimes ammonia, cyanides, nitrates, oil and grease, and phenols introduced with coke, as well as fluorides added as a fluxing agent. Runoff can be minimized and directed to tailing ponds of containment lagoons. Percolation to the groundwater can be controlled by lining the bottom of the pond with clay, paving material, or an impermeable plastic or rubber membrane. Public concern has generated laws in recent years to assist in the management of mining and processing wastes. Pollution from these operations can adversely affect eight types of water uses: municipal supply, industrial supply, agricultural supply, commercial fishing, wildlife preservation, recreation, navigation, and aesthetic enjoyment. Assessing the benefits to these water uses derived from the regulatory statements issued by the federal and state governments is difficult. However, there is impressive evidence of water quality improvement attributable to pollution control regulations. (Baker-FRC)
W82-00612

COAL TAR COATINGS OF STORAGE TANKS, A SOURCE OF CONTAMINATION OF THE POTABLE WATER SUPPLY,
New York State Dept. of Health, Albany. Div. of Lab. and Research.
K. Alben.
Environmental Science and Technology, Vol 14, No 4, p 468-470, April, 1980. 1 Fig, 3 Tab, 10 Ref.

Descriptors: *Storage tanks, *Coatings, Linings, Leaching, Leachates, Water storage, Water tanks, Storage, Hydrocarbons, Water quality, Water pollution sources, *Coal tar coatings, Health hazards.

Forty-liter field samples were collected in duplicate at the inlet and outlet of a 12,000 gallon

storage tank which had been given an interior coating of coal tar five years earlier. Similarly, 40-liter laboratory samples were prepared from tap water exposed to test panels coated with the same coal tar as used on the storage tank. Results obtained from GC-MS analysis of the storage tank samples indicated that concentrations of specific polycyclic aromatic hydrocarbons increased 5 to 30 times over the concentrations of the same chemicals found in the influent to the tanks. Concentrations in micrograms/liter in the influent and effluent respectively for the following compounds were: naphthalene, 0.004 and 0.025; fluorene, 0.001 and 0.021; phenanthrene + anthracene, 0.019 and 0.210; fluoranthene, 0.003 and 0.081; and pyrene 0.002 and 0.071. It was concluded that polycyclic aromatic hydrocarbons can leach from commercial coal tar coatings of storage tanks into the water supply. One of the compounds, fluoranthene, is among the six polycyclic aromatic hydrocarbons designated by the World Health Organization as possessing a health hazard when drinking water is contaminated with it. The levels of each of the chemicals detected are considered to be significant. (Baker-FRC)
W82-00616

AROMATIC AMINES IN AND NEAR THE BUFFALO RIVER,
Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
C. R. Nelson, and R. A. Hites.
Environmental Science and Technology, Vol 14, No 9, p 1147-1149, 1980. 3 Fig, 2 Tab, 7 Ref.

Descriptors: *Dye industry wastes, *Water pollution sources, Industrial wastes, Rivers, *Buffalo River, Fish, Fish diseases, Leaching, New York.

The identification of the 2-propanol-extractable, basic organic compounds present in soil and river sediment obtained near a dye manufacturing plant is described. The environmental implications of this identification are discussed. Sediment samples were collected in midchannel by an Eckman dredge during June of 1979. Soil samples were collected in 1978. The following aromatic amines were found in the sediment samples from the Buffalo River: 4,4'-bis(dimethylamino)biphenyl, 4-(dimethylamino)benzophenone, bis(4-dimethylaminophenyl)methane, bis-(4-dimethylaminophenyl)phenylmethane, 1-naphthylamine, and N-ethyl-N-phenylbenzylamine. Most of the compounds detected are either starting materials, intermediates, byproducts, or products associated with the commercial synthesis of two dyes: malachite green and crystal violet. The remaining compounds were either other products of the dyestuff plant or common industrial chemicals. The findings of so many chemicals in the soil samples suggests that the site was used as a chemical dump by the dyestuff manufacturer, and it is further suggested that the chemicals entered the Buffalo River by leaching from the dump site. Fish in the river have been exposed to these compounds by direct contact with contaminated sediment, and their numerous tumors may have resulted from this exposure. (Baker-FRC)
W82-00622

GROUNDWATER LEACHING OF ORGANIC POLLUTANTS FROM IN SITU RETORTED OIL SHALE. A MASS TRANSFER ANALYSIS,
California Univ., Berkeley. Dept. of Civil Engineering.
G. L. Amy, A. L. Hines, J. F. Thomas, and R. E. Selleck.
Environmental Science and Technology, Vol 14, No 7, p 831-835, July, 1980. 4 Fig, 2 Tab, 18 Ref.

Descriptors: *Groundwater, *Leaching, *Oil shale, Groundwater pollution, Organic compounds, Mass transfer, Diffusion coefficient.

A mass transfer analysis of laboratory data was conducted to evaluate the potential degradation of groundwater quality by organic pollutants leached from in situ retorted oil shale. Two unique samples of in situ retorted oil shale were investigated in a series of laboratory experiments. Results of the experiments were subjected to a mass transfer analysis to determine the rate-limiting step involved in the leaching of organic pollutants by groundwater. This mass transfer analysis suggested that, for one of the samples, internal diffusion through the porous infrastructure of retorted oil shale particles is the rate controlling mass transfer step. For the other sample, no single rate controlling step was conclusively identified, although it appeared that internal diffusion was important in the overall leaching phenomenon. Since internal diffusion is an extremely slow mass transfer process, it is anticipated that low, relatively constant levels of organic pollutants will appear in groundwater and persist for long periods of time. This implies that there may be a chronic, long-term groundwater pollution problem in areas of future in situ oil shale development. (Baker-FRC)
W82-00626

TRACE METAL CATALYSIS IN AQUATIC ENVIRONMENTS,
California Inst. of Tech., Pasadena. W. M. Keck Labs.
M. R. Hoffman.
Environmental Science and Technology, Vol 14, No 9, p 1061-1066, September, 1980. 4 Fig, 1 Tab, 52 Ref.

Descriptors: *Catalysts, *Trace metals, *Water pollution control, *Chemical reactions, Heavy metals, Aquatic environment, Oxidation, Reduction, Sulfur compounds, Suspended matter.

The possible roles that trace metals may play in the catalysis of aquatic reactions are exlored, and the kinetic and mechanistic aspects of hydrolysis, redox, and autoxidation reactions are explained. The applicability of certain catalytic reactions for pollution control is considered. It is noted that transition metals and associated complexes may prove useful from a commercial standpoint for improved pollution control systems. The catalyzed autoxidation of hydrogen sulfide and sulfur dioxide and other reduced sulfur compounds in the presence of homogeneous or heterogeneous organometallic complexes may provide convenient and economical methods for sulfur pollution control. The principal products of the metal phthalocyanine-catalyzed autoxidation of hydrogen sulfide and mercaptans in sour refinery distillates are reported to be colloidal sulfur, polythionates, and sulfate. Conceivably, similar catalytic systems could be used for the autoxidation of selected organic pollutants for industrial wastewater treatment. (Baker-FRC)
W82-00629

KEPONE IN THE JAMES RIVER,
Virginia Inst. of Marine Sciences, Gloucester Point.
R. J. Huggett, and M. E. Bender.
Environmental Science and Technology, Vol 14, No 8, p 918-923, August, 1980. 3 Fig, 3 Tab, 16 Ref.

Descriptors: *Rivers, *Pesticides, *Kepone, *James River, *Virginia, *Chesapeake Bay, Sediments, Bottom sediments, Surface water, Benthic environment, Toxicity, Sediment transport, Fish, Oysters, Mollusks.

The major source of Kepone contamination in Virginia was the manufacturing plants at Hopewell. However, the compound is also generated in the production and degradation of Mirex, and many environmental samples outside of this area of Virginia also record the presence of kepone. In the Chesapeake Bay, moving northward from the James River, most marine species exhibit a significant decline in kepone concentrations. Residues in bottom feeders decline very rapidly, reflecting a decrease in contamination of the immobile food supplies. Piscivorous species showed slower rates of decontamination, possible because their primary food sources were mobile and transported kepone residues to greater distances. Bluefish showed less of a decline in contamination than any other finfish, as these are highly mobile and move in and out of the James to other areas of the bay. The bottom sediments of the James have acted to some degree as a reservoir for kepone. From the bottom it cycles to solution and is taken up by plants and animals, to be returned eventually to the sediments on death of the organisms. Benthic animals may take up kepone directly and transfer it to their predators. Evidence from 1979 suggests that surface sediments are demonstrating lessening levels of contamination. It is noted, however, that a major hurricane, which has not hit this area since the 1950s, could stir up the bottom and redistribute the sediments overnight, possibly even moving the contamination into the Chesapeake Bay. (Baker-FRC)
W82-00631

TRACE ELEMENT ACCUMULATION, MOVEMENT, AND DISTRIBUTION IN THE SOIL PROFILE FROM MASSIVE APPLICATIONS OF SEWAGE SLUDGE,
California Univ., Berkeley. Dept. of Soils and Plant Nutrition.
For primary bibliographic entry see Field 5E.
W82-00640

INFLUENCE OF GASEOUS NITRIC ACID ON SULFATE PRODUCTION AND ACIDITY IN RAIN,
Environmental Sciences Research Lab., Research Triangle Park, NC.
J. L. Durham, J. H. Overton, and V. P. Aneja.
Atmospheric Environment, Vol 15, No 6, p 1059-1068, 1981. 4 Fig, 5 Tab, 33 Ref.

Descriptors: *Acid rain, *Mathematical models, *Nitric acid, Acidity, Hydrogen ion concentration, Air pollution effects, Sulfates, Simulated rainfall.

A physico-chemical subcloud rain model was used to study the pollutant chemistry leading to rain acidification. In the model, drops fall through a polluted region containing trace gases CO2, O3, SO2, HNO3, NO, and NO2. The concentration of each chemical species within a drop was calculated. Subcloud scavenging of HNO3 may control acidification during the beginning of a rain event and may have more control over the final pH than SO2. In fact, gaseous HNO3 inhibits the production of sulfate in rain by lowering the pH. Acidification was not caused by the oxides of nitrogen, NO and NO2. In-cloud scavenging can have greater control over final acidity than subcloud scavenging. Furthermore, gaseous HNO3 is removed from the atmosphere more rapidly than SO2 or O3. In this simulation, cumulative NO3 decreased by 42% in one hour, while SO4 and pH slightly increased. This theoretical study did not consider the formation of rain in the polluted zone, and the effect of in-cloud processes are ignored. (Small-FRC)
W82-00642

ACID PRECIPITATION: THE IMPORTANCE OF NITRIC ACID,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 2K.
W82-00643

THE ORGANIC POLLUTION OF RIVER CUBILLAS (GRANADA, SOUTH SPAIN),
Granada Univ. (Spain). Dept. of Ecology.
J. C. Canteras.
Acta Hydrobiologica, Vol 22, No 4, p 439-448, 1980. 3 Fig, 1 Tab, 6 Ref.

Descriptors: *Organic matter, *Low flow, *Rivers, Water pollution sources, Industrial waste, River flow, Bacteria, Chemical properties, Cubillas River, *Spain.

The pollution of the River Cubillas is investigated with emphasis on the relationship between the heterotrophic bacterial population and various chemical factors which are affected by the organic matter draining from stored olives at oil mills. The river was sampled at six locations, and the following parameters were determined: oxygen, nitrates and nitrites, total alkalinity, and phosphates. The slide sprinkling technique was used to determine the heterotrophic bacterial population. The

number of correlations between variables increased with the degree of pollution. The oil mill located between the first and second sampling stations did not greatly affect the river. The repeated addition of wastes along the river from several mills is the source of the problem because of the river's low flow with no possibility of self-purification between one mill and the next. (Small-FRC)
W82-00674

PERSISTENCE AND DISTRIBUTION OF ERYSIPELOTHRIX RHUSIOPATHIAE AND BACTERIAL INDICATOR ORGANISMS ON LAND USED FOR DISPOSAL OF PIGGERY EFFLUENT,
Victoria Dept. of Agriculture (Australia). Attwood Veterinary Research Lab.
D. S. Chandler, and J. A. Craven.
Journal of Applied Bacteriology, Vol 48, No 3, p 367-375, June, 1980. 3 Tab, 16 Ref.

Descriptors: *Animal wastes, *Land disposal, *Animal diseases, Waste disposal, Bacteria, Bioindicators, Environmental effects, Agriculture, Victoria, *Australia.

Effluent was sampled from 35 Victorian commercial piggeries and tested for the presence of Erysipelothrix rhusiopathiae, the cause of swine erysipelas. Also, the survival of the organism in soil and pasture used for the disposal of untreated piggery waste was determined. The organism was isolated from 15 of the 40 samples. It was found at disposal sites for up to two weeks after application of effluent. It was more common in soil than pasture. The survival of bacterial indicator organisms was determined and fecal coliforms in top soil survived 8 to 19 days and 5 to 12 days on pasture. Fecal streptococci survived 10 to 14 days in soil and 8 to 11 days on pasture. Laboratory studies indicated that the death rate of Erysipelothrix rhusiopathiae was six times greater than E. coli in soil at field capacity. Animals grazing on effluent disposal sites would be more likely to ingest Ery. rhusiopathiae from fecal material and topsoils of disposal sites than from pasture material. The fast decay rate means the risk of infection would be low by the time a hundred- or thousand fold reduction in E. coli or fecal coliform numbers occurred. (Small-FRC)
W82-00686

1980 ANNUAL REPORT - A PERSPECTIVE ON THE PROBLEM OF HAZARDOUS SUBSTANCES IN THE GREAT LAKES BASIN ECOSYSTEM,
International Joint Commission-United States and Canada, Windsor (Ontario).
For primary bibliographic entry see Field 5C.
W82-00707

ASSESSMENT OF AIRBORNE ORGANIC CONTAMINANTS IN THE GREAT LAKES ECOSYSTEM,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
J. J. Eisenreich, B. B. Looney, and J. D. Thornton.
In: 1980 Annual Report - A Perspective on the Problem of Hazardous Substances in the Great Lakes Basin Ecosystem. Appendix A, November, 1980. 150 p. 36 Tab, 199 Ref. International Joint Commission, Windsor, Ontario.

Descriptors: *Lakes, *Organic wastes, *Precipitation, *Organic compounds, *Water pollution sources, *Air pollution effects, Organic pesticides, Air pollution, Lake sediments, Acid rain, Chemical precipitation, Chlorinated hydrocarbons, Hydrocarbons, Water-sediment interfaces, *Great Lakes basin, Ecosystems.

No systematic survey of the identity, concentrations and frequency of occurrence of true organics has been performed in the Great Lakes Basin ecosystem; however, a review of literature and past research was conducted for both dry and wet deposition to assess current needs regarding the identification and control of organic airborne contaminants. Atmospheric deposition was found to be greater for Lakes Superior, Michigan, and Huron than for Lakes Erie and Ontario, as a result of general mass air circulation patterns, a large lake/basin area, and higher atmospheric concentrations. While atmospheric deposition of airbone PCBs is the most serious known toxic organic problem affecting Great Lakes water quality, other trace organics for which the atmospheric pathway is important include DDT-group pesticides, alpha-BHC, beta-endosulfan, methoxychlor, PAHs, and phthalate esters. The report recommends that a study be made of land-based sampling vs. over-lake sampling, the sources of airborne trace organics, and the transport of organics from urban areas to the lakes. In addition, the atmospheric pathway for the input of trace organics should be compared to other input pathways including tributary inflow, municipal and industrial discharges, and erosion. (Garrison-Omniplan)
W82-00709

ASSESSMENT OF AIRBORNE INORGANIC CONTAMINANTS IN THE GREAT LAKES,
Illinois Inst. of Tech., Chicago. Pritzer Dept. of Environmental Engineering.
H. E. Allen, and M. A. Halley.
In: 1980 Annual Report - A Perspective on the Problem of Hazardous Substances in the Great Lakes Basin Ecosystem, Appendix B, November, 1980. 160 p. 19 Fig, 22 Tab, 63 Ref, 5 Append. International Joint Commission, Windsor, Ontario.

Descriptors: *Lakes, *Water pollution sources, *Precipitation, *Heavy metals, *Air pollution effects, *Chemical precipitation, Trace metals, Air pollution, Acid rain, Water-sediment interfaces, Lake sediments, Data interpretation, On-site data collections, *Great Lakes.

Many studies of the atmospheric deposition of inorganic contaminants in the Great Lakes area have been conducted to determine the ecological and geochemical significance of such constituents as nitrate, phosphates, aluminum, cadmium, chromium, copper, iron, manganese, lead, and nickel. This report reviews these studies and concludes that true loading to the Great Lakes may never be fully known. Efforts to increase knowledge of atmospheric deposition should include consideration of sampling sites that (1) represent a relatively large area; (2) consider the optimum above-ground or ground-level height for collectors; (3) include an adequate snow collection method; (4) include rural and urban sites for any loading estimate of local point sources; (5) use wet and dry samplers; and (6) involve coordination between Canadian and U.S. monitoring efforts. It is important that data studies consider the impact and measurement of contaminated samples and the risk of sample evaporation. The report recommends that a joint monitoring network be established between the U.S. Environmental Protection Agency and the Canada Centre for Inland Waters. (Garrison-Omniplan)
W82-00710

SOURCES AND CONTROL OF ORGANIC AIR POLLUTANTS,
Ontario Ministry of the Environment, Toronto (Ontario).
R. B. Canton, and E. T. Barrow.
In: 1980 Annual Report - A Perspective on the Problem of Hazardous Substances in the Great Lakes Basin Ecosystem, Appendix C, November, 1980. 10 p. International Joint Commission, Windsor, Ontario.

Descriptors: *Chemical precipitation, *Air pollution effects, *Air pollution, *Chemical degradation, *Precipitation, Acid rain, Organic compounds, Catalysts, Electro-phoresis, Incineration, Waste disposal, Oxidation.

Total organic air emissions in 1978 for North America were estimated at 33 million tons, of which 38% derived from power sources used in the transportation industry and 27% were from organic solvents, such as paints, and dry cleaning and degreasing processes. This report reviews the complex issue of organic pollution sources and the available technologies for the degradation of organic pollutants. The conclusion is drawn that in most instances, current technology is capable of reducing discharges to tolerable levels. Each approach to reducing emissions---recycling, reducing quantities emitted, and reducing effects of emissions---presents technical problems. Specific reduction methods include electrostatic precipitation, chemical processes, control of ducted particulate or droplet material, control of ducted vapors, control of fugitive emissions, condensation, and incineration. The development of poison-resistant catalysts, and ceramic supports for the catalysts, has improved the capability of catalytic oxidation at temperatures well below those required for thermal oxidation of organics. It is in the use of the so-called phoretic effects---electrophoresis, diffusiophoretics, and thermophoresis---that the development of scrubber technologies has progressed most. (Garrison-Omniplan)
W82-00711

PROPOSED WATER QUALITY CONTROL PLAN FOR INDIO SUBAREA OF THE WHITEWATER HYDROLOGIC UNIT, WEST COLORADO RIVER BASIN.
California Regional Water Quality Control Board, Palm Desert. Colorado River Basin Region.
For primary bibliographic entry see Field 6F.
W82-00716

HYDROGEOCHEMISTRY AND SIMULATED SOLUTE TRANSPORT, PICEANCE BASIN, NORTHWESTERN COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
S. G. Robson, and G. J. Saulnier Jr.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $4.25. Geological Survey Professional Paper 1196, 1981. 65 p, 45 Fig, 4 Tab, 64 Ref.

Descriptors: *Geochemistry, *Groundwater, *Oil shale, *Mine drainage, Model studies, Aquifer characteristics, Water quality, Water pollution sources, Surface-groundwater relations, *Colorado, Piceance basin, Solute-transport modeling.

Oil-shale mining activities in Piceance basin in northwestern Colorado could adversely affect the ground- and surface-water quality in the basin. This study of the hydrology and geochemistry of the area used ground-water solute-transport-modeling techniques to investigate the possible impact of the mines on water quality. Maps of the extent and structure of the aquifer were prepared and show that a saturated thickness of 2,000 feet occurs in the northeast part of the basin. Ground-water recharge in the upland areas in the east, south, and west parts of the basin moves down into deeper zones in the aquifer and laterally to the discharge areas along Piceance and Yellow Creeks. The saline zone and the unsaturated zone provide the majority of the dissolved solids found in the ground water. Precipitation, ion-exchange, and oxidation-reduction reactions are also occuring in the aquifer. Model simulations of ground-water pumpage in tracts C-a and C-b indicate that the altered direction of ground-water movement near the pumped mines will cause an improvement in ground-water quality near the mines and a degradation of water quality downgradient from the tracts. Model simulations of mine leaching in tract C-a and C-b indicate that equal rates of mine leaching in the tracts will produce much different effects on the water quality in the basin. Tract C-a, by virtue of its remote location from perennial streams, will primarily degrade the ground-water quality over a large area to the northeast of the tract. Tract C-b, by contrast, will primarily degrade the surface-water quality in Piceance Creek, with only localized effects on the ground-water quality. (USGS)
W82-00723

TEMPERATURE AND SOLUTE-TRANSPORT SIMULATION IN STREAMFLOW USING A LAGRANGIAN REFERENCE FRAME,
Geological Survey, NSTL Station, MS. Water Resources Div.
For primary bibliographic entry see Field 2E.
W82-00726

METAL LEACHING FROM SEWAGE SLUDGE ASH,
Connecticut Univ., Storrs. Dept. of Chemical Engineering.
H. E. Klei, D. Sundstrom, and C. Sweeney.
BioCycle, Vol. 22, No 3, p 41-43, May/June, 1981. 4 Fig, 3 Tab, 6 Ref.

Descriptors: *Metals, *Leaching, *Sludge ash, Acid rain, Heavy metals, Ash, Water pollution sources, Fate of pollutants, Incineration, Copper, Chromium, Cobalt, Calcium, Iron, Magnesium, Manganese, Lead, Nickel, Potassium, Sodium, Sludge disposal.

Column elution and batch leaching tests, conducted on unquenched incinerator ash from a wastewater plant, recovered varying amounts of metals using water of pH 5.3 and 4.0. No cobalt, iron, or lead was recovered in the leachates. Water at pH 4.0, simulating acid rain, eluted 27% of the Cu, 79% of Cr, 40% Ca, 28% Mg, 25% Mn, 11% Ni, 20% K, and 21 % Na after a single batch extraction. From 0 to 3.76% metals were leached during column elution tests using 6 bed volumes of liquid. Water of pH 5.3 recovered half to 75% of these amounts. If ash is extracted with water before sending it to the landfill, an appreciable fraction of the Ca and Cr may be recovered. (Cassar-FRC)
W82-00770

TRANSFORMATIONS OF NITROGEN IN A POLLUTED ESTUARY: NONLINEARITIES IN THE DEMAND FOR OXYGEN AT LOW FLOW,
Harvard Univ., Cambridge, MA. Center for Earth and Planetary Physics.
S. C. Wofsy, M. B. McElroy, and J. W. Elkins.
Science, Vol 213, No 4509, p 754-757, August 14, 1981. 2 Fig, 16 Ref.

Descriptors: *Ammonium, *Oxygen demand, *Nitrification, *Low Flow, Fate of pollutants, Sewage bacteria, Oxidation, *Potomac River, Delaware River, *Estuaries, Nitrogen cycle, Model studies, Bacteria, Nitrites, Chemical reactions.

A simple kinetic model was developed to describe the oxidation of sewage ammonium in the Potomac River. Growth of nitrifying bacteria is limited by the supply of ammonium ion, supplied at a constant rate of 200 g N per sec. The oxidation rate varies inversely with fresh water inflow, and the oxygen demand varies as the inverse square of the fresh water inflow rate. The model accounts for observed concentrations of ammonium and nitrous oxide except at stream flows less than 80 cu meters per sec (usual range 20-250 cu meters per sec, mean 130 cu meters per sec). At low flow, peculiar behavior of maximum ammonium concentrations is seen. Peak concentrations increase as flow declines from 200 to 100 cu meters per sec, but decrease below 100 cu meters per sec. Both model and observations agree that between 70 and 100% of the ammonia in the Potomac is removed by oxidation of ammonia to nitrous oxide. The rate of nitrification is lowered by a factor of 1.6 for a reduction in water temperature of 10 degrees C, in agreement with results for bacteria cultures, which gave factors of 1.5-2.2. The model is also applicable to the Delaware River. (Cassar-FRC)
W82-00777

BEHAVIOR AND TRANSPORT OF MICROBIAL PATHOGENS AND INDICATOR ORGANISMS IN SOILS TREATED WITH ORGANIC WASTES,
Florida Univ., Stanford. Inst. of Food and Agricultural Sciences.
K. R. Reddy, R. Khaleel, and M. R. Overcash.
Journal of Environmental Quality, Vol 10, No 3, p 255-266, July-September, 1981. 1 Fig, 7 Tab, 82 Ref.

Descriptors: *Bioindicators, *Pathogens, Soil disposal fields, Land disposal, Animal wastes, *Soil properties, Wastewater disposal, Organic wastes, Farm wastes, Viruses, Runoff, Water quality, Soil contamination, Mathematical models, Mathematical equations.

The survival rate of microbial pathogens in the soil after application of wastes is one of the most important factors in determining the number of organisms available for rainfall-runoff transport. A simple conceptual model based on the current state of the art was developed to describe pathogen and indicator organism behavior in land areas receiving animal wastes. The model was used to examine the effects of die-off rate and retention by soil particles on runoff water quality. Microbial die-off was described, assuming first-order kinetics. First order die-off rate constants were calculated from the literature for various pathogens and indicator organisms in soil-water systems. Correction factors were presented to adjust rate constants for changes in temperature, moisture, and pH of the soil. A 10 degree C rise in temperature was found to double the die-off rates of the organisms studied. Die-off rates also increased with a decrease in soil moisture. Soils with pH between 6 and 7 had slow die-off rates. A linear isotherm was assumed in describing the retention of pathogens and indicator organisms by soil particles. Increases in soil surface area and clay content of the soil resulted in increases in the retention of viruses. Leaching and surface runoff transport processes were considered both for land areas receiving direct applications of animal wastes and for pastures and rangeland watershed. Several areas requiring further research with respect to pathogen behavior in soils treated with organic wastes were identified. (Carroll-FRC)
W82-00797

METHYLATION OF TRIMETHYLTIN COMPOUNDS BY ESTUARINE SEDIMENTS,
California Univ., Berkeley. Naval Biosciences Lab.
H. E. Guard, A. B. Cobet, and W. M. Coleman, III.
Science, Vol 213, No 4509, p 770-771, August 14, 1981. 1 Fig, 12 Ref.

Descriptors: *Tin compounds, *Methylation, *Sediments, Fate of pollutants, Chemical reactions, *Estuarine environment, Biotransformation, Organotin compounds, Biocides, *Fouling.

The potential for environmental methylation of trialkyl tin compounds was studied in the laboratory using trimethyltin hydroxide as a model compound and anoxic, organic-rich estuarine tidal flat sediments. After 80 days' incubation, the biologically active sediments produced 2.7 times the amount of volatile tetramethyltin (maximum 2.4% of the added trimethyltin hydroxide) as compared with autoclaved control sediments. No methyltin compounds were produced in the absence of added trimethyltin hydroxide or in the presence of trimethyltin hydroxide in seawater or seawater-bentonite. The amount of trimethyltin produced was doubled by additions of 15 g Na2S and increased 70% by addition of 0.30 g sodium acetate. Adding these compounds to autoclaved sediments did not affect the amount of trimethyltin produced. These studies demonstrate a possible abiotic pathway for the formation of trimethyltin by a Lewis-base redistribution of trimethyltin hydroxide. Methylation of tin is probably of minor importance in the environment. It occurs in low yield, and the volatile, water-insoluble product should escape to the atmosphere, not accumulate in the marine environment. It is likely that the tributyltin compounds used widely as antifouling agents would also methylate to a minor degree. (Cassar-FRC)
W82-00801

URANIUM CONCENTRATION IN THE GROUND WATERS OF THE PULLMAN-MOSCOW BASIN, WHITMAN COUNTY, WASHINGTON, AND LATAH COUNTY, IDAHO,
Washington State Univ., Pullman. R. L. Albrook Hydraulic Lab.
V. T. Ichimura, and J. W. Crosby, III.
Northwest Science, Vol 55, No 1, p 10-22, February, 1981. 6 Fig, 1 Tab, 13 Ref.

Descriptors: *Uranium, *Groundwater pollution, *Groundwater basins, Washington, Idaho, *Pullman-Moscow Basin, Nuclear track technique, Leaching, Water pollutants, Path of pollutants.

The Pullman-Moscow basin is located in the southeastern part of Whitman County, Washington, and west-central Latah County, Idaho. A recent increase of uranium exploration and an earlier finding of anomalously high radiation background in samples of basin groundwater prompted this study of the concentration of dissolved uranium in the Pullman-Moscow basin. A high-sensitivity nuclear track technique, capable of detecting concentrations as low as 5 parts per trillion, was used in this study. The sampling procedure included on-site measurements of temperature, pH, and conductivity. Analysis of the samples using the nuclear track technique showed uranium concentrations as high as 25 parts per billion. Any uranium concentration higher than 6.2 parts per billion was considered anomalous. About 6.8% of the samples fell into this category. Clusters of high uranium concentration were located in groundwaters from the east and southeast sections of the Pullman-Moscow basin on or near the basalt-granite rock contact. These higher concentrations of uranium are probably the result of local leaching of uranium from granitic rocks by oxidizing meteoric waters recharging the basin. Deep, high-yield municipal and domestic wells in the central and western parts of the basin were found to contain very low uranium concentrations, probably as a result of the reducing conditions in the deep groundwater environment of the basin. Although attempts to correlate conductivity, pH, and well depth with uranium concentrations demonstrated the absence of any correlation, samples that had high uranium concentrations generally also had high conductivities. (Carroll-FRC)
W82-00809

CHEMISTRY OF LAKE WATER AND GROUNDWATER IN AREAS OF CONTRASTING GLACIAL DRIFTS IN EASTERN MINNESOTA,
Southern Illinois Univ. at Edwardsville. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2K.
W82-00821

RETENTION OF RADIONUCLIDES BY SOME AQUATIC FRESH WATER PLANTS,
Atomic Energy Establishment, Cairo (Egypt). Radiation Protection Dept.
R. M. K. El-Shinawy, and W. E. Abdel-Malik.
Hydrobiologia, Vol 69, No 1/2, p 125-129, March, 1980. 4 Tab, 15 Ref.

Descriptors: *Macrophytes, *Bioindicators, *Radioactivity, *Radioactive wastes, Aquatic plants, Hydrogen ion concentration, Cesium, Cobalt, Plutonium, Water pollution sources, Retention.

Relative uptake and accumulation of Co60, P32, and Cs134 by three aquatic macrophytes were determined in the Ismailia Canal, which is adjacent to the Egyptian Nuclear Research Center. The plants were Lemna gibba, a floating plant; Ceratophyllum demersum, a submerged plant near the water's surface; and Potamogeton crispus, a rooted submerged plant. Uptake of radionuclides decreased at increasing pH from 5 to 9. When pH was constant, uptake increased with increased contact time. Concentration factors obtained for Co60 were higher than those for P32, while Cs134 showed the lowest concentration factors for all three macrophytes. Maximum uptake values were found at all pH values after a contact time from 4 to 12 days. Thus, the tested macrophytes proved to be reliable biological indicators. They may be used in studies to develop safe limits for disposal of low level radioactive wastes and to evaluate the hazards of the accidental release of radioactivity to the canal water. (Small-FRC)
W82-00853

METHODS OF INVESTIGATING THE STATE OF METAL IONS IN NATURAL WATERS,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
For primary bibliographic entry see Field 5A.
W82-00859

WATERBORNE METHYLENE BIS(2-CHLOROANILINE) AND 2-CHLOROANILINE CONTAMINATION AROUND ADRIAN, MICHIGAN,
Food and Drug Administration, Washington, DC.
G. E. Parris, G. W. Diachenko, R. C. Entz, J. A. Poppiti, and P. Lombardo.
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 4, p 497-503, 1980. 1 Fig, 2 Tab, 6 Ref.

Descriptors: *Organic compounds, *Contamination, *Wastewater, *Environmental effects, *Indusrial waste, Chemical wastes, Chlorine, Water pollution, Lagoons, Waste treatment, Discharge frequency, Flow discharge, Fish physiology, Toxicity, Carcinogens, Fish populations, Water sampling, Streams, Adrian, *Michigan.

Results which trace waterborne methylene bis (2-chloroaniline) (M2CA) and 2-chloroaniline (2CA) contamination from an industrial waste treatment lagoon in Michigan through the municipal wastewater treatment plant and surface runoff to a stream are reported. Sludge, sediment, fish, and water samples were collected and analyzed. Samples were extracted successively with ethyl acetate and methanol, and analyzed on gas chromatographic columns. M2CA was the dominant compound in the waste lagoon sediment, while 2CA is the dominant compound at the sewage treatment plant sludge. The 2CA may be more readily mobilized through the wastewater systems because of its water solubility or lesser tendency to sorb to sediments. Contamination was found in a deep well on the manufacturing site and in surface runoff from the site. No M2CA was detected in water from the Raisin River near the sewage treatment plant outfall. Possible traces of M2CA were found in the influent and effluent water from the municipal sewage treatment plant. Results of the fish tissue analysis suggest that the contaminant residues are chemically bound to macromolecules of the tissue. (Titus-FRC)
W82-00873

ABSORPTION OF FENITROTHION BY PLANKTON AND BENTHIC ALGAE,
Moncton Univ., (New Brunswick).
J. S. S. Lakshminarayana, and H. Bourque.
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 3, p 389-396, 1980. 1 Fig, 1 Tab, 26 Ref.

Descriptors: *Absorption, *Uptake, *Benthos, *Pesticides, Forestry, Accumulaton, Benthic fauna, Benthic flora, Plankton, Aquatic life, *Lakes, Organic compounds, Water pollution, Zooplankton, Environmental effects, Water sampling, Fenitrothion, Fate of pollutants, *Peabody Lake, New Brunswick, Canada.

Results of a preliminary survey on the response of plankton and benthic algae of Peabody Lake in New Brunswick, Canada to fenitrothion spray formulations are presented. Fenitrothion is an organophosphate insecticide used selectively for forest protection against the spruce budworm. The survey indicates that concentrations of fenitrothion diminish rapidly under conditions where water temperatures and pH values ranged from 11 to 15 degrees Centigrade and 6.1 and 7.2 respectively. Fenitrothion is actively taken up by plankton to a degree that depends on various environmental conditions including growth rates, seasonal variation, and bloom formation. The algal species observed in the Peabody lake did not suggest any toxicity or polluted conditions. (Titus-FRC)
W82-00874

MERCURY AND SELENIUM CONCENTRATIONS IN FISH, SEDIMENTS, AND WATER OF TWO NORTHWESTERN QUEBEC LAKES,
Noranda Research Centre, Pointe Claire (Quebec). Process Technology Dept.
M. R. Speyer.
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 3, p 427-432, 1980. 3 Tab, 15 Ref.

Descriptors: *Fish populations, *Sediments, Water pollution, *Lakes, Heavy metals, Toxicity, Fish physiology, *Mercury, *Selenium, Environmental effects, *Fish toxins, Ecosystems, Trace metals, Aquatic environment, Aquatic organisms, Chemical analysis, *Quebec.

Findngs of a detailed study conducted in Quebec are presented. The study concerned mercury in the aquatic ecosystem and techniques to reduce the toxicity of mercury accumulated by aquatic organisms. The interaction between mercury and selenium in biological systems is both antagonistic and synergistic. Fish samples from two lakes were obtained and analyzed for mercury and selenium. Results showed significant differences between the mercury and selenium concentrations of fish samples from the two lakes. Elevated selenium concentrations in fish from Lake Dufault corresponded to elevated background selenium concentrations. The two lakes have similar physical dimensions and mining histories, but have different types of bottoms. Lake Dufault has a heavy-metal enriched sludge sediment covered by glacial clay, while Lake Duparquet has a fine silt overlying glacial clay. (Titus-FRC)
W82-00876

ENRICHMENT OF THE AGRICULTURAL HERBICIDE ATRAZINE IN THE MICROSURFACE WATER OF AN ESTUARY,
Smithsonian Institution, Edgewater, MD. Chesapeake Bay Center for Environmental Studies.
T. L. Wu, L. Lambert, D. Hastings, and D. Banning.
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 3, p 411-414, 1980. 1 Fig, 1 Tab, 10 Ref.

Descriptors: *Agricultural chemicals, *Agricultural runoff, Crop production, *Estuaries, *Plankton, Agricultural watersheds, Agriculture, Farm wastes, Water pollution, Organic compounds, Diffusion, Convection, Pollutants, Water sampling, Pellicular water, Seasonal variation, *Herbicides, *Atrazine.

Results of a study of the distribution and concentration of atrazine in the Rhode River estuary in Maryland are presented. Atrazine is an herbicide commonly used to control broadleaf weeds and grasses in cornfields. During two seven-month sampling periods the peak concentractions were detected in August. Concentrations in microsurface and bulk water decreased in October. The effects of a high concentration of herbicides in the microsurface layer on the diversity and species composition of bacteria, phytoplankton, submerged macrophytes, and zooplankton exposed to the surface microlayer are not known. (Titus-FRC)
W82-00877

THE IMPACT OF AN INDUSTRIALLY CONTAMINATED LAKE ON HEAVY METAL LEVELS IN IT'S EFFLUENT STREAM,
Purdue Univ., Lafayette, IN. Dept. of Bionucleonics.
T. G. Adams, G. J. Atchison, and R. J. Vetter.
Hydrobiologia, Vol. 69, No 1/2, p 187-193, March, 1980. 1 Fig, 6 Tab, 27 Ref.

Descriptors: *Cadmium, *Zinc, *Stream degradation, Lakes, Stream pollution, Ecology, *Industrial wastes, Atomic absorption spectroscopy, Heavy metals, Water quality, Water pollution. Palestine Lake, Indiana, *Electroplating, Wastewater.

Levels of cadmium and zinc were determined in a stream receiving water from an industrially contaminated lake. Water samples were collected in Williamson Ditch (a contaminated stream flowing into Palestine Lake), Trimble Creek (a stream draining Palestine Lake), and the Tippecanoe River (a river receiving Trimble Creek). Atomic absorption spectrophotometry was used to analyze water, sediment, plant, fish, and clam samples. In Trimble Creek unweighted mean metal concentrations were: water, 51 microgram Zn/liter, 4.2 microgram Cd/liter; sediment, 592 microgram Zn/g, 48.4 microgram Cd/g; plants, 375 microgram Zn/g and 7.91 microgram Cd/g; fish, 145 microgram Zn/g and 6.02 microgram Cd/g. In general, concentrations were higher in Williamson Ditch and lower in the Tippecanoe River. The water is polluted by wastes from an electroplating plant. Results indicate that a large percentage of the metal wastes are not held in the lake. The stream which is the outlet for the lake contains metals in concentrations higher than background levels reported for other aquatic systems. (Small-FRC)
W82-00886

DEGRADATION OF HYDROCARBONS IN OXIDIZED AND REDUCED SEDIMENTS,
Louisiana State Univ., Baton Rouge, Lab. for Wetland Soils and Sediments.
R. D. Delaune, G. A. Hambrick, III, and W. H. Patrick, Jr.
Marine Pollution Bulletin, Vol 11, No 4, p 103-106, April, 1980. 5 Fig, 10 Ref.

Descriptors: *Degradation, *Hydrocarbons, *Sediments, Wetlands, Gulf of Mexico, Oxidation, *Salt marshes, *Louisiana, Oxidation-reduction potential, Anaerobic conditions, Aerobic conditions.

The effect of sediment oxidation-reduction or redox potential on hydrocarbon degradation was investigated in samples collected from a Gulf Coast salt marsh. Carbon-14 labelled octadecane, an alkane hydrocarbon, and carbon-14 labelled naphthalene, an aromatic hydrocarbon, were used in this study. Both of these hydrocarbons were very stable in the anaerobic sediment. Naphthalene did not degrade at all in the anaerobic sediment. Naphthalene showed less degradation in both oxidized and reduced sediment than did octadecane. Hydrocarbon degradation was significantly increased by a shift from strict anaerobic conditions in the sediment, where the hydrocarbons are stable and only a few microbial species function, to aerobic sediment conditions where aerobic and facultative anaerobic bacteria function. The redox profile of the sediment cores showed a distinct oxidized surface layer, between 5 and 10 millimeters thick, in which hydrocarbons were oxidized. Beneath this layer, anaerobic conditions, in which hydrocarbons did not degrade, prevailed. The study results clearly demonstrate that petroleum hydrocarbons in estuarine environments are significantly affected by the oxidation-reduction status of the sediment in contact with the hydrocarbons, and that aromatic hydrocarbons which enter an anaerobic sediment environment may persist. (Carroll-FRC)
W82-00907

CHEMICAL COMPOSITION OF LABILE FRACTIONS IN DOM,
Tokyo Metropolitan Univ. (Japan). Dept. of Chemistry.
For primary bibliographic entry see Field 2H.
W82-00917

MACROBENTHOS OF PINE ISLAND BAYOU IN THE BIG THICKET NATIONAL PRESERVE, TEXAS,
Lamar University, Beaumont, TX. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-00924

TRANSPORT OF SALTS IN SOILS AND SUBSOILS,
Volcani Inst. of Agricultural Research, Bet Dagan (Israel). Div. of Soil Physics.
E. Bresler.
Agricultural Water Management, Vol 4, No 1-3, p 35-62, 1981. 14 Fig, 23 Ref.

Descriptors: *Salts, *Soil water, *Estimating equations, Flow, Mathematical studies, Infiltration, Evaporation, Arid lands, Salinity, Water quality, *Israel, Agriculture, *Solute transport.

Factors affecting the movement of salts in saturated and unsaturated soils and subsoils under dryland conditions are reviewed. The transport occurring in homogeneous soils is described, and the factors affecting salt transport are quantitatively formulated. Equations are presented which describe combined diffusion-convection transient transport and

miscible displacement of salts and non-steady water flow. Equations and boundary conditions are described for infiltration, redistribution, and evaporation, in terms suitable for mathematical modeling. One-dimensional vertical profiles of non-interactive salts are described for homogeneous, bare fallow soil. Where physico-chemical interaction takes place between solution and soil matrix, these effects are considered. Also, vegetation effects are considered. Salt dispersion and distribution in heterogeneous fields are also discussed, including the concentration distributions for steady and transient leaking. A knowledge of these processes makes possible the development of optimum management practices to prevent the salinization of groundwaters, streamflows, and farmland. (Small-FRC)
W82-00930

EVALUATION OF WINTER APPLICATION OF LIQUID SLUDGE TO FARMLAND,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
T. Bates, J. W. Ketcheson, R. A. Johnston, and Y. K. Soon.
Water/Engineering and Management, Vol REF, No HB, p R155-156, 1981. 2 Tab.

Descriptors: *Sludge, *Land disposal, Runoff, Seasonal variation, Nitrogen, Phosphorus, Farms, Rainfall, Snowmelt, Thaw, Heavy metals, Water pollution sources, Path of pollutants, Ontario.

Field runoff was investigated from fall, winter, and spring applied sludge over a five year period on a silt loam soil at a location north of Guelph, Ontario. Rainfall averaged 858 mm and snowfall averaged 1,618 mm. Fluid anaerobically digested sludge from the North Toronto treatment plant was used for the study. Sewage was treated with ferric chloride for phosphorus removal and received secondary treatment with activation. Sludge was applied at 200 and 800 kg nitrogen/hectare rates on areas with 2% and 6% slopes. Treatments were replicated twice on each slope. Water was collected after each runoff event and total runoff, solids, and total and soluble nitrogen, phosphorus and metals were measured. Total runoff in winter was four times as much as in summer, with very little difference between the 2% and the 6% slopes. In summer there was more runoff from the steeper slope. Annual losses of N and P ranged from less than 1% to 10% of that applied and were greater in summer except for January, when total N losses were greater in the winter. Nearly all the nitrogen and phosphorus in winter runoff was water soluble, but in summer runoff only 1-2% was water soluble. Losses of nitrogen and phosphorus were high from November and January applied sludge when rainfall or snow melt immediately followed sludge application. The North Toronto sludge was low in metals, but some metal losses did occur, with the effects of slope and time of application similar to those for nitrogen and phosphorus. It was noted that fluid sludge should not exceed 1.5 cm depth on the soil surface nor supply more than the crop requirements for available nitrogen. Fluid sludge should not be applied near waterways. (Baker-FRC)
W82-00952

THE FATE OF HEAVY METALS IN THE RUHR SYSTEM AND THEIR INFLUENCE ON DRINKING WATER QUALITY,
Ruhrverband, Essen (Germany, F. R.).
K. R. Imhoff, and P. Koppe.
Water Science and Technology, Vol 13, No 3, p 211-225, 1981. 4 Fig, 9 Tab, 18 Ref.

Descriptors: *Heavy metals, *Nickel, *Drinking water, Path of pollutants, *Ruhr River, Sediments, Water pollution control, *Industrial wastewater, Artificial recharge, Recharge, Infiltration, Chelation, Water treatment, Wastewater treatment, Adsorption, Pretreatment of water, Sludge disposal, Water quality control, Manganese, Zinc, Lead, Chromium.

Nickel is used to illustrate the path of heavy metals from the factory to the drinking water supply of the heavily populated and industrialized Ruhr River basin. Ni concentrations (in mg per liter) in various influents and effluents are as follows; untreated wastewater from the 300 electroplating plants in the basin, up to 1,000; pretreated effluent, 10; combined industrial and municipal wastewater influent, 0.5; municipal treatment plant effluent, 0.3; river water (flow 40 cu meters per sec) downstream of the effluent discharge, 0.05; and waterworks reservoir, 0.04. Drinking water obtained from artificial groundwater recharge contains 7.9 micrograms per liter of Ni, and from bank infiltration, 4.5 micrograms per liter (original river water, about 38.5 micrograms per liter). Most heavy metals decreased similarly in the path from water supply source to tap, with the exception of Mn in bank filtration and Cu in artificial groundwater recharge. In the distribution system concentrations of Zn decreased; Pb, Cr, and Cd did not change; and Cu and Ni increased to 62 and 13 micrograms per liter, respectively. Measures are suggested to further reduce heavy metals in drinking water: supervision in industries and avoidance of complexing agents in industry and detergents. Other problems are the high levels of metals in land applied sewage sludge and possible mobilization of metals from river sediments and subsoil. (Cassar-FRC)
W82-00962

ASSOCIATIONS AND MESOSCALE SPATIAL RELATIONSHIPS AMONG RAINWATER CONSTITUENTS,
Illinois State Water Survey, Urbana.
For primary bibliographic entry see Field 2B.
W82-00964

SULFUR AND ASSOCIATED ELEMENTS AND ACIDITY IN CONTINENTAL AND MARINE RAIN FROM NORTH FLORIDA,
Florida State Univ., Tallahassee. Dept. of Oceanography.
For primary bibliographic entry see Field 2B.
W82-00965

TRENCHING OF DIGESTED SLUDGE,
Science and Education Administration, Beltsville, MD.
For primary bibliographic entry see Field 5E.
W82-00974

BIOCONCENTRATION OF PESTICIDES BY EGG MASSES OF THE CADDISFLY, TRIAENODES TARDUS MILNE,
Illinois Natural History Survey, Urbana.
D. Belluck, and A. Felsot.
Bulletin of Environmental Contamination and Toxicology, Vol 26, No 3, p 299-306, March, 1981. 3 Fig, 1 Tab, 18 Ref.

Descriptors: *Eggs, *Caddisflies, *Bioaccumulation, *Pesticides, Aquatic insects, Biological magnification, Solubility, Fate of pollutants, Organic compounds.

Significant quantities of pesticides were accumulated by caddisfly egg masses (Triaenodes tardus Milne) from water with the following concentrations of pesticides: DDD, DDT, and HCB, 1 ppb; carbofuran, 8 ppb; dieldrin, 20 ppb; and methoxychlor, terbufos, malathion, diflubenzuron, and monuron, 100 ppb. The maximum bioconcentration factors, which correlated with phsyicochemical properties of the pesticides, were as follows: DDD, 2580; HCB, 550; DDT, 250; dieldrin, 100; methoxychlor, 80; diflubenzuron, 20; terbufos, 10; and carbofuran, malathion and monuron, zero. DDD, HCB, and DDT bioconcentration factors reached a peak at 72-96 hours, then declined sharply. Dieldrin and methoxychlor curves were not declining by the end of the 120 hour test. The remainder of the pesticides showed a small rise at 72-96 hours and decreased slightly. A strong correlation existed between water solubility of the pesticides and 72 hour bioconcentration factors. (Cassar-FRC)
W82-00982

ROLE OF SOLUTE-TRANSPORT MODELS IN THE ANALYSIS OF GROUNDWATER SALINITY PROBLEMS IN AGRICULTURAL AREAS,
Geological Survey, Reston, VA.
L. F. Konikow.
Agricultural Water Management, Vol 4, No 1/3, p 187-205, 1981. 11 Fig, 1 Tab, 20 Ref.

Descriptors: *Salinity, *Groundwater, Farming, Groundwater movement, Soil properties, Model studies, Solute transport, Salts, Surface-groundwater relationships, Hydrology, *Agricultural watersheds.

Accurate technical evaluations of the sources of salinity and of salt transport in a variety of hydrogeologic settings are important if control of groundwater salinity in agricultural areas is to be achieved. Two examples are given which illustrate the crucial role of groundwater in transporting and dispersing salts through a local or regional aquifer to the land surface or into a surface water body and the value of a model as an investigative tool to understand the processes and parameters controlling the movement and fate of the salt. The purpose of a model that simulates solute transport in groundwater is to compute the concentration of a dissolved chemical species in an aquifer at any specified place and time. The increase in salinity of groundwater and surface water in the Arkansas River Valley of south-eastern Colorado is primarily related to irrigation practices. An 18 km reach of the valley was selected for a detailed study. A detailed study was also performed in a nonirrigated area of a wheat field on a dryland farm in the South Platte River valley, near Denver. The model was also used to test some possible water management alternatives, including the coupling of artificial recharge with construction and operation of hydraulic sinks along the northern boundary of the Rocky Mountain Arsenal, which is adjacent to the dryland farm area. Such complex engineering solutions may be feasible in cases where the salt problem is predominantly related to an isolated and specific industrial activity, as is the case here. However, use of such measures in areas where salt seeps out due to agricultural activities is not likely to be helpful. (Baker-FRC)
W82-00993

DETERMINATION OF PICOGRAM AMOUNTS OF TECHNETIUM-99 BY RESIN BEAD MASS SPECTROMETRIC ISOTOPE DILUTION,
DuPont de Nemours (E. I.) and Co., Aiken, SC. Savannah River Lab.
For primary bibliographic entry see Field 5A.
W82-00999

HEAVY METAL CONTENTS IN SOME MACROPHYTES FROM SAGINAW BAY (LAKE HURON, U.S.A.),
Cranbrook Inst. of Science, Bloomfield Hills, MI.
J. R. Wells, P. B. Kaufman, and J. D. Jones.
Aquatic Botany, Vol 9, No 2, p 185-193, September, 1980. 1 Tab, 11 Ref.

Descriptors: *Heavy metals, *Macrophytes, *Lakes, Water pollution control, Algae, Bioaccumulation, Water pollution effects, Lake Huron, *Saginaw Bay.

An investigation was designed to see which aquatic species, if any, offered potential for the removal of heavy metals from freshwater lakes. During the summer of 1977 in Saginaw Bay (Lake Huron), 71 plants representing 22 species were collected and analyzed for heavy metal content. Neutron activation analysis was used to measure levels of Ag, As, Ba, Cd, Ce, Co, Cr, Cs, Ni, Rb, Sb, Se, Th, U, and Zn in the 21 spermatophytes and one green alga. Both submersed and emergent species showed considerable accumulations of a range of metals. Different organs of the same species or of the same plant were found to vary widely in concentrations of the same element. Highest element uptake amounts were found near the mouth of the Saginaw River. Some plants growing in the polluted bay contained lower amounts of certain metals than did plants of the same species growing in a wilderness area. Thus, plants can accumulate large amounts of metals, but these high concentrations may not result from water pollution. (Small-FRC)
W82-01000

SALINE SEEP DEVELOPMENT AND CONTROL IN THE NORTH AMERICAN GREAT PLAINS - HYDROGEOLOGICAL ASPECTS,
Montana Bureau of Mines and Geology, Butte.
M. R. Miller, P. L. Brown, J. J. Donovan, R. N. Bergatino, and J. L. Sonderegger.
Agricultural Water Management, Vol 4, No 1/3, p 115-141, 1981. 14 Fig, 2 Tab, 30 Ref.

Descriptors: *Seepage, *Salinity, Chemical properties, *Groundwater, Contamination, Water pollution sources, Groundwater movement, Seepage control, Hydrology, Geohydrology, Groundwater hydrology, Farming, Path of pollutants, *Great Plains.

Hydrogeological aspects of saline seeps are discussed, emphasizing the formation and development, regional extent and potential impacts, and effective control practices for such seeps. Dryland salinity is caused by a combination of cultural, climatic, and hydrogeological conditions. The process begins with excess water percolating down beneath the root zone, picking up soluble salts, accumulating on shallow, less-permeable layers, and forming a local groundwater flow system which moves saline water from the recharge to the discharge area or seep, where it evaporates, depositing the salts on the surface. Geological conditions favorable for such development exist throughout the Northern Great Plains region. There, sufficient soluble salts are available in the upper 6 meters of the soil profile to continue existing saline seeps for the next 25-100 years. Shallow groundwater resources appear to be showing signs of contamination by the saline seep process. High concentrations of dissolved solids, nitrates, and selenium are the most troublesome. Alternate crop-fallow farming techniques allow significant quantities of water to move beneath the root zone, activating the local groundwater flow system and contributing to dryland salinity. The use of deep-rooted perennial crops, flexible cropping systems, and surface drainage of cultivated upland recharge areas will help control dryland salinity. Research results are presented from ten years of study on a typical site, the Hanford-Bramlette test area, about 56 km northeast of Great Falls, Montana, with an area of about 65 ha. (Baker-FRC)
W82-01022

IMPACT OF WATER RESOURCE DEVELOPMENT ON SALINIZATION OF SEMI-ARID LANDS,
California Univ., Davis. School of Civil Engineering.
G. T. Orlob, and A. Ghorbanzadeh.
Agricultural Water Management, Vol 4, No 1/3, p 275-293, 1981. 9 Fig, 14 Ref.

Descriptors: *Salt balance, *River basin, *California, *San Joaquin River, Drainage, Catchment areas, Model studies, Rivers, Farming, *Tile drainage, Semiarid lands.

The development of water resources in the San Joaquin Valley of California is reviewed. The valley is one of the most productive agricultural areas of the world. All of its major rivers have been regulated for power production, water supply, flood control and irrigation. Through the Central Valley Project water was impounded and subsequently diverted to the Tulare Basin to the south. This water was replaced in part by importation from the Sacramento-San Joaquin Delta through the Delta Mendota Canal. This deprived the main river system downstream of Mendota of normal runoff and has led to a serious impact on agriculture in the northern portion of the valley. Changes in water quality have been noted, particularly a reduction in diluting flows of natural runoff and increases in salt accretions to the natural drainage courses due to irrigation drainage. By analyzing runoff and water quality at a sufficient number of locations along the San Joaquin River it was determined that virtually all of the sulfate that reaches Vernalis originates with drainage upstream of the mouth of the Merced River. The salt load carried by the San Joaquin River is steadily increasing. An important step in rectifying the basin's salt balance will be the installation of drainage facilities to convey out of the basin accretions from discrete sources. This will include tile drainage. Model studies have been made, based on the Galerkin-type Finite Element Method. A brief description of one case study using this model is presented. (Baker-FRC)
W82-01024

LEACH CHARACTERISTICS OF COAL-GASIFICATION CHAR,
Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering.
R. Luthy, P. Vassiliou, and M. J. Carter.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE1, p 81-103, February, 1980. 9 Fig, 6 Tab, 20 Ref.

Descriptors: *Leaching, *Coal gasification, Gasification, *Char, Infiltration, Percolation, Leachates, Carbon, Boron, Molybdenum, Metals, Acidity, Groundwater pollution, Irrigation water, Industrial wastes, Path of pollutants.

Attempts were made to quantify the extent and rate of release of trace elements from char when leached with eluants of varying qualities. Char is produced when carbon conversion is incomplete. The solid waste evaluated here was Hygas western coal char formed at about 63% carbon conversion. In a continuous-flow leaching experiment, 200 g of char was placed loosely in the leaching columns without compaction. Leachate and digested char samples were analyzed for 22 elements using simultaneous multielement analysis by inductively coupled argon-plasma atomic emission spectroscopy. Six different leaching solutions were used: distilled water (simulating rainwater), model intermediate hard water (simulating a typical surface water), model hard water, model acid mine water, acetate-tartrate/hydrosulfite eluant, and deaerated (boiled) tap water (simulating a mildly acidic mineral water with low buffering capacity). The amount of material extracted depended on the nature and strength of the extractant, with pH and buffer capacity of the extractant being important factors. Boron poses a leaching problem due to its deleterious effects on irrigation waters. Molybdenum was the only heavy metal specie routinely identified in the leachate, excluding the acetate-tartrate experiment. This could be a problem, as ground waters carry levels of this element that can give rise to plant concentrations toxic to cattle. (Baker-FRC)
W82-01025

UPTAKE OF POLYCHLORINATED BIPHENYLS BY NATURAL PHYTOPLANKTON ASSEMBLAGES: FIELD AND LABORATORY DETERMINATION OF C14-PCB PARTICLE-WATER INDEX OF SORPTION,
Texas A and M Univ., College Station. Dept. of Oceanography.
D. C. Biggs, C. D. Powers, R. G. Rowland, H. B. O'Connors, Jr., and C. F. Wurster.
Environmental Pollution, (Series A) Vol 22, No 2, p 101-110, June, 1980. 3 Fig, 2 Tab, 19 Ref.

Descriptors: *Polychlorinated biphenyls, *Phytoplankton, *Sorption, Algae, Accumulation, *Fate of pollutants, Chlorinated hydrocarbons, Pesticides, Estuarine environment, Long Island Sound.

Uptake of C14-polychlorinated biphenyls (PCB, 54% chlorine) by a natural phytoplankton community and particulate matter was studied in glass containers in the laboratory and in dialysis cultures in Long Island Sound. Particles at a concentration of 25 million cu micrometers per ml took up 19-22% of the PCB, leaving 1-3% on the glass walls of the container and 70-72% in the water. At particle concentrations 4-fold higher, particles adsorbed 66-69% of the PCB, leaving 22-23% in the water. The percentage sorption appeared to be independent of the PCB concentration (5.8 and 11.6 micrograms per liter) used. Heat-killed cells sorbed significantly more PCB than live particles. In desorption experiments, most of the PCB leached from the particles within 5 days when dialyzed against PCB-free water. The water lost PCB more rapidly than the particles. The ratio of PCB sorbed to particles to that in an equal volume of water averaged 20,000. (Cassar-FRC)
W82-01032

UPTAKE AND TRANSFER OF THE CHLORINATED HYDROCARBON LINDANE (GAMMA-BHC) IN A LABORATORY FRESHWATER FOOD CHAIN,
Hamburg Univ. (Germany, F.R.) Inst. fuer Hydrobiologie und Fischereiwissenschaft.
For primary bibliographic entry see Field 5C.
W82-01033

TRACE METAL FLUXES TO NEARSHORE LONG ISLAND SOUND SEDIMENTS,
New Hampshire Univ., Durham. Dept. of Earth Sciences.
W. B. Lyons, and W. F. Fitzgerald.
Marine Pollution Bulletin, Vol 11, No 6, p 157-161, June, 1980. 1 Fig, 5 Tab, 31 Ref.

Descriptors: *Trace metals, *Marine sediments, *Long Island Sound, *Bottom sediments, Sediment, Metals, Lead, Zinc, Cadmium, Silver, Iron, Manganese, Copper, Fluctuations, Estuaries.

Sediments can act as 'sinks' or 'traps' for trace metals in the coastal marine environment. The concentrations and fluxes of iron, manganese, copper, lead, cadmium, zinc, and silver in the sediments of two nearshore areas in Long Island Sound were investigated. The calculated natural metal fluxes of iron, manganese, zinc, cadmium, and silver for the Mystic River estuary, which is representative of the nearshore sedimentary environment of the eastern part of the Sound, were found to resemble those of the Santa Barbara Basin and the Baltic Sea rather than those of other New England estuaries. The natural fluxes of copper and lead at this site are the lowest ever reported. There was no correlation between increases in dacmium, copper, lead, silver, and zinc in the uppermost sediments and increases in organic carbon. The concentrations of these metals were all strongly correlated with each other, suggesting that they are due to increases in human activity. However, there was no strong relationship between these metals and iron. The calculated fluxes for the Branford Harbor sediments, located offshore from a more industrialized area on the western part of the Sound, resembled those of other New England estuaries. The higher anthropogenic fluxes of metals found at Branford Harbor, as compared to those at the Mystic River site, indicate greater inputs of metals in the western and central portion sections of the Sound due to human activity. Increased trace metal concentrations in the sediments of the Sound proceeding from east to west support this conclusion. Metal concentrations in the sediments at various locations appear to mirror the location of the introduction of the metals into the estuarine system. The highest metal fluxes in the sediments occurred at sites closest to known sources of anthropogenic metal inputs. (Carroll-FRC)
W82-01040

DISPERSAL OF SALMONELLA FROM A POLLUTED STREAM TO NEIGHBORING TERRESTRIAL HABITATS,
Elmhurst Coll., IL. Dept. of Biology.
For primary bibliographic entry see Field 5A.
W82-01043

EFFECTS OF NITRAPYRIN ON NITRATE MOVEMENT IN SOIL COLUMNS,
Science and Education Administration, Coshocton, OH. North Appalachian Experimental Watershed.
For primary bibliographic entry see Field 5G.
W82-01048

GROUNDWATER QUALITY MODELS - STATE OF THE ART,
Wisconsin Univ.-Madison. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 5G.
W82-01061

EFFECTS OF RENTON WASTEWATER TREATMENT PLANT EFFLUENT ON WATER QUALITY OF THE LOWER GREEN/DUWAMISH RIVER,

Washington State Dept. of Ecology, Olympia.
For primary bibliographic entry see Field 5D.
W82-01063

THE IMPACT OF EFFLUENT FROM THE RENTON WASTEWATER TREATMENT PLANT ON THE DISSOLVED OXYGEN REGIMEN OF THE LOWER GREEN/DUWAMISH RIVER,
Washington State Dept. of Ecology, Olympia.
For primary bibliographic entry see Field 5D.
W82-01064

AN INDUSTRIAL AND HAZARDOUS WASTE INVENTORY OF WASHINGTON'S MANUFACTURING INDUSTRIES (1980),
Washington State Dept. of Ecology, Olympia.
D. M. Kruger.
Document WDOE 81-4, February 1981. 28 p. 4 Fig, 12 Tab, 9 Ref, 3 Append.

Descriptors: *Industrial wastes, *Waste management, Inorganic compounds, Waste characteristics, *Landfills, *Hazardous materials, Organic wastes, Toxins, Waste dumps, Solid waste disposal, Waste disposal, Wastes, Wastewater lagoons, *Washington, *Hazardous waste inventory.

The State of Washington is currently developing a statewide hazardous waste management program. Over 500 manufacturing industries, representing 15 percent of Washington industries, were sent an inventory to obtain information on the amount, type, chemical nature (organic or inorganic), and ongoing management practices for treatment, storage, and disposal of industrial and hazardous waste. A total of 350 forms were returned, with 200 industries reporting hazardous waste generation. Inventory information showed that most of Washington's manufacturing waste is inorganic. Nearly 0.4 million tons and 14.3 million gallons of inorganic hazardous waste were generated in 1980. Common waste names reported in the inventory were waste oils, spent solvents, PCB's, heavy metal sludges, paint strippers, pentachlorophenol, metal plating sludges, and spent potliners. Most of the hazardous waste generated in Washington stays in-state. Although a variety of treatment, storage, and disposal methods exist for handling hazardous wastes, in general, little or no treatment technology is employed. Percolation and evaporation lagoons are the primary treatment methods used for liquid wastes. Most solids and sludges are not treated. The primary storage methods for hazardous solids and sludges are piles, while hazardous liquids are stored in pits, ponds, and lagoons. The primary disposal method for solids and sludges is landfilling. Recovery of hazardous wastes, at this time, is the least practiced; less than half the solid hazardous waste is either recycled or reclaimed. (Garrison-Omniplan)
W82-01065

ASSESSMENT OF WATER QUALITY CONDITIONS IN SKAMOKAWA CREEK, WASHINGTON,
Washington State Dept. of Ecology, Olympia.
For primary bibliographic entry see Field 5C.
W82-01066

WATER QUALITY CONDITIONS IN THE BELLINGHAM BAY AREA 1979-1980,
Washington State Dept. of Ecology, Olympia.
R. F. Stanley.
Document DOE 80-14, December, 1980. 13 p, 2 Fig, 4 Append.

Descriptors: *Pulp and paper industry, Mills, *Wastewater treatment, *Water quality management, Wood waste, Industrial wastewater, Water quality standards, Effluent, Anaerobic bacteria, Bays, Wastewater disposal, Data collection, *Bellingham Bay area, *Washington.

The prime contributor to inner Bellingham Bay's water quality problems, and the focal point of this study, is the pump, paper, and chemical complex operated by the Georgia-Pacific Corporation along the eastern bank of the Whatcom Waterway. This large industrial facility produces, as its main product, approximately 600 tons of sulfite wood pulp per day. Other products from the mill include wastepaper pulp, semichemical pulp, tissue paper, alcohol, lignin byproducts, sulfuric acid, chlorine, and sodium hydroxide. Wastewaters resulting from these activities approach 50 million gallons per day, and in the past have accounted for more than 90 percent of the oxygen-demanding discharges to the inner harbor. The cumulative effect of these wastes and the resulting buildup of anaerobic sludge deposits on the bottom of the Whatcom Waterway resulted in environmental conditions which virtually excluded all but the very lowest and most resistant life forms. These poor conditions existed until May 1979 when Georgia-Pacific constructed a wastewater treatment plant. Data collected during two Bellingham area receiving water surveys document a major improvement in water quality. Completion of the mill's new treatment system in 1979 included the interception of all major mill waste streams. These streams were then re-routed through the mill's aerated lagoon before being discharged to outer Bellingham Bay. Study data from 1980 indicate that the mill's final effluent had a relatively minor negative impact on the quality of the outer bay waters. Environmental quality within this relatively enclosed portion of the bay continues to be somewhat degraded by remaining anaerobic sludge beds. (Garrison-Omniplan)
W82-01068

WILSON CREEK DRAINAGE - SURFACE AND GROUND WATER QUALITY, JULY 1978 TO JULY 1979.
Washington State Dept. of Ecology, Olympia.
Document DOE 80-13, November, 1980. 50 p. 12 Fig, 8 Tab, 13 Ref, 3 Append.

Descriptors: Surface water, Groundwater pollution, Water quality management, Well water, Wastewater treatment, *Urban runoff, *Industrial wastewater, *Agricultural runoff, Irrigation wells, *Water pollution sources, Effluent standards, On-site data collection, Atomic absorption spectroscopy, *Wilson Creek, *Washington, Water pollution effects.

Surface water and groundwater quality were monitored in Wilson Creek drainage in central Washington State from July 1978 through July 1979 to evaluate impacts of irrigated agriculture, urban runoff, municipal and industrial waste disposal, and residential development. While water in domestic wells was found to meet drinking water standards, shallow irrigation wells contain water of poor bacterial quality and are fit for irrigation purposes only. Kittitas sewage treatment plant (STP) effluent was found to be significantly degrading water quality in Cooke Creek with respect to fecal coliforms, nutrients, and aesthetics. Temperature, pH, and dissolved oxygen were generally within Class A standards in Wilson Creek and its tributaries. Return flows from irrigated agriculture were identified as the cause of increased turbidity, solids, nutrient, and bacteria levels in the central and lower drainage. The other point and non-point sources monitored did not appear to impact water quality significantly. The study area encompassed approximately 190 square miles and involved 59 sampling stations. The four surface water parameters measured on site were temperature, pH, specific conductivity, and dissolved oxygen (Winkler-Azide modification). Eleven other parameters were measured in the laboratory, in addition to tests for total coliforms, chlorides, calcium hardness, and total iron. Field parameters measured in the groundwater study included temperature, pH, specific conductivity, and well water levels. Grab samples of water and sediment were collected once each month for determination of lead, mercury, and zinc content by atomic absorption spectrophotometry. (Garrison-Omniplan)
W82-01069

ENTERIC VIRUSES IN RENOVATED WATER IN MANITOBA,
Cadham Provincial Lab., Winnipeg (Manitoba).
For primary bibliographic entry see Field 5A.
W82-01090

ARE METALS FROM HIGHWAY DUSTFALL HAZARDOUS IN SWIMMING POOLS,
Florida International Univ., Miami. School of Technology.
J. A. Beech.
Journal of Environmental Health, Vol 42, No 6, p 328-331, May/June, 1980. 4 Tab, 18 Ref.

Descriptors: *Swimming pools, *Highway effects, Heavy metals, Recreation facilities, Highways, Roads, Dusts, Metals, Sediments, Water quality.

The possible effect of roadwar dust on the heavy metal content of swimming pool water was investigated. Water from 20 pools alongside busy highways was compared with water from 80 other freshwater pools classified into four groups by pool location and/or type. All samples came from public or commercial open-air pools, originally filled from the Miami municipal water supply. Powdery sediments were noted on the bottom of several pools alongside busy highways. These sediments were also analyzed. Three pool samples exceeded or equaled interim primary drinking water standards for lead or cadmium. Two of these contained 73 and 50 micrograms per liter of lead and one contained 12.1 micrograms of cadmium. Only 20 pool samples contained less than 100 mg/liter of sodium. Sodium ions are added during routine maintenance. Copper content of the sediments varied greatly. Some sediments contained very large amounts of lead. Pool sediments were somewhat higher in metals than are most roadside dusts. No significant differences were found between soluble heavy metal concentrations of water from pools alongside highways and water from other city pools. Until more is known about the properties of these bottom sediments in pools, it is recommended that they be removed from the entire circulating system when the pools are cleaned. (Baker-FRC)
W82-01093

5C. Effects Of Pollution

EFFECT OF CRUDE OIL AND PETROLEUM-DEGRADING MICROORGANISMS ON THE GROWTH OF FRESHWATER AND SOIL PROTOZOA,
Toronto Univ. (Ontario). Dept. of Zoology.
A. Rogerson, and J. Berger.
Journal of General Microbiology, Vol 124, No 1, p 53-59, May, 1981. 3 Fig, 21 Ref.

Descriptors: *Protozoa, *Oil, *Growth rates, *Bacteria, Microorganisms, Water pollution effects, Oil pollution, Microbial degradation, Microbiological studies, *Crude oil.

The ability of a known oil-degrading microflora to support the growth of several common freshwater and soil protozoa was investigated. Also, the protozoa were cultured with emulsified crude oil to study the effects of their directly ingesting oil globules. The following protozoa were cultured either in the presence or in the absence of partially degraded crude oil: Colpidium campylum, Tetrahymena pyriformis, Colpidium colpoda, Colpoda cucullus and Uroleptus. Also, the soil amoeba Naegleria gruberi was cultured. Comparisons were made using the regression coefficient characterizing the slope of the growth curve. The presence of hydrocarbons in the batch culture system did not consistently affect protozoan growth. Protozoan replication was not deterred by the oil droplets observed within the food vacuoles of ciliates. The protozoa most susceptible to reduced growth rates in the presence of emulsified oil were the small pelagic ciliates. In general, there was a slight tendency towards larger protozoa in the presence of oil. (Small-FRC)
W82-00517

ACID RAIN: FACTS AND FALLACIES,
Northeastern Forest Experiment Station, Durham, NH.
J. W. Hornbeck.
Journal of Forestry, Vol 79, No 7, p 438-443, July, 1981. 3 Fig, 45 Ref.

Descriptors: *Acid rain, *Air pollution, *Precipitation, Snowmelt, Rainfall, Acidity, Chemical properties, Industrial wastes, Forests, Ecosystems, Vegetation, Soil environment, Leaching, Water pollution effects.

The sources and effects of acid rain are complex environmental phenomena. Although the major sources are thought to be atmospheric emissions, primarily from urban sources, the exact locations of sources and the mechanisms of transformation of emissions to acid rain are not entirely understood. In the absence of long term records, it is difficult to analyze changes in rainfall acidity and whether this problem is intensifying or spreading. Long range transport of airborne emissions by weather systems has made acid rain a potential threat to aquatic and forest ecosystems in rural areas. Acid rain contains not only substances that donate hydrogen ions, such as nitric and sulfuric acid, but also dissolved ions of common and heavy metals and trace elements. Aquatic ecosystems are the most vulnerable to acid rain in the short run. Acidification of streams and lakes may lead to decreased fish populations and increased concentrations of toxic metals. Acid rain may accelerate the replacement and leaching of basic cations and speed the rate of acidification of soils, particularly shallow, coarse textured forest soils which are already lacking in basic cations. This gradual acidification of the soil could increase leaching of nutrient ions, slow microbiological processes, reduce the variety and populations of soil fauna, and increase the mobility of some toxic elements. Acid rain also appears to be depositing heavy metals on forest soils. Long range effects of acid rain may include reduction of forest productivity and alteration of species composition or diversity. (Carroll-FRC)
W82-00518

SESTON DYNAMICS IN SOUTHERN APPALACHIAN STREAMS: EFFECTS OF CLEAR-CUTTING,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
For primary bibliographic entry see Field 4C.
W82-00543

SEDIMENTOLOGICAL AND BIOLOGICAL CHANGES IN THE WINDSOR MUDFLAT, AN AREA OF INDUCED SILTATION,
McMaster Univ., Hamilton (Ontario). Dept. of Geology.
T. R. Turk, M. J. Fisk, R. W. M. Hirtle, and R. K. Yeo.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 9, p 1387-1397, September, 1980. 10 Fig, 2 Tab, 40 Ref.

Descriptors: *Tidal powerplants, *Sedimentation, *Mud flats, *Silting, *Secondary productivity, *Tidal marshes, Tidal flats, Water resources development, Aquatic productivity, Environmental effects, Sediments, Clams, Polychaetes, Amphipods, Ecological effects, Windsor, *Nova Scotia.

The effect of rapid sedimentation on the sedimentological and biological properties of an intertidal mudflat was examined at the causeway-formed mudflat at Windsor, Nova Scotia. The sediments on the Windsor mudflat have occurred as a result of construction of a tidal power dam. The Windsor mudflat is characterized by high water levels, small grain sizes and high levels of organic carbon. The amphipod, Corophium volutator and the clam, Macoma balthica are less abundant in the study site than in surrounding mudflats. The polychaete, Heteromastus filiformis is very abundant at Windsor, while M. balthica grows faster and has a shorter lifespan. However, the weight of the Windsor clams increases more slowly with increasing shell size, probably in response to the greater fluidity of Windsor sediments. These findings suggest that the secondary productivity of Corophium and Macoma could be reduced by about 66% for another decade in existing Minas Basin mudflats. (Geiger-FRC)
W82-00548

RESIDUES IN CUTTHROAT TROUT (SALMO CLARKI) AND CALIFORNIA NEWTS (TARICHIA TOROSA) FROM A LAKE TREATED WITH TECHNICAL CHLORDANE,
Simon Fraser University, Burnaby (British Columbia). Dept. of Biological Sciences.
L. J. Albright, P. C. Oloffs, and S. Y. Szeto.
Journal of Environmental Science and Health, Part B, Vol 15, No 4, p 333-349, 1980. 4 Tab, 13 Ref.

Descriptors: *Chlorinated hydrocarbons, *Residual chlorine, Water pollution, Lake sediments, *Chlordane, Sediments, *Trout, Fish, Salamanders, Amphibians, Cutthroat trout.

Laboratory studies with chlordane and other chlorinated hydrocarbons showed that these compounds were not metabolized in water but, except for lindane, were readily partitioned into the sediments where some metabolism occurred. A subsequent whole-lake study, conducted to extend these laboratory investigations, involved treatment of a lake with about 10 parts per billion of technical chlordane. The uptake of chlordane residues from the lake water and sediment and their metabolism by two macroorganisms was investigated using the California newt, Tarichia torosa, which lives closely associated with the sediment, and the cutthroat trout, Salmo clarki. The newts were collected at 14, 279, 451, and 1,036 days after the water was treated, while the trout were collected at 93, 279, 421, and 1,014 days. Both of the organisms had residue concentrations in their bodies and livers which far exceeded those in their habitat at the first sampling. These first residue concentrations resembled that of technical chlordane, except for heptachlor, which was quantitatively epoxidized in newts after 14 days. Some heptachlor was still present in trout at 93 days. Concentrations of total chlordane in body tissues of both species declined more than 98% by the final sampling. Trans-nonachlor was the most persistent constituent of technical chlordane, accounting for about 50% of the total chlordane in the specimens collected last. Although the chlordane rapidly disappeared from the water into the sediment, the concentrations of total chlordane in the bodies of newts and trout after the samplings taken at 279 days were very similar, suggesting that the newt metabolizes and eliminates chlordane residues more effectively than the cutthroat trout. Both species were found to produce oxychlordane, probably from gamma-chlordane. (Carroll-FRC)
W82-00558

EFFECT OF TEMPERATURE ON MINERALIZATION BY HETEROTROPHIC BACTERIA,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Biology.
D. L. Tison, and D. H. Pope.
Applied and Environmental Microbiology, Vol 39, No 3, p 584-587, March, 1980. 4 Fig, 9 Ref.

Descriptors: *Thermal pollution, *Bacteria, Heated water, *Temperature effects, Waste heat, Thermal powerplants, Thermal stress, Water pollution effects, Thermal water, Algae.

The results of shifts in temperature on the percentage of substrate mineralized (% Min) by pure cultures of psychrotrophic, mesophilic, and thermophilic bacteria and by naturally occurring microbial communities were studied. The possibility that changes in the % Min may be an indication of stress in microbial communities is discussed. Pure cultures of the bacteria Pseudomonas fluorescens (a psychrotroph), Escherichia coli (a mesophile) and SRL 261 (a thermophile) were shifted away from temperatures to which they were adapted. At this point the % Min increased. The increase was noticeably larger for larger temperature shifts. When natural heterotrophic bacterial populations from sediments of Lake George, New York were subjected to temperature shifts similar responses were noted. The same response was found when a thermophilic algal-bacterial mat community at the Savannah River Plant in Aiken, South Carolina was subjected to temperature shifts. It is suggested that an increase in the % Min may be an indication of thermal stress in bacterial populations. (Baker-FRC)
W82-00583

SURVIVAL OF HUMAN ENTEROVIRUSES IN THE HAWAIIAN OCEAN ENVIRONMENT: EVIDENCE FOR VIRUS-INACTIVATING MICROORGANISMS,
Hawaii Univ., Honolulu. Water Resources Research Center.
R. S. Fujioka, P. C. Loh, and L. S. Lau.
Applied and Environmental Microbiology, Vol 39, No 6, p 1105-1110, June, 1980. 7 Fig, 1 Tab, 10 Ref.

Descriptors: *Seawater, *Enteroviruses, Hawaiian Ocean, Viruses, Temperature effects, Poliovirus, Nutrients, Antibiotics, Microorganisms, *Hawaii, Oahu.

This report describes the stability of human enteroviruses in the seawaters surrounding Oahu, the major island in the state of Hawaii, and characterizes the virus-inactivating agents present in these waters. The time required for a 90% reduction of poliovirus type 1 at 24 degrees C ranged from 24 to 48 hr. Complete inactivation occurred within 72 to 96 hr. A virus-inactivating agent(s) of a microbiological nature was found in both the clean and sewage-polluted seawaters, but not in fresh, mountain stream waters. Antiviral activity disappeared when the seawater samples were subjected to boiling, autoclaving, or filtration through a 0.22- or 0.45-micrometers, but not a 1.0 micrometer membrane filter. The concept that the antiviral activity of the seawater was related to the growth activities of microorganisms was corroborated by the observed effects of added nutrients, a lower temperature of incubation, and the presence of certain antibiotics. Other enteric viruses, such as coxsackie virus B-4 and echo virus-7, were also shown to be similarly inactivated in seawater. (Baker-FRC)
W82-00587

TOXICITIES OF PARAQUAT AND DIQUAT HERBICIDES TO FRESHWATER COPEPODS (DIAPTOMUS SP. AND EUCYCLOPS SP.),
Southern Univ., Baton Rouge. LA. Dept. of Biological Sciences.
S. M. Naqvi, T-S. Leung, and N. Z. Naqvi.
Bulletin of Environmental Contamination and Toxicology, Vol 25, No 6, p 918-920, 1980. 2 Tab, 12 Ref.

Descriptors: *Paraquat, *Diquat, *Copepods, *Herbicides, Toxicity, Mortality, Crustaceans, Invertebrates, Water pollution effects, *Aquatic animals, Zooplankton.

Zooplankton were collected from a natural lake with a plankton net. Copepods were separated out by concentrating the sample and removing the upper portion containing the aggregated copepods. Freshwater copepods (Diaptomus sp. and Eucyclops sp.) were exposed to various concentrations (0 to 140 ppm) of the herbicides diquat and paraquat for 24 and 48 hours. LC50 results in ppm were: diquat, 74 at 24 hours, 19 at 48 hours; paraquat, 10 at 24 hours, 5.3 at 48 hours. Mortalities of 98-100% were observed at concentrations of 140 ppm diquat and 100 ppm paraquat in 24 hours and 60 ppm diquat and 30 ppm paraquat in 48 hours. The copepods were slightly more tolerant to these herbicides than cladocerans; however, copepods mortality in aquatic ecosystems due to excessive use of diquat and paraquat cannot be ruled out. (Cassar-FRC)
W82-00589

TOXICITY OF FIVE FOREST INSECTICIDES TO CUTTHROAT TROUT AND TWO SPECIES OF AQUATIC INVERTEBRATES,
Columbia National Fisheries Research Lab., MO.
D. F. Woodward, and W. L. Mauck.
Bulletin of Environmental Contamination and Toxicology, Vol 25, No 6, p 846-853, 1980. 3 Tab, 13 Ref.

Descriptors: *Fish, *Insecticides, *Invertebrates, Aquatic life, Toxicity, *Trout, Water pollution effects, Pesticides, Carbamate pesticides, Organophosphorus pesticides, Acephate, Fenitrothion, Trichlorofon, Aminocarb, Carbaryl, *Toxicity.

The toxicity of five forest insecticides was determined for cutthroat trout obtained from the Jack-

son Wyoming National Fish Hatchery and aquatic invertebrates, stonefly naiads from The Snake River and amphipods collected from small springs. The 96-hour LC50s for trout (Salmo clarki) in 12 degrees C soft water at pH 7.5 were (in micrograms per liter): acetate 100,000; aminocarb 28,000; carbaryl 3,950; fenitrothion 2,880; and trichlorofon 1,680. For amphipods (Gammarus pseudolimnaeus) the 96-hour LC50 were (in micrograms per liter): acephate 25,000; aminocarb 1,000-2,200; carbaryl 7-13; fenitrothion 4.3-5.6; and trichlorofon 52-108. In stoneflies (Pteronarcella badia) the 96-hour LC 50s (in micrograms per liter) were: acephate 6,400-21,200; aminocarb 26-28; carbaryl 11-29; fenitrothion 5.1-7.2; and trichlorofon 5.3-100. It is important to note that toxicity of some insecticides varies significantly (by as much as 300-fold) when they are formulated and applied in water of different pH, hardness, or temperatures. All five insecticides, excluding aminocarb, appear safe to cutthroat trout at pH 7.5 or less at normal formulation and application rates. The aquatic invertebrates are much more sensitive to the toxicants. Acephate is the safest forest insecticide to both trout and invertebrates. However, a 2 lb per acre application rate has shown evidence of cholinesterase inhibition in songbirds. (Cassar-FRC)
W82-00590

ASSESSMENT OF THERMAL DISCHARGES ON ZOOPLANKTON IN CONOWINGO POND, PENNSYLVANIA,
Radiation Management Corp., Drumore, PA. Muddy Run Ecological Lab.
D. Mathur, T. W. Robbins, and E. J. Purdy, Jr.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 6, p 937-944, June, 1980. 4 Fig, 5 Tab, 13 Ref.

Descriptors: *Zooplankton, *Thermal pollution, *Statistical analysis, Heated water, Temperature effects, Powerplants, Mathematical studies, Conowingo Pond, Pennsylvania.

Analysis of covariance was used to separate natural variations in zooplankton from those caused by power station operation. The covariants were: density of zooplankton at control station, ambient water temperature, and average daily river flows. The assessment was made at Conowingo Pond, a 35.8 km sq impoundment on the lower Susquehanna River which is part of the Peach Bottom Atomic Power Station, a once-through cooling system. Some of the problems associated with using the ratio of density at the control station to the density at an affected station to adjust for ambient variations were overcome using the convariance technique. Significant differences were found in adjusted preoperational and postoperational means, but these were not attributable to station operation. Multiple regression analysis indicated that an increase in zooplankton production could result from the addition of heated water when river flows were less than 280 cu m/sec. Temperature differences from ambient averaged 10C in winter and 8C in summer. (Small-FRC)
W82-00592

EFFECT OF METALS ON THE BIOMASS PRODUCTION KINETICS OF FRESHWATER COPEPODS,
Canada Center for Inland Waters, Burlington (Ontario).
U. Borgmann, R. Cove, and C. Loveridge.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 4, p 567-575, April, 1980. 5 Fig, 11 Tab, 12 Ref.

Descriptors: *Water pollution effects, *Heavy metals, *Copepods, *Toxicity, Cadmium, Copper, Mercury, Lead, Arsenic, Biomass, Aquatic productivity, Canals, Fluctuations, Seasonal variation, Crustaceans, Mathematical studies.

The effects of cadmium (Cd), copper (Cu), mercury (Hg), lead (Pb), and arsenic (As) on the kinetics of in situ copepod production in the Burlington Canal were examined under static conditions. Nauplii were collected and exposed for two weeks to various concentrations of the metals. Biomass growth rate, mortality rate, cohort biomass growth rate and recoverable metal concentrations were calculated and subjected to mathematical analysis. Results showed seasonal cycles in toxicity for all of the metals except As. Pb toxicity was associated with the ash-free dry weight of the seston, but the fluctuations in Cd, Cu and Hg toxicity could not be explained. Metal toxicity to copepods and daphnids is often more similar in the chronic form than in the acute form. Mathematical relationships between metal levels and growth and mortality rates are presented along with a method for determining sublethal metal concentrations. (Geiger-FRC)
W82-00593

DYNAMICS OF SELENIUM IN MERCURY-CONTAMINATED EXPERIMENTAL FRESHWATER ECOSYSTEMS,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 5B.
W82-00595

INSECT COMMUNITY STRUCTURE AS AN INDEX OF HEAVY-METAL POLLUTION IN LOTIC ECOSYSTEMS,
Miami Univ., Oxford, OH. Dept. of Zoology.
R. W. Winner, M. W. Boesel, and M. P. Farrell.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 4, p 647-655, April, 1980. 2 Fig, 6 Tab, 28 Ref.

Descriptors: *Heavy metals, *Chironomids, *Stream pollution index, Copper, Chromium, Zinc, Aquatic insects, Caddisflies, Mayflies, Midges, Water pollution effects, Aquatic populations, Bioindicators, Macroinvertebrates, *Lotic environment, Insects, Ecosystems.

Measurements of macroinvertebrate populations in two streams of southwestern Ohio suggest that community structure shows a predictable, graded response to pollution by heavy metals. In heavily polluted regions of both streams, only chironomids and tubificid worms survived in rock rubble and riffle sections. Midge larvae predominated in the most polluted areas. The correlation coefficient for percentage of chironomids in relation to copper levels was +0.93. The lowest changes in coefficient of variation (CV) were found at the most polluted stations and increased along a gradient of decreasing metal levels. The number of chironomid species increased as metal pollution levels decreased. Caddisflies were numerically important at points of intermediate pollution along both streams, while mayflies were found only at areas of very low pollution. The percentage of chironomids present in lotic water samples is proposed as a useful index of stream pollution by heavy metals. (Geiger-FRC)
W82-00596

METAL SPECIATION. EFFECTS ON AQUATIC TOXICITY,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5A.
W82-00610

AN ENVIRONMENTAL SAFETY ASSESSMENT OF BUTYL BENZYL PHTHALATE,
Monsanto Co., St. Louis, MO.
For primary bibliographic entry see Field 5A.
W82-00615

ENVIRONMENTAL HEALTH HAZARDS,
For primary bibliographic entry see Field 5F.
W82-00625

HUMAN HEALTH HAZARDS ASSOCIATED WITH CHEMICAL CONTAMINATION OF AQUATIC ENVIRONMENT,
Environmental Protection Agency, Cincinnati, OH.
J. F. Stara, D. Kello, and P. Durkin.
Environmental Health Perspectives, Vol 34, p 145-158, February 1980. 1 Fig, 7 Tab, 88 Ref.

Descriptors: *Human diseases, *Water pollution, Natural waters, *Chemical wastes, Water quality, Carcinogens, Mutagens, Teratogens, Pharmacokinetics, Risks, Public health, Hazardous materials.

The development of ambient water criteria to protect human health is the focus of this paper. Both human and aquatic health assessments involve extrapolating results of observable responses in test species to projected or acceptable levels in the species of concern. Certain practical differences exist between human and aquatic risk assessment. Human health hazard assessment attempts to convert a risk from various mammalian species to only a single species. Aquatic hazard assessment is concerned with the effect of xenobiotic stress in aquatic communities, groups of species interacting by mechanisms which are neither readily quantified nor clearly understood. Information on sources of exposure, pharmacokinetics, and adverse effects must be carefully evaluated. Source data is essential to determine the contribution of exposure from water relative to all other sources. Pharmacokinetic data allow extrapolation and characterization of the mode of toxic action. Toxic effects information includes data on acute, subchronic and chronic toxicity, mutagenicity, teratogenicity, and carcinogenicity. A distinction must be made between threshold and nonthreshold effects. For carcinogens and mutagens criteria are calculated by postulating an acceptable increased level of risk and using extrapolation models to estimate the dose which would result in these increased levels of risk. For other chemicals, thresholds are assumed and criteria are calculated by deriving acceptable daily intakes. (Baker-FRC)
W82-00632

SEDIMENTS AS A SOURCE OF PHOSPHATE: A STUDY OF 38 IMPOUNDMENTS,
Department of Water Affairs, Pretoria (South Africa). Hydrological Research Inst.
For primary bibliographic entry see Field 2H.
W82-00653

ACIDITY FLUCTUATIONS AT A BROADLAND SITE IN NORFOLK,
Ministry of Agriculture, Fisheries, and Food, Norwich (England). Coypu Research Lab.
For primary bibliographic entry see Field 2K.
W82-00656

DISTRIBUTION AND BIOLOGICAL AVAILABILITY OF REACTIVE HIGH MOLECULAR WEIGHT PHOSPHORUS IN NATURAL WATERS IN NEW ZEALAND,
Department of Scientific and Industrial Research, Taupo (New Zealand). Freshwater Section.
For primary bibliographic entry see Field 2H.
W82-00659

FACTOR ANALYSIS OF THE IMPACT OF THE ENVIRONMENT ON MICROBIAL COMMUNITIES IN THE TVARMINNE AREA, SOUTHERN COAST OF FINLAND,
Zoological Station, Tvarminne (Finland).
P. Vaatanen.
Applied and Environmental Microbiology, Vol 40, No 1, p 55-61, July, 1980. 2 Tab, 22 Ref.

Descriptors: *Microbial studies, *Environmental effects, Populations, Temperature effects, Wind, Seasonal variations, *Finland, Coasts, Estuarine environments, Brackish water, Seawater, Microorganisms, Rainfall, Coliforms, Wastewater outfalls, Effluents, Bacteria.

Data obtained regarding 10 environmental parameters and 16 microbiological parameters at a sampling station on the Tvarminne Archipelago, Finland, had been subjected to regression analysis in a previous study. In the present study, the correlations between the parameters were factorized using the principal axis solution, and eight of the factors of apparently greatest importance were rotated by the varimax method for the total data and the data for the open-water period. The eight factors selected were characterized by different loadings for water temperature, salinity, ice cover, organic and

humic matter, microbial counts, transparency, microbial respiration, wind vectors, and rainfall. All of the microbiological parameters aside from H2S producers, proteolytic bacteria, enterococci and yeasts are mainly loaded in one factor. The factors dealing with freshwater outflows cover 50-69% of the variance of fluorescent pseudomonads, bacterial spores, and fecal coliforms. The water temperature factor explains most of the variance of direct counts. A third factor, vernal phytoplankton bloom, not identified by regression analysis, explains most of the variance of the respiration parameters. These three factors, plus the periods before and after the bloom, covered about 90% of the factor variance in the populations and also the major part of the variance of most microbiological parameters. The west winds, summer rains, and early winter factors did not contribute much to the factor variances, but the parameters contributing to them are still needed for satisfactory interpretation of the factors. Although much of the information provided by factor analysis was the same as that of regression analysis, the environmental processes affecting microbes were easier to identify with the factor analysis than with regression analysis. (Baker-FRC)
W82-00672

ANNUAL SUCCESSION OF PHYTOPLANKTON IN ONE HEATED POND IN CENTRAL FINLAND,
Jyvaeskylae Univ. (Finland). Dept. of Biology.
P. Eloranta.
Acta Hydrobiologica, Vol 22, No 4, p 421-438, 1980. 10 Fig, 4 Tab, 13 Ref.

Descriptors: *Phytoplankton, *Cooling ponds, *Seasonal variation, Cooling water, *Temperature effects, Thermal pollution, Water quality, Primary productivity, Biomass, *Finland.

Seasonal fluctuations of phytoplankton biomass and the structure of communities were determined in a pond used to cool one small thermal power plant. The following were monitored: water quality, primary production in situ and in vitro in different temperatures, periphyton on artificial substrates, and zooplankton. The phytoplankton reached a maximum in March of 10.3 gm/cu m, primarily comprising cryptophytes and Asterionella gracillima Heib. The autumn maximum of 11.2 g/cu m was in September and was made up of Cyclotella meneghiniana Kutz. Green algae were dominant in spring and summer. The biomass minimum in the darkest winter season was less than 0.2 g/cu m. The chlorophyll alpha concentration of the phytoplankton fresh weight biomass averaged 0.34%. The Shannon diversity was calculated with natural logarithms, and on the basis of each species amounted to 2.5 to 2.9 in summer and 2.7 to 2.8 in winter. There was no significant correlation between Shannon diversity and the logarithm of the phytoplankton biomass. (Small-FRC)
W82-00673

EFFECT OF OTTER PRAWN TRAWLING ON THE MACROBENTHOS OF A SANDY SUBSTRATUM IN A NEW SOUTH WALES ESTUARY,
New South Wales State Fisheries, Sidney (Australia).
P. J. Gibbs, A. J. Collins, and L. C. Collett.
Australian Journal of Marine and Freshwater Research, Vol 31, No 4, p 509-516, 1980. 5 Fig, 3 Tab, 19 Ref.

Descriptors: *Estuarine environment, *Benthic environment, *Trawling, Benthos, Estuaries, Environmental effects, *Ecological effects, Substrates, Benthic fauna, Sediments, Crustaceans, Fishing industry, New South Wales, *Australia.

Recreational fishermen along the New South Wales coast in Australia have made persistent claims that estuarine otter prawn trawling by commercial fishermen kills benthic organisms, depriving fish species of their food source. This study made a quantitative assessment of the effect of commercial prawn trawling in New South Wales on the macrobenthos of the trawl grounds and made a visual assessment of the operation of commercial nets and otter boards underwater. Macrobenthos at three treatment sites and one control site were sampled on three occasions: before and after intensive trawling, prior to the opening of the commercial prawning season, and at the close of the commercial prawning season. Divers made underwater observations of the otter trawl nets in operation. Numerical clustering techniques were used as a preliminary step to statistical comparisons of the number of individuals, number of species, and species diversity at the four sites. The underwater observations revealed that the effect on the sea bottom and the macrobenthos was minimal when the prawn trawls were operating efficiently. Very little sand was disturbed and the sea bottom appeared only slightly marked by the trawl's passage after repeated trawls. The differences between sites demonstrated by the classificatory analysis and community statistics were thought to be due to the patchiness in distribution generally associated with benthic animals and differences in sediment types at the sites, rather than with the trawling. It was concluded that the otter prawn trawling, as conducted in most estuaries in New South Wales, causes no detectable alterations in the macrobenthic fauna of the trawl grounds. (Carroll-FRC)
W82-00677

BACTERIAL DNA REPAIR ASSAY OF SELECTED COMPOUNDS IN PULP AND PAPER MILL EFFLUENTS,
International Paper Co., Tuxedo Park, NY.
V. J. Boyle, and C. A. Simpson.
Tappi, Vol 63, No 10, p 127-130, October, 1980. 4 Fig, 1 Tab, 14 Ref.

Descriptors: *Pulp and paper industry, *Bacteria, *Mutagenesis, Water pollution effects, Effluents, Toxicity, Organic compounds.

Compounds commonly found in pulp and paper mill effluents were evaluated using the DNA Repair Test, recommended in proposed EPA guidelines. None of the chemicals--abietic acid, trichloroguaiscol, tetrachloroguaiacol, dichlorostearic acid, and epoxystearic acid--showed selective killing of the DNA polymerase-deficient (Pol A-) strain of E. coli at concentrations of 50 to 200 micrograms per disk (100-600 times more concentrated than in papermill final effluents). Nalidixic acid was used as a positive control. Results show that these compounds do not have the potential for the alteration of genetic material as assessed by the DNA Repair Test. (Cassar-FRC)
W82-00687

RECEIVING STREAM FISHERIES STUDIES RELATIVE TO SECONDARY TREATED PULP AND PAPER MILL EFFLUENTS,
Consolidated Papers, Inc., Wisconsin Rapids, WI.
J. D. Weinbauer, D. A. Thiel, V. W. Kaczynski, and C. S. Martin.
Tappi, Vol 63, No 10, p 121-125, October, 1980. 4 Fig, 5 Tab, 11 Ref.

Descriptors: *Pulp and paper industry, *Water pollution control, *Fisheries, Aquatic animals, *Water pollution effects, Fish, Effluents, Wisconsin River, Invertebrates, Benthic fauna, Pike, Water pollution prevention, Ecological effects, Wastewater treatment, Industrial wastes, Organoleptic properties, Taste.

A 70-mile section of the Wisconsin River receiving treated wastes from eight paper mills at five outfalls was the site of a biological study on fish and invertebrate populations. The walleye pike (Stizostedion vitreum) population appeared healthy, as determined by age structure, growth rates, and condition factors. A creel survey of 2028 fishermen indicated that 47.8% felt that fishing had improved over the last few years and 22.2% thought it had not improved. Flavor of the fish was designated excellent by five percent of the fishermen, good by 36%, acceptable by 46%, and poor by 13%. Walleye filets collected at four sites were evaluated by an 18-member flavor test board. The Wisconsin River fish, especially those upstream from the paper mill effluents, had more flavor impairment than control Canadian fish. Evidently, effluents and nonpoint source pollution upstream of the paper mills had more adverse affect on fish flavor than did effluents from the mills. The fish survey identified 1594 fish representing 24 species. Macroinvertebrate species have shown a clear shift from pollution-tolerant species to pollution-intolerant species over the course of the study, which has been conducted annually since 1962. These improvements in biological and water quality status correspond with construction of effluent treatment facilities at the paper mills during the 1970's. (Cassar-FRC)
W82-00688

THE CHANGING STATUS OF REEDSWAMP IN THE NORFOLK BROADS,
Institute of Terrestrial Ecology, Huntingdon (England). Monks Wood Experimental Station.
L. A. Boorman, and R. M. Fuller.
Journal of Applied Ecology, Vol 18, No 1, p 241-269, April, 1981. 7 Fig, 8 Tab, 67 Ref.

Descriptors: *Wetlands, *Vegetation, *Distribution patterns, Swamps, Marshes, *Reedswamp, Rodents, Coypus, Geese, Eutrophication, Grazing, Norfolk Broads, Succession, Water pollution effects, Ecological effects, Lakes, *England.

Changes in the distribution and area of reedswamp (vegetation of various tall immersive graminoids growing where the normal summer water table is above the substratum) from 1880 to the present were documented by Ordnance Survey maps and aerial photographs of the Norfolk Broads. Between 1880 and 1905 reedswamp increased from 216.5 ha to 244.6 ha. Starting in 1905 the reedswamp area decreased steadily to the present 1977 level of 49.2 ha. Prior to 1946, losses were from succession to fern; after 1946, from regression to open water. A major factor in the decline of the reedswamp was grazing by the coypu (Myocaster coypus Molina), a large South American wetland rodent which escaped from fur farms by 1936 and became well established during the 1940's. The population reached a height of about 70,000 in 1962 and presently numbers about 15,000. Feral geese are now actively limiting reedswamp in some areas. Eutrophication appeared to have no direct effects on reedswamp, but increased sedimentation rates can make the reeds, especially the shoots, more available for grazing. Neither soil type or boat traffic were responsible for the reedswamp changes. (Cassar-FRC)
W82-00691

1980 ANNUAL REPORT, COMMITTEE ON THE ASSESSMENT OF HUMAN HEALTH EFFECTS OF GREAT LAKES WATER QUALITY,
International Joint Commission-United States and Canada, Windsor (Ontario).
1980. 34 p. 3 Tab, 11 Ref.

Descriptors: *Lakes, *Toxicity, *Water quality, *Hazardous materials, *Viruses, Epidemiology, Fish populations, Fish diseases, Aquatic populations, Enteroviruses, Toxins, *Great Lakes.

This report summarizes the 1979-80 activities of the Committee on the Assessment of Human Health Effects of Great Lakes Water Quality. High priority was placed on evaluating the health hazards of chemicals identified in the Great Lakes ecosystem. Also investigated were viruses in the Great Lakes, the development of compatible cancer registries within the Great Lakes Basin, and levels of contaminants in fish. The committee attempted a study of the health hazards of 381 compounds but found that toxicological and exposure data on the chemicals were insufficient for a meaningful evaluation. Additional toxicology and exposure studies of potentially hazardous chemicals are recommended. Results of an investigation of enteric viruses indicated that water quality standards for Great Lakes water are successfully preventing these viruses from being spread via the public water supply. However, the development of more sensitive indicators of the presence of viruses is recommended, as well as better data on the relationship between water treatment processes and the fate of water-borne viruses. The Committee also recommended that: (1) additional fish surveillance studies be carried out to assess 'real time'

exposures of man, and to assess the effectiveness of contaminant control strategies; and (2) a workshop be held on the compatibility of Great Lakes Basin cancer registries, as a prelude to a proposed cancer morbidity and mortality survey of the countries bordering Lake Ontario. Also suggested is a workshop on the interaction of toxic chemicals in the Great Lakes ecosystem. (Garrison-Omniplan)
W82-00706

1980 ANNUAL REPORT - A PERSPECTIVE ON THE PROBLEM OF HAZARDOUS SUBSTANCES IN THE GREAT LAKES BASIN ECOSYSTEM,
International Joint Commission-United States and Canada, Windsor (Ontario).
November, 1980. 70 p. 10 Tab, 20 Ref, 1 Append.

Descriptors: *Lake basins, *Contaminants, *Waste water disposal, *Chemical wastes, *Polychlorinated byphenyls, Eutrophication, Halogens, Residual chlorines, Sediments, Sludge, Aquatic populations, Human populations, Suspended solids, Trace metals, Potable water, Chlorine, *Great Lakes basin, Ecosystems.

The infusion of synthetic industrial chemicals has increased exponentially in the Great Lakes ecosystem, particularly in the last 40 years. Some of these chemicals may be toxic. This report discusses these substances relative to biological and human health effects, transport and fate, sources, and control alternatives, and presents a plan for attacking the problems. Effects on human health are often not readily distinguishable; those on aquatic life are more easily seen. Two main sources of human exposure are through drinking water and eating fish. No conclusions have been drawn concerning the health effects of the water quality. One study examined the correlation between PCB residues in Lake Michigan fish and concentrations of PCBs in the blood of those eating the fish. Higher levels were found in those eating large amounts of fish. Hazardous substances in large lakes, such as DDT, dieldrin, mirex, PCBs, phthalates, and mercury, are persistent in the water, sediment, and biota and will be widely dispersed through the lakes. Hazardous substances enter the Great Lakes through emissions to the atmosphere, industrial and municipal wastewater discharges, urban and rural land runoff, and other sources such as spills and leaching from solid waste disposal sites. Recommendations to reduce the problem of hazardous substances include reuse and treatment technologies, reducing the loss or use of stubstance that enter the air or water effluents, identifying high-exposure populations, establishing tolerance levels for toxic substances, and centralizing an information system for data on hazardous substances. (Atkins-Omniplan)
W82-00707

1980 REPORT ON GREAT LAKES WATER QUALITY - APPENDIX,
International Joint Commission-United States and Canada, Windsor (Ontario).
November 12, 1980. 82 p. 14 Fig, 17 Tab.

Descriptors: *Lake rehabilitation, *Eutrophic lakes, *Water quality, *Phosphorus removal, *Algal growth, Algal blooms, Fish populations, Fish conservation, Aquatic populations, Fish diseases, Aquatic environment, Water quality data, *Great Lakes ecosystem.

This appendix was developed to assist the Great Lakes Water Quality Board in preparing its report to the International Joint Commission. Water quality status in the Great Lakes ecosystem is presented with a review of municipal phosphorus control programs. Also included is a brief summary of the development and implementation of data quality assurance programs with specific reference to interlaboratory comparisons. Municipal phosphorus loads are presented on a lake-by-lake basis. Municipal treatment plants are ranked according to the difference between their actual annual phosphorus load and their estimated load at an effluent phosphorus concentration of 1 milligram per liter. A special section on Aquatic Ecosystem Quality reviews the progress in eutrophication control and the decreased residue levels of contaminants observed in several fish species in the lower lakes as well as in gull eggs collected throughout the basin. PCB levels in gull eggs in Lake Superior have exhibited little change, possibly reflecting the importance of atmospheric inputs. Three new problem areas have been identified in the Great Lakes Basin: Marquette and Munising bathing beaches on Lake Superior, which exceeded state fecal and total coliform objectives, and White Lake on Lake Michigan, which was added to the problem area list because of oganics found in water, sediments, and fish. (Garrison-Omniplan)
W82-00708

ACUTE TOXICITY OF ZINC TO SOME FISHES IN HIGH ALKALINITY WATER,
Illinois State Water Survey, Urbana.
P. Reed, D. Richey, and D. Roseboom.
Illinois Institute of Natural Resources, Circular 142, 1980. 21 p. 4 Fig, 5 Tab, 48 Ref, 2 Append.

Descriptors: *Fish populations, *Toxicity, *Zinc, *Alkaline water, *Fish toxins, Poisons, Catfish, Bluegills, Bass, Hazardous materials, Mud-water interfaces, Alkalinity, Water pollution effects, Water pollution sources.

The alkalinity of lakes and streams in Illinois are variable, with concentrations, as calcium carbonate, generally exceeding 200 mg/l in the northern and central part of the state and often less than 100 mg/l in the southern part. This study documents the acute toxic effects of varying concentrations of zinc on certain fishes native to Illinois. Fourteen-day bioassays were performed with bluegill fry, channel catfish fingerlings, and largemouth bass fingerlings in waters relatively high in the salts of calcium and magnesium, with correspondingly high alkalinity. The levels of total zinc in natural water bodies in Illinois generally do not exceed 0.5 mg/l. Soluble zinc concentrations are usually less than 0.05 mg/l, except in those surface waters that are significantly influenced by urban centers. Elevated concentrations of zinc occur at the mud-water interface, during anaerobic conditions, in Illinois lakes. The concentrations thus far observed are generally two to three times higher than those detected in the overlying waters. The 14-day median tolerance limit at 20 degrees Celsius was 11.0 mg/l soluble zinc for the bluegill, 8.2 mg/l soluble zinc for the channel catfish, and 8.0 mg/l soluble zinc for the largemouth bass. For protection of the fishes investigated, and in compliance with Illinois water pollution regulations, soluble zinc concentrations in Illinois streams having alkalinity and hardness should not exceed 0.8 mg/l. (Garrison-Omniplan)
W82-00713

DOES IMPROVED WASTE TREATMENT HAVE DEMONSTRABLE BIOLOGICAL BENEFITS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
H. H. Seagle Jr, A. C. Hendricks, and J. Cairns Jr.
Environmental Management, Vol 4, No 1, p 49-56, January, 1980. 3 Fig, 4 Tab, 22 Ref.

Descriptors: *Textile mill wastes, *Water quality control, *Effluents, Industrial wastes, *Wastewater treatment, Aquatic habitats, Water pollution effects, Water pollution control, Invertebrates, Fish, Zinc, Toxicity, Benthic fauna, Diversity indices, Shenandoah River, *Ecological effects.

Ten benthic surveys and 9 static fish bioassays were conducted since 1972 on the South Fork of the Shenandoah River near the Avtex rayon and polyester fibers plant at Fort Royal, Virginia. Prior to construction of an activated sludge treatment system in February 1974, zinc and BOD5 inputs averaged 239 and 733 kg per day, respectively. The benthic community, especially on the right side of the river, where the effluent was channelized, had low diversity values (0-2.42) and reduced numbers of taxa and organisms compared with the upstream control. A fish bioassay showed that the effluent was acutely toxic at an admixture of 34.5% with river water. While water chemistry and temperature were little affected by the improved waste treatment facilities, levels of Zn and BOD5 were significantly reduced and the aquatic habitat improved. The plant's treated effluent contained 70% less BOD5 and 60% less zinc. In 1974 the effluent was toxic to fish at 80% concentration, but it was more toxic after that. Diversity values for fauna increased to 1.19-3.39. Taxa and numbers of organisms increased. Only during drought conditions in 1976 and 1977 did the improved situation regress. Although the benefits of pollution control were clearly demonstrated, complete recovery of the river is unlikely, particularly in areas where the effluent is channelized and at low flow conditions. (Cassar-FRC)
W82-00779

THE RELATIONSHIP OF ENVIRONMENTAL EPIDEMIOLOGY TO WATER AND WASTEWATER PLANT OPERATORS,
Oklahoma State Dept. of Health, Oklahoma City.
D. Farley.
Southwest and Texas Water Works Journal, Vol 63, No 3, p 10, 12, June, 1981.

Descriptors: *Epidemiology, *Water pollution effects, *Wastewater treatment, Water treatment, Public health, Toxicity, Legislation, Regulations, Legal aspects, Oklahoma State Department of Health, *Wastewater plant operators, Personnel.

Water and wastewater treatment plant operators should be aware of the potential health effects of each step in the processes. The Oklahoma State Department of Health is attempting to apply the concept of epidemiology to this field. The short term acute effects of pollutants in drinking water or renovated wastewater are quickly handled, but chronic, long term effects may be discerned only by epidemiological analysis. (Cassar-FRC)
W82-00789

EFFECTS OF HYPOLIMNETIC DISCHARGE ON FISH HEALTH BELOW A RESERVOIR,
Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.
J. M. Grizzle.
Transactions of the American Fisheries Society, Vol 110, No 1, p 29-43, January, 1981. 1 Fig, 3 Tab, 106 Ref.

Descriptors: *Sublethal effects, *Fish, *Hypolimnion, Thermal stratification, *Thermal pollution, Temperature effects, Trout, Perch, Buford Dam, Georgia, Infection, Pathology, Metals, Reservoirs, *Reservoir releases.

Dams often cause changes in the impounded stream or river which have important effects on their fish populations. The release of anoxic, hypolimnetic waters, which often contain dissolved manganese, iron, ammonia, hydrogen sulfide, and other chemicals, from impoundments may increase the downstream concentrations of these substances. Rainbow trout, brown trout, brook trout, and yellow perch from two locations in the tailwater from the Buford Dam, in Georgia, and trout from a hatchery which used the tailwater as a water supply were examined for infections, lesions, and liver metal concentration. The fish were found to be infected by 9 genera of parasites, 19 bacteria species, and 1 virus species. Many of the fish that did not have bacterial infections were found to have microscopic lesions in the gills, liver, spleen, and trunk kidney. The occurrence of lesions indicating exposure to a toxicant was related to increases in iron and manganese concentrations, but not to copper concentrations. While manganese did not indicate exposure to high levels of these metals. Since the tailwater contained copper, zinc, iron, manganese, and dissolved oxygen concentrations considered possibly harmful to fish, acclimation may have allowed survival of the fish in the river. The release of hypolimnetic water from the impoundment resulted in low pH, low dissolved oxygen concentrations, low oxidation-reduction potential, and high metal concentrations. Water characteristics, acclimation by the fish, and possible synergistic activity make most bioassay data unreliable for the prediction of the toxicity of tailwaters. (Carroll-FRC)
W82-00805

THE EFFECT OF SEASON AND LOCATION ON PHOSPHOADENYLATE CONCENTRATIONS AND ADENYLATE ENERGY CHARGE IN TWO SPECIES OF FRESHWATER CLAMS,
Savannah River Ecology Lab., Aiken, SC.
For primary bibliographic entry see Field 2H.
W82-00810

POTENTIAL EUTROPHICATION OF THE RIDEAU RIVER BY AN URBAN DRAINAGE WATERWAY,
MacLaren (J. F.) Ltd., Willowdale (Ontario).
M. H. Habicht, K. Adamowski, and A. C. Middleton.
Canadian Journal of Civil Engineering, Vol 8, No 2, p 165-172, June, 1981. 4 Fig, 8 Tab, 9 Ref.

Descriptors: *Eutrophication, *Predictions, *Water management, Management planning, Bioassay, Chemical properties, Storm water, Dam effects, Environmental effects, Nutrients, Algae, Biomass, *Urban watersheds, Industrial wastes, Lumber industry, *Saw mills.

Agricultural activities and industrialization promote natural nutrient enrichment, nuisance blooms of algae, depletion of dissolved oxygen, increased turbidity, and changes in aquatic communities, which lead to eutrophication. A study of the eutrophication potential of an urban drainage waterway (Saw Mill Creek) on the Rideau River in Ottawa was designed to determine the usefulness of a combination of bioassay and chemical characterization for estimating the eutrophication potential of storm water and to investigate possible effects of two storm water management alternatives on eutrophication potential. Samples were collected from the creek and the river during eight different peak storm flow conditions. Although nutrient concentrations were found to increase during storm flows, peak flow concentrations of total phosphorus and nitrogen averaged only 0.190 and 2.5 milligrams per liter, respectively. Saw Mill Creek had no significant effect on algal growth in the Rideau River at nutrient addition ratios of 5 percent or less, which probably includes most dry weather flows. However, bioassays produced significantly different algal standing biomass at 10 and 20 percent nutrient addition levels, indicating that the creek can have statistically significant effects on the algal growth in the river during peak flow conditions, when both nutrient concentrations and flow ratios are high. Algal bioassays were shown to be a valuable technique in analysis of the eutrophication of a receiving water by urban drainage water. Simulation of alum treatment of the creek using a jar test did not result in significant reductions in algal growth when compared to that at any of the nutrient addition levels. A reduction in the volume of storm flows of the creek could significantly affect algal growth in the river, however. (Carroll-FRC)
W82-00834

RELATIONSHIPS BETWEEN WATER CHEMISTRY AND RESPIRATION RATE IN SEVERAL POPULATIONS OF LYMNAEA PEREGRA MULLER (GASTROPODA:MOLLUSCA),
For primary bibliographic entry see Field 2K.
W82-00854

CONVERSION OF ABIENOL INTO TETRAHYDROEPIMANOOL BY ANAEROBIC PROCESSES IN WOODROOM DEBARKING EFFLUENT,
British Columbia Research Council, Vancouver.
A. B. McKague, and E. G-H. Lee.
Journal of Chemical Technology and Biotechnology, Vol 30, No 5, p 263-265, 1980. 5 Ref.

Descriptors: *Anaerobic conditions, *Abienol, *Wood wastes, Terpenes, Fish, Toxicity, Chemical reactions, Fate of pollutants, Tetrahydroepimanool, *Fish toxins, Organic compounds, Industrial wastes, Microbial degradation.

During a study of softwood woodroom debarking effluents toxic to fish, a sample was delayed in transit for three weeks. When retrieved and analyzed, this sample contained less than 1 mg per cu dm abienol and 13-epimanool, but contained 12 mg per cu dm of tetrahydroepimanool, which is more toxic to fish than the starting compounds. The conversion was duplicated in the laboratory by anaerobic conversion of abienol in samples of woodroom effluent. Microscopic examination of the effluent indicated the presence of a mixed culture of actively motile bacteria. (Cassar-FRC)
W82-00860

EFFECTS OF THERMAL EFFLUENTS ON COMMUNITIES OF BENTHIC MARINE MACROALGAE,
University of Southern California, Los Angeles.
J. S. Devinny.
Journal of Environmental Management, Vol 11, No 3, p 225-242, November, 1980. 2 Fig, 5 Tab, 39 Ref.

Descriptors: *Algae, *Thermal pollution, *Powerplants, Macrophytes, Benthic flora, Effluents, Marine algae, Humboldt Bay, *California, Punta Banda, Mexico, Plant communities, Species diversity, Species composition, Temperature effects.

Marine benthic macroalgae were studied in three sites with thermal water. Two study areas (Humboldt Bay, northern California, and near Long Beach, southern California) received thermal effluents from powerplants, and the third, Punta Banda, Mexico, had no powerplant discharge but a natural thermal gradient in a shallow bay with restricted circulation. Ordination analysis of the algal communities showed that a 10% change in species composition occurred for each degree of temperature up to 3C, but numbers were not reduced. Temperatures 7C above ambient eliminated large macrophytes. Populations of brown algae were reduced or eliminated, and green algal species were a larger proportion of the community. Temperatures 10C above ambient left ephemeral communities low in diversity. (Cassar-FRC)
W82-00870

EFFECTS OF A CATTLESKIN TANNERY OF STREAM QUALITY AND BENTHIC MACROINVERTEBRATES IN CENTRAL MAINE,
Maine Univ. at Orono. School of Forest Resources.
R. L. Duval, C. R. Ferris, R. B. Owen, K. E. Gibbs, and L. K. Fink.
Bulletin of Environmental Contamination and Toxicology, Vol 25, No 2, p 269-276, 1980. 1 Fig, 4 Tab, 6 Ref.

Descriptors: *Water pollution, *Industrial wastes, *Benthic fauna, *Streams, Heavy metals, Benthos, Wastewater treatment, Sulfuric acid, Chromium, Flow discharge, Environmental effects, Sediments, Water sampling, Turbidity, *Tannery wastes, Conductivity, Substrates, *Marine, Ecological effects.

The effects of a cattleskin tannery on stream quality and benthic macroinvertebrates in central Maine are discussed. Water quality measurements were made at monthly intervals during the summer months at five locations along a river which receives tannery waste. Sediment samples were collected, and the effects of the effluent and accumulation of heavy metals were determined. A distinct reduction in water and substrate quality was evident in June, coinciding with the period of lowest streamflow. The benthic invertebrate community was affected in two ways. The number of taxa was reduced by 60%, and the diversity and distribution of taxa at the collection sites were altered. The number of invertebrates samples for heavy metals was too small to permit drawing conclusions. However, the concentrations of metals found in those sampled approached lethal levels. Contamination was greatest for chromium. (Titus-FRC)
W82-00872

FACTORS CONTROLLING PHYTOPLANKTON PRIMARY PRODUCTIVITY IN BYRAM LAKE, MT. KISCO, N.Y., SUMMER, 1977,
Fordham Univ., Bronx, New York. Louis Calder Conservation and Ecology Study Center.
For primary bibliographic entry see Field 2H.
W82-00915

INFLUENCE OF PHOSPHORUS LOADS AND OF SOME LIMNOLOGICAL PROCESSES ON THE PURITY OF LAKE WATER,
Polish Academy of Science, Warsaw. Inst. of Ecology.
For primary bibliographic entry see Field 2H.
W82-00923

MACROBENTHOS OF PINE ISLAND BAYOU IN THE BIG THICKET NATIONAL PRESERVE, TEXAS,
Lamar University, Beaumont, TX. Dept. of Biology.
R. G. Darville, and R. C. Harrel.
Hydrobiology, Vol. 69, No 3, p 213-223, March, 1980. 1 Fig, 5 Tab, 27 Ref.

Descriptors: *Water quality, *Benthic fauna, *Streams, *Pine Island, *Texas, Big Thicket National Preserve, Species diversity, Biological communities, Water pollution effects, Seepage, Brines, Oil.

Water quality was generally good at 7 stations on Pine Island and Little Pine Island bayous of southeast Texas, according to surveys conducted June 1977 to May 1978. Seepage of brines from nearby oil fields was revealed by higher Cl and conductivity values at four stations. The higher chloride content (up to 1440 ppm) improved stream conditions by flocculation of suspended solids and reducing turbidity. BOD was relatively low, 0.1-10.4 mg per liter. Dissolved oxygen ranged from 0.8 ppm in small isolated pools to 12.2 ppm. Carbon dioxide concentrations generally decreased downstream. pH was lowest at the upper stations (4.2-7.4) and highest (5.4-7.8) near the sewage effluent outlet. Turbidity ranged from 20 to 395 JTU. Orthophosphates and nitrates were highest near the effluent outfall. The highest chlorophyll a concentration measured was 0.2948 mg per liter. Dominant benthic fauna were oligochaetes (62.3%) and chironomids (22.5%). The intolerant mayfly Hexagenia limbata was found at all stations except below the sewage outfall. The number of taxa found varied from 71 at the station with lowest turbidity to 43 below the effluent discharge. The highest annual diversity, 3.82, was found at the station with lowest turbidity. All other stations had diversity values of 2.57 to 3.09, indicating moderately stressed communities. (Cassar-FRC)
W82-00924

THE EFFECTS OF HEAVY METALS ON MICROBIAL BIOMASS IN SEDIMENTS OF PALESTINE LAKE,
Purdue Univ., Lafayette, IN. Dept. of Bionucleonics.
C. E. Nugent, G. J. Atchison, D. W. Nelson, and A. W. McIntosh.
Hydrogiologia, Vol 70, No 1/2, p 69-73, April, 1980. 2 Fig, 4 Tab, 20 Ref.

Descriptors: *Heavy metals, *Sediments, *Metal finishing wastes, Biomass, Microorganisms, Metals, Zinc, Chromium, Cadmium, *Palestine Lake, Indiana, Lake sediments, Lakes, Water pollution effects, Microbial degradation, Degradation, Organic matter, *Eutrophic lakes.

Palestine Lake, Indiana, a highly eutrophic lake which receives chromium, cadmium, and zinc from an electroplating plant, showed suppression of organic decomposition and low microbial biomass in the most contaminated sediment, averaging metal concentrations (micrograms per g dry weight) of 17,840 Zn, 4380 Cr, and 585 Cd. Adenosine triphosphate (ATP) concentrations and microbial colony numbers on pour plates were used as biomass indicators. The highly contaminated area had 3.7 million mean microbial colonies in 1 g sediment; the less contaminated sites had 27-62 million. ATP concentrations were 2.9 times 10 to the minus 7th power in the highly contaminated area and 4.5-7.6 times 10 to the minus 7th power in the less contaminated sites. (Cassar-FRC)
W82-00925

AN ALTERNATIVE WASTEWATER DISINFECTANT,

Maryland Environmental Service, Annapolis.
For primary bibliographic entry see Field 5D.
W82-00950

BIOCONCENTRATION OF PESTICIDES BY EGG MASSES OF THE CADDISFLY, TRIAENODES TARDUS MILNE,
Illinois Natural History Survey, Urbana.
For primary bibliographic entry see Field 5B.
W82-00982

SEA URCHIN SPERM BIOASSAY FOR SEWAGE AND CHLORINATED SEAWATER AND ITS RELATION TO FISH BIOASSAYS,
Washington Univ., Seattle. Fisheries Research Inst.
For primary bibliographic entry see Field 5A.
W82-00988

EXPERIMENTAL MANIPULATION OF ALGAL BLOOM COMPOSITION BY NITROGEN ADDITION,
Department of Fisheries and Oceans, Winnipeg (Manitoba).
J. Barica, H. Kling, and J. Gibson.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 7, p 1175-1183, July, 1980. 4 Fig, 3 Tab, 15 Ref.

Descriptors: *Eutrophication, *Fishkill, *Algal control, *Species composition, *Nitrogen, Nutrients, Nitrate, Algal growth, Biomass, Aquatic productivity, Primary productivity, Ammonium, Cyanophyta, Chlorophyta, Ponds.

The nutrient contents of a small prairie lake and a pond which has experienced seasonal anoxia as a result of collapses of Aphanizomenon flos-aquae blooms were experimentally manipulated to see if changes in phytoplankton composition rather than pesticides could be used to control summerkill. Ammonium, nitrate or both were added to the prairie lake in enclosures and to the whole pond over an 8 to 12-wk period. When nitrogen was added prior to the appearance of A. flos-aquae, the bloom magnitude and species composition of the algae were altered. The biomass of this alga was reduced when low level additions (0.75-1.5 g/cu m/wk) of nitrogen were added after the appearance of cyanophyte blooms. With high nitrogen additions (7-14 g/cu m/wk), cyanophytes disappeared and small chlorophytes and cryptomonads dominated. In the absence of A. flos-aquae, the fishkill did not occur. High additions of nitrogen caused significant nitrate residues in the water. Without nutrient supplements, both the lake and pond returned to heavy A. flos-aquae blooms and fishkills the following summer. (Geiger-FRC)
W82-00998

A RAPID SIMPLE LONG-TERM TOXICITY ASSAY FOR AQUATIC CONTAMINANTS USING THE NEMATODE PANAGRELLUS REDIVIVUS,
Manitoba Univ., Winnipeg. Dept. of Zoology.
For primary bibliographic entry see Field 5A.
W82-01017

THE ACTIVITY OF ENVIRONMENTAL SAMPLES IN A CELL CULTURE TEST FOR ASBESTOS TOXICITY,
Naylor Dana Inst. for Disease Prevention, Valhalla, NY.
B. Reiss, J. R. Millette, and G. M. Williams.
Environmental Research, Vol 22, No 2, p 315-321, August, 1980. 2 Tab, 21 Ref.

Descriptors: *Asbestos, *Drinking water, Potable water, *Toxicity, Culturing techniques, Cultures, Carcinogens, Particulate matter.

Six coded samples of particulate matter were provided by the United States Environmental Protection Agency for use in tests designed to assay the toxic potential of the samples through the inhibition of colony-forming efficiency of cultured human embryonic intestine-derived epithelial (I-407) cells. The samples were: (1) particulates filtered from Duluth, Minnesota drinking water, known to contain amphibole crystals, red clay, and biological fragments; (2) particulates from Seattle, Washington drinking water, containing chrysotile asbestos; (3) particulates filtered from San Francisco, California drinking water, containing chrysotile asbestos; (4) a sample of less than 2 micrometer size fraction of taconite tailings prepared by a sedimentation separation procedure; (5) a sample of attapulgite clay, a nonasbestos mineral consisting of fibers of the same or smaller diameter range as chrysotile asbestos; (6) amosite fibers, used to study the effects of ingested asbestos on rats and hamsters. The results of the assay indicated that the most toxic of the samples was amosite. The toxicities of the particulates from drinking water were about 100-fold less than that of amosite. The order of toxicity of the drinking water particulate samples decreased from San Francisco, to Seattle, to Duluth. Samples of attapulgite clay and taconite tailings displayed about half the toxicity of the drinking water particulates. These results indicate that this assay provides a sensitive and accurate method for screening asbestos and asbestiform contamination for potential toxicity. (Baker-FRC)
W82-01031

UPTAKE AND TRANSFER OF THE CHLORINATED HYDROCARBON LINDANE (GAMMA-BHC) IN A LABORATORY FRESHWATER FOOD CHAIN,
Hamburg Univ. (Germany, F.R.) Inst. fuer Hydrobiologie und Fischereiwissenschaft.
P. D. Hansen.
Environmental Pollution, (Series A) Vol 21, No 2, p 97-108, February, 1980. 4 Fig, 14 Ref.

Descriptors: *Lindane, *Food chain, *Accumulation, Daphnia, Algae, Chlorella, Stickleback, *Fish, Insecticides, Pesticides, Fate of pollutants, Adsorption, Chlorinated hydrocarbons.

The uptake, transfer, and accumulation of lindane (gamma-BHC) was studied in a freshwater food chain consisting of Chlorella sp., the primary producer; Daphnia magna, Consumer 1; and the stickleback, Gasterosteus aculeatus, Consumer 2. The algae used had an accumulation factor of 749 from a medium containing 10 micrograms per liter lindane. Total accumulation factors for the other 2 links in the food chain were: Daphnia, 66.8; and fish, 118.6. A model was developed showing the lindane accumulated by each consumer during 50 days feeding in water with 10 micrograms per liter lindane. Adsorption from water was essentially complete within 1 to 3 days while accumulation from food continued to increase. Laboratory Daphnia accumulated far more lindane than free-living Daphnia. The sublethal concentrations of lindane caused irritation and a 50% reduction in reproduction rate in Daphnia. Fish rapidly approached the equilibrium concentration. After 9 days, 67% of the total lindane was found in the fish, with large amounts in gills, stomach, liver, and gut. Female sticklebacks took up more lindane than males; males in breeding condition had an accumulation factor 5.8 times larger than those in normal condition. (Cassar-FRC)
W82-01033

ASSESSMENT OF WATER QUALITY CONDITIONS IN SKAMOKAWA CREEK, WASHINGTON,
Washington State Dept. of Ecology, Olympia.
D. Norton.
Document DOE 81-7, February, 1981. 16 p, 3 Fig, 3 Tab, 20 Ref.

Descriptors: *Water quality standards, *Coliforms, *Streams, *Feces, Cattle, *Bacteria, Contamination, On-site data collections, Benthic environment, Fish populations, Spawning, Dissolved oxygen, Skamokawa basin, *Washington.

A sanitary survey was conducted to determine water quality conditions in the Skamokawa basin, located in Wahkiakum county in Washington. Skamokawa Creek is a small tributary of the lower Columbia River Basin. The creek met all criteria for Class A waters in the state with the exception of fecal coliforms. Skamokawa Creek was in violation of the Class A standard with a median value of 200 organisms per 100 ml with 50 percent of the samples exceeding 200 organisms per 100 ml. The high fecal coliform levels most likely result from the proximity to the creek of older homes, many of which discharge directly into the creek. This proximity prevents adequate buffering between the drain fields of the residences and the creek. In addition, cattle access is virtually unrestricted throughout most of the area. Contamination from dairy cattle could be expected to increase during the rainy season when runoff from adjacent pastures increases. Fourteen sampling stations were established, and water samples were collected for laboratory analysis of fourteen components. Physical and chemical factors analyzed were pH, total alkalinity, specific conductivity, turbidity, total suspended solids, and nutrients. Bacteriological and biological factors were also studied. Skamokawa Creek appears to be quite suitable for fish passage and spawning success, except when very heavy spawning is combined with unusually low dissolved oxygen concentrations. Dissolved oxygen concentrations during the survey were well within the acceptable limits for fish survival. Overall, it appears that the benthic community in Skamokawa Creek has been only slightly to moderately impacted. (Garrison-Omniplan)
W82-01066

WILSON CREEK DRAINAGE - SURFACE AND GROUND WATER QUALITY, JULY 1978 TO JULY 1979.
Washington State Dept. of Ecology, Olympia.
For primary bibliographic entry see Field 5B.
W82-01069

THE EFFECT OF CONTINUOUS ADVANCED WASTEWATER TREATMENT BY THE CITY OF SPOKANE ON THE TROPHIC STATUS OF LONG LAKE, WA DURING 1979.
Eastern Washington Univ., Chemey. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W82-01070

AN ASSESSMENT OF THE TROPHIC STATUS OF DEER, LOON, AND DIAMOND LAKES,
Washington State Dept. of Ecology, Olympia.
For primary bibliographic entry see Field 2H.
W82-01072

CHLORINATED HYDROCARBONS AS A FACTOR IN THE REPRODUCTION AND SURVIVAL OF LAKE TROUT (SALVELINUS NAMAYCUSH) IN LAKE MICHIGAN.
National Marine Fisheries Dervice, Ann Arbor, MI. Great Lakes Fishery Lab.
Technical Papers of the U.S. Fish and Wildlife Service, No 105, 1981. 44 p, 6 Fig, 18 Tab, 136 Ref.

Descriptors: *Trout, *Lake Michigan, *DDE, *Polychlorinated biphenyls, *Toxicity, *Mortality, Growth, Pesticide residues, Metabolism, Chlorinated hydrocarbons, Aroclors, Water pollution effects, Fish behavior, Fish food, Growth stages.

Although lake trout were considered extinct in Lake Michigan by the mid 1950's, control of the sea lamprey and restocking resulted in an abundance of hatchery-produced lake trout in the lake by the early 1970's. However, no naturally produced yearling or older lake trout have been found in the lake. Studies were carried out on the performance and survival of fry hatched from eggs of Lake Michigan lake trout and exposed for 6 months to PCB's (Aroclor 1254) and DDE at concentrations similar to those present in offshore waters and zooplankton (10.0 ng/l PCB's and 1.0 ng/l DDE in water; 1.0 micro g/g PCB's and 0.1 micro g/g DDE in food) and at concentrations 5 and 25 times higher. Cumulative mortality of the fry exposed to simulated Lake Michigan levels of PCB's and DDE for 6 months was 40.7%, nearly twice that of unexposed (control) fry, and mortality at the highest exposure level was 46.5%. Evaluation of the growth, swimming performance, predator avoidance, temperature preference, and me-

tabolism of the fry showed no significant effects attributable to exposure to PCB's and DDE, except for a lowering of preferred temperature at the 25X exposures. Although several factors have undoubtedly contributed to the lack of recruitment of naturally produced lake trout in Lake Michigan, the levels of PCB's and DDE present during the early to mid 1970's were sufficient to significantly reduce survival of any fry produced in the lake and thereby impede restoration of self-sustaining lake trout populations. The added exposure of the fry to other toxic substances known to be present in the lake could have further reduced survival. (Moore-SRC)
W82-01079

MANAGING OIL AND GAS ACTIVITIES IN COASTAL ENVIRONMENTS: REFUGE MANUAL,
RPC, Inc., Austin, TX.
For primary bibliographic entry see Field 5G.
W82-01081

HEALTH EFFECTS OF MONOCHLORAMINES IN DRINKING WATER,
Massachusetts Univ., Amherst. Div. of Public Health.
G. S. Moore, E. J. Calabrese, and M. McGee.
Journal of Environmental Science and Health, Part A, Vol 15, No 3, p 239-258, 1980. 3 Tab, 36 Ref.

Descriptors: *Chlorination, *Drinking water, Potable water, Disinfection, Chloramines, Water treatment, Water quality, *Monochloramines.

The possibility that monochloramines in drinking water might alter any of a variety of blood characteristics, including those reflecting oxidant stress, in laboratory mice exposed over a wide range of monochloramine concentrations was investigated. Male A/J mice were randomly allocated to one of seven treatment groups: 200, 100, 50, 25, and 2.5 ppm monochloramine in drinking water plus one group receiving deionized water and one group receiving deionized water with a carbonate-bicarbonate buffer. Exposure continued for 30 days. Significant decreases in water consumption were seen at monochloramine concentrations in excess of 2.5 ppm. No significant treatment-related changes in mortality were seen. With the exception of hematocrit, which rose slightly (possibly due to reduced water intake), none of the blood characteristics indicative of oxidant stress and prehemolytic conditions was significantly affected at any dose level. (Baker-FRC)
W82-01091

ASBESTOS CEMENT PIPE AND CANCER IN CONNECTICUT 1955-1974,
Yale Univ., New Haven, CT.
J. W. Meigs, S. D. Walter, J. F. Heston, J. R. Millette, and G. F. Craun.
Journal of Environmental Health, Vol 42, No 4, p 187-191, January/February, 1980. 1 Tab, 18 Ref.

Descriptors: *Pipes, *Asbestos cement, Conveyance structures, Water transport, Public health, *Carcinogens, Epidemiology.

To assess the possible influences of asbestos cement (A/C) pipe use on cancer occurrence in Connecticut, individual town cancer rates were entered into a regression equation as the dependent variable, while asbestos exposure indicators for each town were entered as independent variables. Over 40 years of cancer incidence data were available. For 82 towns in which public water supplies were delivered either partly or wholly through A/C pipe, chrysotile asbestos fibers per liter were measured at the source and in water that had passed through A/C pipe. None of these towns had asbestos values as high as 100,000 fibers/liter in source waters. No consistent patterns of association between A/C pipe and cancer were found. Fairly consistent associations of certain cancer rates with town population density and socioeconomic status were found. Socioeconomic scores of Connecticut towns were negatively associated with stomach cancer but positively associated with male colon cancer. A positive association between length of A/C pipe and incidence of kidney cancer was found for both sexes in the 1955-64 study. Also in the 1955-1964 period, a lack of corrosion control for A/C pipes was correlated with bladder cancer, and a high aggressiveness index of water was correlated with colon cancer. No evidence was seen which would warrant changing current water distribution policies for Connecticut public water due to the use of A/C pipes. (Baker-FRC)
W82-01094

5D. Waste Treatment Processes

FEEDING ANIMALS ACTIVATED SLUDGE,
S. Beszedits.
Water and Pollution Control, Vol 119, No 4, p 16, 17, 27, April, 1981.

Descriptors: *Domestic animals, *Feeds, *Activated sludge, Amino acids, Proteins, Vitamins, Sludge disposal, Industrial wastes, Recycling, Waste recovery.

Properly prepared activated sludge has been fed to chickens, pigs, cattle and other animals in experimental studies for years. It has a 25-40% protein content and is a rich source of B-vitamins. Municipal sewage sludge has been fed to pigs at levels up to 4% and to chickens at 2.5% with no adverse effects. Sludges from industry vary in protein and vitamin content according to their source. Studies on composition and feeding studies of treated wastes from breweries, slaughterhouses, citrus fruit processing plants, canneries, dairies, and cane molasses distilleries are briefly discussed. (Cassar-FRC)
W82-00523

FOAM CONTROL IN AERATION TANKS,
Terminal Island Treatment Plant, Los Angeles, CA.
K. L. Ludwig.
Water/Engineering and Management, Vol 128, No 6, p 34, 39, June, 1981.

Descriptors: *Water treatment facilities, *Foaming, *Foam separation, Wastewater treatment, Secondary wastewater treatment, Industrial wastes, Los Angeles.

The Terminal Island Treatment Plant (TITP) is one of the three large wastewater treatment plants operated by the city of Los Angeles and is located in the Los Angeles Harbor area. TITP is designed to provide complete secondary treatment for an average 30 mgd flow of combined domestic and industrial type wastewaters. The plant relies on the sludge process to achieve the desired level of secondary treatment. The plant operates under diurnal conditions. The present flow through this plant is about 60% of the design capacity, with about 45% of the flow being of industrial origin. Problems encountered due to excessive foam accumulation have been numerous. Foam has overflowed aeration tanks and drained into adjacent pipe galleries. This has required extensive cleanup operations. Since the air feed had to be cut due to extensive foaming, expensive chemical oxygen supplements had to be used. Heavy use of the spray system results in misting conditions arising around the aeration tanks, which leads to numerous other problems as well. TITP tested the Koach Foam Splitter under heavy foam conditions for about six weeks. The unit successfully reduced foams; they were destroyed at the rate of two inches of foam depth per hour for an aeration tank 30 feet wide and 300 feet long. Following the testing period, the foam splitter was installed permanently. While the foam was not completely eliminated, it was controlled. (Baker-FRC)
W82-00525

BETTER DEWATERING IMPROVES SLUDGE RECYCLING AND GIVES SIGNIFICANT ENERGY SAVINGS,
Racine Wastewater Utility, WI.
For primary bibliographic entry see Field 5E.
W82-00526

PRESSURE SEWER SYSTEMS,
Los Angeles County Sanitation District, CA.
D. Glasgow.
Water/Engineering and Management, Vol 128, No 6, p 68-70, June, 1981. 2 Fig, 5 Ref.

Descriptors: *Sewer systems, *Wastewater collection, Wastewater treatment, Water conveyance, Design considerations, Pressure head, Hydraulics, Equipment, Pumps, Interceptor sewers, Septic tanks, Septic sludge.

In geographical areas where adverse topographical conditions exist, pressure sewer systems have found increasing application. In 1978 a survey revealed that 60 individual pressure sewer systems were in use. Two major types of pressure sewer systems are the grinder pump system and the septic tank effluent pump system. A third type is the variable gradient system. The grinder pump system consists of a holding tank receiving the sewage directly from the service location and retaining it until enough liquid has accumulated to allow the grinder pump to operate for a 1 or 2 minute cycle. The septic tank effluent system consists of a conventional interceptor or septic tank in which the solid materials discharged from the service user are retained in the tank as either settled sludge or as a floating scum. A pressure sewer is normally designed to flow full at all times. During no-flow periods problems can develop due to grease or solids accumulation. Typically the pressure sewer mains are patterned in either dendriform or grid horizontal layouts. Dendriform layouts theoretically require the least amount of pressure sewer main construction. (Baker-FRC)
W82-00528

EMPIRE CONTROLLED BY COMPUTER,
Short-Elliott-Hendrickson, Inc., St. Paul, MN.
D. E. Lund.
Water/Engineering and Management, Vol 128, No 6, p 30-33, June, 1981.

Descriptors: *Water treatment facilities, *Computers, *Wastewater treatment, Tertiary wastewater treatment, Filtration, Sludge, Activated sludge, Effluents, Consolidated facilities, *Minnesota, Empire, Apple Valley, Lakeville, Farmington.

A two-stage activated sludge process followed by tertiary filtration was suggested for the Empire Wastewater Treatment Plant, serving the communities of Apple Valley, Lakeville and Farmington, Minnesota. A central computer system monitors and controls each process and about 98% of the mechanical equipment throughout the treatment facility. The system consists of two identical computers powered by an uninterruptible power supply. Either computer can serve as the primary unit, with the second one continually gathering data and being maintained in a ready status in case of a malfunction by the other. The computer system also provides the plant operators with numerous reports, logs and displays which alert operators of any critical conditions that may develop in the plant. It also creates many operating reports that normally would require a considerable amount of operator time to complete. Tertiary filtration at Empire is obtained with gravity-type dual-media filters for removal of fine suspended materials. The tertiary filters also provide a substantial safeguard in the treatment process. Methane gas produced during the primary sludge and waste activated sludge thickening process is used as fuel in the plant boilers. (Baker-FRC)
W82-00529

MIDWESTERN WASTEWATER CHARACTERISTICS,
Environmental Protection Agency, Chicago, IL.
D. H. Stoltenberg.
Public Works, Vol 111, No 1, p 52-53, January, 1980. 3 Fig, 2 Tab, 6 Ref.

Descriptors: *Wastewater composition, *Municipal wastewater, Wastewater treatment, Biological oxygen demand, Suspended solids, Water treatment facilities, Illinois, Indiana, Ohio, Minnesota, Surveys, Operating policies.

Analyses were conducted of data obtained from operation and maintenance inspection forms completed by personnel from the Environmental Protection Agency or state personnel. Inspections were conducted in 1974-1979; reports were analyzed from 100 municipalities in Illinois, Indiana, Ohio, and Minnesota, with treatment plants serving from 10,000 to more than 100,000 inhabitants. Daily per capita loadings for flow, BOD, and suspended solids were about 40% higher than values reported in standard engineering texts. Statistical analysis produced the following values (mean of 100 plants): flow, 166 gallons per capita per day; BOD5, 0.203 lb per capita per day; and suspended solids, 0.246 lb per capita per day. Comparable data from the literature were: flow, 58-135 gallons per capita per day; BOD5, 0.1-0.2 lb per capita per day; and suspended solids, 0.08-0.23 lb per capita per day. Increased use of garbage grinders may account for the increase in suspended solids loadings. (Cassar-FRC)
W82-00534

A NOTE ON THE FATE OF EL TOR CHOLERA AND OTHER VIBRIOS IN PERCOLATING FILTERS,
Surrey Univ., Guilford (England). Dept. of Microbiology.
R. R. Daniel, and B. J. Lloyd.
Journal of Applied Bacteriology, Vol 48, No 2, p 207-210, April, 1980. 1 Fig, 1 Tab, 4 Ref.

Descriptors: *Human disease, *Percolating filters, *Anaerobic conditions, *Vibrio, Performance evaluation, Wastewater treatment, Public health.

Field results and laboratory experiment results are presented from a study designed to test the ability of Vibrio cholerae El Tor and non-cholera vibrios to grow in anaerobic sewage effluent. Samples of sewage effluent from the anaerobic settling tanks of the Oxfam Sanitation System contained reduced populations of Enterobacteriaceae and small numbers of non-cholera vibrios (NCV's). Samples were passed through percolating filters made of broken honeycomb bricks or zig-zag stakes of corrugated iron. The NCV's multiplied in both filter types. In the laboratory, NCV's were able to multiply in sewage effluent in static culture. Also, Vibrio cholerae El Tor did not multiply in the laboratory but died rapidly. The efficiency of percolating filters may be improved by ensuring an excessively strong liquor and ponding of the liquid. (Small-FRC)
W82-00566

ENUMERATION OF BACTERIOPHAGES AND HOST BACTERIA IN SEWAGE AND THE ACTIVATED-SLUDGE TREATMENT PROCESS,
Clemson Univ., SC. Dept. of Microbiology.
For primary bibliographic entry see Field 5A.
W82-00584

MOVEMENT OF ENDOTOXIN THROUGH SOIL COLUMNS,
Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
For primary bibliographic entry see Field 5B.
W82-00586

LAND TREATMENT OF MUNICIPAL WASTEWATER IN SMALL COMMUNITIES,
Economics, Statistics, and Cooperatives Service, Washington, DC. Natural Resources Economics Div.
C. E. Young, and D. J. Epp.
American Journal of Agricultural Economics, Vol 62, No 2, p 238-243, May, 1980. 3 Tab, 11 Ref.

Descriptors: *Land disposal, *Municipal wastewater, *Wastewater treatment, Economic aspects, Effluents, Irrigation, Overland flow, Infiltration, Agriculture, Simulation analysis, Crop production, Cost analysis.

Many small communities allocate a substantial portion of their budgets to wastewater treatment. Increasing numbers of small rural communities are being required to provide advanced wastewater treatment in order to meet surface water quality standards. Land treatment of municipal wastewater can meet water quality standards at about half the cost of other advanced treatment alternatives. Irrigation, overland flow, or rapid infiltration can be used to apply wastewater to land for treatment and removal of pollutants. The cost of land application of wastewater (CLAW) simulation model was used to study the design of land application systems. This computer simulation model can be used to design land application systems capable of treating between 0.1 and 100 million gallons of wastewater per day using solid-set irrigation, center pivot irrigation, border strip irrigation, ridge and furrow irrigation, overland flow, and infiltration basins. The model considers preapplication treatment, effluent transmission, wastewater storage, application method, cropping, and recovery of renovated wastewater, if desired. Capital and operating costs are computed and net crop revenue is determined. The choice of crop is a significant factor in the cost of land application facilities, since crops capable of treating smaller amounts of wastewater or irrigation over shorter periods will necessitate facilities for the storage of wastewater. Federal grants for the construction of wastewater treatment facilities can lead to the choice of an option which minimizes local costs without maximizing the amount of wastewater applied. (Carroll-FRC)
W82-00588

SYSTEM FOR OIL AND WATER SEPARATION,
J. Di Perna.
U.S. Patent No 4,203,842, 5 p, 4 Fig, 6 Ref; Official Gazette of the United States Patent Office, Vol 994, No 3, p 987, May 20, 1980.

Descriptors: *Patents, *Oil pollution, *Water pollution treatment, *Separation techniques, Water quality control, Equipment, Oil tankers.

The principal object of the invention is to provide an improved system for oil and water separation when these fluids are intended to be removed from a ship, so that only the water can be dumped back into the sea while the oil is collected in tanks so as not to pollute the sea water. It provides a system for oil and water separation that utilizes a siphon and vacuum means for moving the oil and water mixture instead of employing a pump. The system includes a relatively small, sealed tank upon the deck of the vessel, a hand controlled vent valve on top of the tank, an outlet end of a siphon line entering the tank while an inlet end of the siphon line may run into a collection or other tank, and discharge lines from lower and upper ends of the sealed tank being connected to pumps for discharging oil at the top and water at the bottom. (Sinha-OEIS)
W82-00611

CORRELATION OF MICROBIAL DEGRADATION RATES WITH CHEMICAL STRUCTURE,
Environmental Research Lab., Athens, GA.
For primary bibliographic entry see Field 2K.
W82-00621

MANAGEMENT TRAINING IS THE KEY TO GOOD OPERATOR PERFORMANCE,
V. W. Langworthy.
Water and Sewage Works, Vol 127, No 4, p 58, April, 1980.

Descriptors: *Management planning, *Training, Administration, Water treatment facilities, *Wastewater facilities, Water distribution.

The Association of Boards of Certification has worked hard to develop compatibility between states for effective intrastate programming of operator performance levels that are acceptable for water and wastewater operations. Standardization of examination questions and formats among the various grades of certification is one area of concern. A program is needed which will encourage the top individuals in this field to aim for increased self-improvement so that situations which arise can be met by persons capable of handling them. Management/supervisory training is currently available, but few are interested in participating in these programs. Some states are now insisting that an applicant for a managerial position in the water and wastewater industry must have some management expertise. Adequate programs with adequate incentives must be accepted nationwide to increase interest in and appreciation of this area of employment. (Baker-FRC)
W82-00623

MIXING TECHNOLOGY REDUCES ENERGY USE,
General Motors Corp., Saginaw. Steering Gear Div.
H. G. Peters, Sr.
Industrial Wastes, Vol 26, No 3, p 26-27, 34, May/June, 1980.

Descriptors: *Industrial wastes, *Energy conservation, *Water treatment facilities, Wastewater treatment, Design criteria, *Oil industry, Oil pollution, Oily water, Oil.

Plant needs called for a wastewater treatment facility that could extract both soluble and insoluble oils and reduce phosphate and metal contaminates to proposed acceptable levels, while requiring the lowest levels of energy consumption possible. API-type separators were installed to remove floating oils and extract settleable solids. However, these did not deal with the soluble oils present, which ranged from 1,000-1,500 ppm, with surges as high as 5,000 ppm. A new facility was needed to handle an immediate treatment load of 1.5 mgd, with a longer-term daily treatment potential of 2.5 mgd and a short term emergency capacity of 5 mgd. The facility must extract soluble as well as insoluble oils, thus eliminating the major disposal problem, and reduce phosphate and metal contaminants to acceptable levels. The final design calls for two API-type oil separators, each of 1,000 Gpm capacity, to mechanically remove floating oils and settleable solids. The secondary treatment consists of a batching operation followed by a pumping system and a flow-splitter feeding dual dissolved air flotation cells (DAF). The tertiary treatment stage consists of two parallel systems, each fed by the two secondary DAF's. All stages of the system are supplied with additives. Wastewater passing through a final DAF is monitored for turbidity. An automatic interlock/reject system prevents the release of any wastewater that does not meet discharge standards. Actual oil in the discharge has ranged from 5 to 20 ppm, versus the 100 ppm code standard. (Baker-FRC)
W82-00634

COLD WEATHER WASTE TREATMENT,
Hoover-NSK Bearing Plant, Ann Arbor, MI.
M. Bitondo.
Industrial Wastes, Vol 26, No 1, p 29, 33, January/February, 1980. 1 Tab.

Descriptors: *Wastewater treatment, *Bacteria, Water treatment facilities, Temperature effects, Cultures, Seasonal variations, Bacterial physiology, Cold regions, Winter, Freezing, *Economic efficiency, *Ann Arbor, Michigan.

Bacterial supplementation was attempted in wastewater treatment facilities in Ann Arbor, Michigan, where the freezing temperatures encountered during the winter season would kill off the bacteria naturally found in sewage, thereby upsetting the bacterial balance needed for efficient wastewater degradation. During the 1978-1979 winter season, the plant's BOD levels were within state limits in spite of prolonged periods of freezing temperatures. During this time DBC Plus bacterial cultures were used in the bioaugmentation program. In this program specially selected and formulated bacteria are added to a sewage treatment plant. Initially relatively large doses of the preparation are added to fully inoculate the system. Application of the bacterial cultures is easy. The operation costs less than $100 per month and has enabled the company to meet state standards without expensive new equipment. (Baker-FRC)
W82-00636

FOAM CONTROL AND DEGRADATION OF NONIONIC DETERGENTS,
Sybron Corp., Salem, VA. Biochemical Div.
P. Spraker, and M. Telepchak.
Industrial Wastes, Vol 26, No 1, p 16-17, 34, January/February, 1980. 1 Fig, 2 Tab, 1 Ref.

Descriptors: *Industrial wastes, *Wastewater treatment, Detergents, Soaps, *Surfactants, *Phenols, Biodegradation, Foaming, Bacteria, Cultures, *Textile mill wastes.

A decision was made to treat textile manufacturing wastewater containing phenols and surfactants with biological methods through the addition of mutant bacterial cultures to a biotower and aerated lagoons. The increased efficiencies of the bacteria produced a system capable of biological oxidation with considerably less aeration, with large reductions obtained in energy consumption and cost. Large quantities of foam were not produced by this system. A full scale biotower was designed to remove 150 mg/liter of phenol from 30,000 Gpd wastewater. The biotower structure contains 1,000 cubic feet of packing and has 6,000 gal reservoir capacity. The recycle rate was 960 Gpm. The biotower began showing reduction of the wastewater after 8 days of operation. COD and phenol content were measured. Average COD reductions were between 58-68% from an initial value of 4,481 mg/liter. Phenol content was reduced 99.4% from an original value of 9.2 to 12.8 mg/liter. Data collected over a year's time showed up to 66% reduction of BOD. Thus the system of mutant bacteria and the biotower has produced a much more efficient system, capable of handling difficult to degrade compounds in a more cost effective manner. (Baker-FRC)
W82-00637

CHEMICAL TREATMENT SOLVES TANNERY WASTE PROBLEMS,
Gunnison Bros. Girard, PA.
M. Giles.
Industrial Wastes, Vol 26, No 2, p 30-31, March/April, 1980. 1 Fig.

Descriptors: *Tannery wastes, *Wastewater treatment, Industrial wastes, Water treatment facilities, Biological oxygen demand, Suspended solids, Aerated lagoons, Chemical treatment, Alum, Coagulation.

With the help of chemicals and specialized flexible waste treatment equipment, about 33,000 Gpd of non-uniform wastewater is treated at the Gunnison Brothers tannery in Pennsylvania. The wastewaters typically contain lime, hair and other protein, grease and fatty acids, and numerous acids and dyes. A batch type system is used in the wastewater treatment facility. Jar tests are performed daily to determine how the influent will be treated. Use of alum as the primary coagulant in conjunction with other coagulant aids has enabled the tannery to meet regulatory requirements. The company reduced suspended solids from an average of 10,000 mg/liter to 80 mg/liter; oil and grease is reduced from 30 to 10 mg/liter. BOD in the influent is about 2,000 and is reduced to 200 mg/liter. COD is reduced from 15,000 to 1,000 mg/liter. Ammonia is reduced from 100 to less than 50 mg/liter. The primary effluent is pumped to a 450,000 gal aerated lagoon, where detention time is 6-10 days. From the aerobic lagoon the wastewater is pumped to a 55,000 gal secondary settling tank for final liquid/solids separation. Wastewater in the lagoon has picked up biological sludge which is treated in the secondary treatment tank. After flocculating, settling and clarifying the wastewater is disinfected and discharged. The clear effluent flows into Brandy Run, a tributary of Elk Creek which feeds Lake Erie. Dried sludge is hauled off to a sanitary landfill. (Baker-FRC)
W82-00638

REMOVAL OF PRIORITY POLLUTANTS,
Du Pont de Nemours (E. I.) and Co., Deepwater, NJ.
D. G. Hutton.
Industrial Wastes, Vol 26, No 2, p 22, 24, 26, March/April, 1980. 6 Tab.

Descriptors: *Industrial wastes, *Chemical wastes, *Wastewater treatment, Water treatment facilities, Wastewater, *Organic compounds, Heavy metals, Acid water, Sludge, Activated sludge.

Du Pont's Chambers Works in Deepwater, New Jersey, has an effective method of handling pollutants from an organic chemicals manufacturing site by neutralization and settling followed by a combined powdered carbon-biological process. The wastewater ranged from 23-50 million gallons per day. Lime slurry is added for neutralization; polyelectrolyte is added to aid in coagulating the fines prior to primary clarification. Primary sludge settles and thickens in clarifiers, is pumped to storage tanks and filtered to 45% solids concentration, and is disposed of in a lined landfill. Powdered activated carbon is added to the primary clarifier effluent as it is fed to the secondary/tertiary biological aeration tanks. The wastewater is strongly acidic, highly colored and of medium strength. Its BOD/DOC ratio suggests a high fraction of non-biodegradable compounds. The water is slightly brackish and has a relatively low suspended solids content. Primary treatment consisting of lime neutralization and settling was far more important for metals removal than the PACT process. There are at least 20 organic priority pollutants in the plant's wastewater. Thirteen of these are in the volatiles category. The secondary/tertiary PACT process does an effective job of removing organic pollutants, with 90% removal achieved for 13 of them and greater than 75% for 18 of the 20. (Baker-FRC)
W82-00639

MECHANISM OF CHARGED MEMBRANE ULTRAFILTRATION OF SALT SOLUTIONS,
State Univ. of New York at Buffalo. Dept. of Microbiology.
C. J. Van Oss.
Separation Science and Technology, Vol 15, No 2, p 159-161, 1980. 7 Ref.

Descriptors: *Acid mine water, *Filtration, Mine drainage, Acid streams, Acidic water, Membranes, Mine wastes, Industrial wastes, Membrane processes, *Membrane filters, *Wastewater treatment, *Ultrafiltration.

Optimal electrolyte removal by charged membrane ultrafiltration from acid mine water is discussed. A positively charged membrane would be the most effective, given the preponderance of bi- and trivalent cations, in which case the anions used would preferably be monovalent, and since low pH would be desirable to enhance the membrane potential, acidification with hydrochloric rather than sulfuric acid would be preferable. There does not appear to be any advantage in generating greater upstream turbulence than that corresponding to a Reynolds number of about 2500. As high a pressure differential as is compatible with membrane longevity and energy cost should be aimed for, so as to maximize the streaming potential across the pores of the membrane skin and thus the eletrolyte retention. Salt retention is likely to be increased by higher temperatures of operation due to the influences of temperature on viscosity, conductivity, and dielectric constant of the solution. If, for reasons of longevity, anionic membranes are preferred, sulfate will lead to a better salt retention than chloride ions, but then a high pH will be more advantageous to attain maximum membrane and streaming potentials. (Baker-FRC)
W82-00641

OCCURRENCE OF CYTOPHAGAS IN SEWAGE PLANTS,
Gesellschaft fuer Biotechnologische Forschung, m.b.H., Stockheim (Germany, F.R.).
For primary bibliographic entry see Field 5A.
W82-00682

RECEIVING STREAM FISHERIES STUDIES RELATIVE TO SECONDARY TREATED PULP AND PAPER MILL EFFLUENTS,
Consolidated Papers, Inc., Wisconsin Rapids, WI.
For primary bibliographic entry see Field 5C.
W82-00688

FUNGAL DECOLORIZATION OF KRAFT BLEACH PLANT EFFLUENTS,
North Carolina State Univ. at Raleigh. Dept. of Wood and Paper Science.
D. Eaton, H-M. Chang, and T. K. Kirk.
Tappi, Vol 63, No 10, p 103-106, October, 1980. 8 Tab, 10 Ref.

Descriptors: *Color removal, *Pulp and paper industry, *Fungi, Industrial wastewater, Wastewater treatment, Kraft mills, Effluents, Biological treatment.

Color was reduced by 60% in two to four days in kraft bleach plant effluents using the white rot fungus, Phanerochaete chrysosporium. Optimum conditions for decolorization were different from those favoring fungal growth. If the fungus was first allowed to grow at optimum pH, 4.3-4.8, decolorization then proceeded rapidly as low as pH 3. The best temperature for growth was 40 degrees C, but decolorization took place at temperatures as low as 28 degrees C. These results suggest that fungal decolorization is a secondary metabolic event attributable to lignin metabolism. The decolorization continued for 25 days, after which it was necessary to add glucose or cellulose, but not nitrogen. The decolorizing continued for at least 60 days before fresh cellulose was needed. Sodium chloride up to 6000 ppm did not significantly inhibit decolorization. (Cassar-FRC)
W82-00689

ANAEROBIC BIOLOGICAL TREATMENT OF FOOD INDUSTRY WASTEWATERS,
Water Pollution Research Lab., Stevenage (England).
F. E. Mosey.
Water Pollution Control, Vol 80, No 2, p 273-291, 1981. 9 Fig, 3 Tab, 25 Ref.

Descriptors: *Food processing industry, *Wastewater treatment, Industrial plants, Anaerobic digestion, Effluents, Food-processing wastes, Industrial wastes, Bacteria.

High-rate biological filtration through plastic media is a rugged, reliable treatment process capable of operating at high organic loadings of two to four kg BOD/cubic meter, which is well in excess of those sustainable in conventional activated-sludge plants or biological filters. The use of anaerobic digestion for the treatment of wastewaters incurred in food processing industries is becoming more and more appealing. Over the past 10 years there has been a worldwide reawakening of interest in this method of digestion, and the process is making great strides on several fronts in the food industry. Hydrogen-utilizing methane bacteria can now be isolated and grown on a large scale in pure cultures. The biochemical pathways of these bacteria are now being studied, with new information being gained into the microbial ecology of the anaerobic digestion process. The translation of these fundamental studies into kinetic data for the process engineer is spawning a new type of anaerobic biological treatment plan every five years. The anaerobic-digestion process is currently the main research topic in the field of wastewater treatment, and its potential for treating warm, moderately concentrated waste waters, especially those produced by the food industry, is both large and increasing rapidly. (Baker-FRC)
W82-00698

THE CONTROL OF BACTERIAL POLLUTION CAUSED BY SEA DISCHARGES OF SEWAGE,
Wessex Water Authority (England).
R. G. Toms, C. L. Saunders, and E. Hodges.
Water Pollution Control, Vol 80, No 2, p 204-220, 1981. 9 Fig, 1 Tab, 4 Ref.

Descriptors: *Pollution control, *Wastewater disposal, Outfall, Chlorination, Disinfection, Bacteria, Outfall sewers, Sewers, Seawater, Wastewater treatment, Coastal waters, Water pollution control, *United Kingdom, Wessex, Model studies.

An EEC directive has imposed bacterial levels on bathing water that are considerably more stringent than frequently is true in inland rivers, particularly

downstream from sewage treatment works. The EEC directive has been aimed primarily at protecting the environment and public health. Two methods used in the Wessex Water Authority area to control the bacterial level of bathing waters are described. The siting of a long sea outfall, now being studied at various positions off the Dorset and Somerset coasts, is one method. Use of chlorination to disinfect one important short sea outfall from the Avon coast is the second method. Model studies are being devised to gain more information on the long sea outfall. The studies will consider the effect of winds, including wind-generated shear, and also the effect of the sea bed in reflecting the sewage plume. Chlorination studies have shown this to be an inexpensive method of reducing bacterial populations of bathing water in this area. The total capital cost of equipment was less than 0.5% of the cost of construction of a long sea outfall. Chlorination should, however, be looked on as a short term solution only. (Baker-FRC)
W82-00699

APPLICATION OF IMMOBILIZED HYDROGENASE FOR THE DETRITIATION OF WATER,
Massachusetts Inst. of Tech., Cambridge. Lab. of Applied Biochemistry.
A. M. Klibanov, and J. Huber.
Biotechnology and Bioengineering, Vol 23, No 7, p 1537-1551, July, 1981. 8 Fig, 35 Ref.

Descriptors: *Catalysts, *Tritium, *Radioactive wastes, Nuclear powerplants, Waste treatment, Bacteria, Enzymes, Hydrogenase, Alcaligenes eutrophus, *Platinum, *Wastewater treatment, Isotope fractionation.

Removal of tritium from water contaminated during nuclear power production was accomplished by a catalyzed hydrogen isotope exchange process using immobilized hydrogenase in place of the commonly-used platinum catalysts. Whole bacterial cells of Alcaligenes eutrophus immobilized in calcium alginate or K-carrageenan gels were efficient catalysts for the reaction of hydrogen-tritium (H-T) exchange in both a batch tank reactor and a column. This enzymatic exchange (an equilibrium between HT + H20 and H2 + HT0) was not controlled by diffusion, as shown by the dependence of the reaction rate on the amount of immobilized cells in the system and the concentration of cells in the matrix. These immobilized cells were active over a wide pH range with a maximum at 6.0-8.0 and were quite resistant to hydrogenase inhibitors such as oxygen and carbon monoxide. The rate of the exchange reaction increased five fold upon increasing the temperature from 4 to 37 C. Ten grams of cells (wet weight) were equivalent in catalyst efficiency to 1 gram of Pt02. The bacterial hydrogenases are inexpensive, readily available, and very active in water. (Cassar-FRC)
W82-00768

MANGANESE DIOXIDE AS AN ADSORBANT FOR HEAVY METALS,
West Kent Water Co. (England).
For primary bibliographic entry see Field 5F.
W82-00775

DOES IMPROVED WASTE TREATMENT HAVE DEMONSTRABLE BIOLOGICAL BENEFITS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
For primary bibliographic entry see Field 5C.
W82-00779

VEGETATIVE FILTER TREATMENT OF LIVESTOCK FEEDLOT RUNOFF,
Nebraska Univ. Lincoln. Dept. of Agricultural Engineering.
E. C. Dickey, and D. H. Vanderholm.
Journal of Environmental Quality, Vol 10, No 3, p 279-284, July/September, 1981. 7 Fig, 5 Tab, 16 Ref.

Descriptors: *Feedlot runoff, *Land disposal, *Biofiltration, Runoff, Filtration, Nutrients, Biological oxygen demand, Water quality, Water pollution control, Animal wastes.

Four vegetative filters installed on feedlots in central and northern Illinois were evaluated over a 2 year period to determine the feasibility of using these systems for the management of feedlot runoff. Both channelized flow and overland flow systems were studied. Partial solids removal was achieved by settling, following which the runoff was applied directly to the experimental plots. Samples of influent, effluent, and surface flow at intermediate points were analyzed. There was no filter discharge from most runoff events. Runoff from larger events was partially discharged. Treatment with the vegetative filters resulted in reductions of nutrients, solids, and oxygen-demanding materials in the runoff of over 80 percent on a concentration basis and over 90 percent on a weight basis. Both the type of flow and the length of flow affected the degree of pollutant removal. Overland flow systems were more effective than channelized flow systems. Channelized flow systems required much greater flow lengths than overland systems for a similar degree of treatment. The discharge concentrations did not meet water quality standards for the receiving streams. The vegetative filters did not significantly reduce bacteria levels in the runoff. The study results indicate that discharge from adequate size vegetative filters ocurs only during large runoff events, when stream flows are also high, and that the overall impact of multiple vegetative filter systems appears to be negligible. (Carroll-FRC)
W82-00794

BEHAVIOR AND TRANSPORT OF MICROBIAL PATHOGENS AND INDICATOR ORGANISMS IN SOILS TREATED WITH ORGANIC WASTES,
Florida Univ., Stanford. Inst. of Food and Agricultural Sciences.
For primary bibliographic entry see Field 5B.
W82-00797

LOW-COST WASTEWATER TREATMENT,
C. E. Morris.
Food Engineering, Vol. 53, No. 7, p 51-56, July, 1981. 3 Fig.

Descriptors: *Food-processing wastes, *Wastewater facilities, *Construction costs, Food processing industry, Industrial wastes, Costs, Oily water, Separation techniques, Runoff, Cooling water, Wastewater treatment, Vegetable oil refinery.

The nation's largest independent vegetable oil refinery located in Opelousas, Louisiana, designed and built wastewater treatment facilities to meet federal requirements in one year. Simplicity and redundancy were the keys to designing and building a system to handle both current and future flows. The engineering team hired by the company acted as its own design engineer and general contractor, but used some outside consultants. This approach helped keep costs at 2.2 million. The plant was designed to treat 121,000 gal/day and to handle increased effluent load in the future. Costs were also reduced by using simple oil/water separators in the form of gravity-separation decanters built of fiberglass reinforced plastic. Redundancy in the system permits components to be shut down for cleaning or repair without disrupting the system operation. All pumps were installed in pairs so system operation will not be jeopardized by pump failure. The system treats three wastewater streams: process wastewater, rainwater runoff, and cooling water. Chemical, mechanical, and biological processes are used. Oil residues collected by the stream are approved for soil enrichment. (Small-FRC)
W82-00841

PURIFICATION OF WASTEWATER BY ELECTROLYSIS,
Chile Univ., Santiago. Dept. of Fisica.
S. Contreras, M. Pieber, and J. Toha.
Biotechnology and Bioengineering, Vol 23, No 8, p 1881-1887, August, 1981. 9 Fig, 1 Tab.

Descriptors: *Electrolysis, *Bacteria, *Disinfection, Flocculation, *Wastewater treatment, Microbiological studies, Hydrogen ion concentration.

A simple and rapid wastewater treatment procedure is presented which is based on an electrolytic treatment. Wastewater samples containing an equivalent of 1 g of total solids per liter and about 10 to the 6th power microorganisms per liter were processed. Electrolysis was carried out at 30 V and 200 mA in a cell with two electrodes separated by an asbestos plate. Flocculation of the suspended material present in the wastewater was followed by optical density measurements. The number of microorganisms was evaluated before and after treatment. The percentage of microorganism survival decreased exponentially with increasing electrolysis time. The percentage of microorganisms decreased exponentially with increasing water volume. The effect of pH on microorganism viability was also investigated, and above and below neutral pH the percentage of microorganism survival decreased exponentially. Thus, the method can be used to produce clarified water free of microorganisms. (Small-FRC)
W82-00847

SEDIMENTATION OF ZEOLITE TYPE A IN WATER AND WASTE WATER,
Imperial Coll. of Science and Technology, London (England).
M. J. T. Carrondo, R. Perry, and J. N. Lester.
Canadian Journal of Civil Engineering, Vol. 8, No 2, p 206-217, June, 1981. 9 fig, 6 Tab, 35 Ref.

Descriptors: *Sedimentation, *Zeolites, *Wastewater treatment, Sedimentation rates, Activated sludge, Detergents, Suspended solids.

Zeolite type A is a synthetic aluminosilicate which has been considered as a possible substitute for phosphorus builders in detergents. A series of experiments was conducted to investigate the settling characteristics of zeolite type A in water and waste water. Settling column tests yielded results which compared well with predictions made by applying Stokes' law to the particle size distribution curves, despite the non-sphericity of the particles. Predictions of removals at different overflow rates made from the column tests were in substantial agreement with the results of the model sedimentation tank tests. Zeolite type A removal in water was low even at low flow rates. The presence of zeolite type A resulted in slight reductions of the percentage of suspended solids removed in static column tests using raw sewage. Zeolite type A was removed to a lesser extent than the other suspended solids, particularly during the initial stages of settling tests. Zeolite type A removal averaged 88 percent in activated sludge pilot plant tests. These results indicate that zeolite type A removals higher than 80 percent can be anticipated in wastewater treatment facilities using primary settling and secondary treatment by activated sludge; removals greater than 90 percent are regarded as probable. (Carroll-FRC)
W82-00848

PILOT PLANT PERFORMANCES IN MUNICIPAL WASTEWATER TREATMENT BY ACTIVATED CARBON ADSORPTION,
Lagos Univ. (Nigeria). Dept. of Civil Engineering.
K. O. Iwugo, and R. J. Martin.
Effluent and Water Treatment Journal, Vol 20, No 7, p 327-329, 332-336, July, 1980. 6 Fig, 2 Tab, 30 Ref.

Descriptors: *Activated carbon, *Organic compounds, *Adsorption, *Pilot plants, Color removal, *Wastewater treatment, Organic carbon, Suspended solids.

A 0.5 cu meter per day sand-anthracite filtration-carbon adsorption pilot plant was operated under varying hydraulic loadings, organic loadings, and pH conditions to study removal of organics from municipal wastewater effluents. The carbon bed effluent organic carbon concentration varied almost directly with the concentration in the efluent after a steady state had been reached. This indicates that a certain fraction of organics in the

biologically treated sewage effluent cannot be adsorbed in this system no matter how the operating conditions are varied. The removal rates for various parameters (in mg per liter) in the granular carbon bed are summarized as follows: total organic carbon, 46.1%; soluble organic carbon, 49%; suspended solids, 56.8%; BOD5, 55.1%; BOD20, 24.5%+ and color, 90%. (Cassar-FRC)
W82-00851

CHLORAMINE-T AS A POTENTIAL SCRUBBING AGENT: REMOVAL OF ODOROUS SULFUR-CONTAINING ENVIRONMENTAL POLLUTANTS,
Texas Univ., Galveston. Medical Branch.
N. M. Trieff, N. M. Made Gowda, and V. M. Sadagopa Ramanujam.
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 3, p 383-388, 1980. 2 Tab, 11 Ref.

Descriptors: *Sulfur, *Odor control, Water pollution, Air pollution, *Industrial wastes, *Oxidation, Wastewater, Phenols, Carcinogens, Pollutants, Organic compounds, Chemical reactions, Chemical industry, Chemical treatment.

A detailed study of the reaction of thioacetamide, thiobenzamide, and other industrial pollutants with chloramine-T has been conducted. Odor studies were performed on the reactants and the reaction mixtures. In all cases, reaction with chloramine-T raised the odor threshold concentration. Results suggest that this oxidative technique has potential application in removing odorous contaminants from stock gases and industrial wastewater effluent. (Titus-FRC)
W82-00871

FACTS FIX FUND FINDING,
Havens and Emerson Ltd., Cleveland, OH.
For primary bibliographic entry see Field 9A.
W82-00885

DAIRY LIQUID WASTE DISTRIBUTION IN AN OVERLAND FLOW VEGETATIVE-SOIL FILTER SYSTEM,
Southern Illinois Univ. at Carbondale. Dept. of Agricultural Industries.
J. J. Paterson, J. H. Jones, F. J. Olsen, and G. C. McCoy.
Transactions of the ASAE, Vol 23, No 4, p 973-977, 984, July/August, 1980. 3 Fig, 3 Tab, 6 Ref.

Descriptors: *Industrial wastewater, *Dairy industry, *Land disposal, Animal wastes, *Wastewater disposal, Wastewater irrigation, Overland flow, Water pollution control, Vegetation, Soil-water-plant relationships, *Feedlot wastes.

A vegetative-soil filter system provides a disposal method for livestock wastes which small operators can install themselves and which may be substituted for a zero-discharge system where the dairy herd comprises 100 cows or less. Distribution and management problems resulting from the use of 10 centimeter diameter polyvinyl chloride (PVC) pipe for a 'sheet flow' vegetative-soil filter system for liquid wastes from a 70 cow dairy operation are discussed. The liquid dairy wastes consisted of liquid waste from the feedlot resulting from runoff during rainfall and snowmelt plus liquid waste from the milking parlor and milkroom washwater. The width of effluent discharge was too narrow to make the best use of the utilization area when the pipe distribution line was shorter than 9 meters. Distribution lines longer than 30 meters were difficult to level for uniform flow. Under wet conditions, 1 gallon per square yard per day was found to be a safe loading rate for the filter area, except during rainfall and snowmelt events. During high rainfall events, pollution can be minimized by increasing the flow distance from the settling basin to the disposal area. The botanical composition of the filter area changed significantly over the 2-year period during which wastewater from livestock was applied daily to tall fescue sod. Maintaining a suitable grass cover was a major problem. The advantages of rotating between two or more utilization areas on a weekly basis with respect to maintenance of a grass cover are being investigated. Analysis of effluent samples from the disposal sites showed that the grass filter effectively removed pollutants from the liquid dairy wastes. (Carroll-FRC)
W82-00897

SEPARATION OF SELENIUM FROM SULFIDE LEACH LIQUORS,
Canmet, Ottawa (Ontario). Mineral Sciences Lab.
V. S. Sastri, and K. S. Subramanian.
Separation Science and Technology, Vol 15, No 1, p 75-79, 1980. 2 Tab, 7 Ref.

Descriptors: *Selenium, *Leaching, Metals, *Industrial wastes, Wastewaters, *Wastewater treatment, Coprecipitation, Cation exchange, Ion exchange.

The removal of selenium from leach liquors and metal-barren effluents before discharging into the natural waterways is essential due to the fact that selenium and its various compounds are extremely toxic and carcinogenic. A systematic study of the separation of selenium from leach solutions is presented. Selenium can be separated as the thiol complex by the procedure of Kovalskii. To effect removal as cuprous seleinde, buffer solution composed to citric acid and copper sulfate with a pH of 4.5 and aqueous ammonia was added to neutral Se(IV) solution. Aqueous hydroxylamine sulfate solution (1 ml of 10% solution) was added, and the mixture placed in a small funnel in the neck of a flask. After boiling and subsequently cooling, the contents were filtered through a microfilter stick. Separation as lead selenite is achieved by the procedure of Jachwerth based on coprecipitation of selenite as lead selenite with lead sulfate, which is subsequently dissolved in ammonium tartrate solution and the solution analyzed for selenium by a spectrophotometric method using 3,3'-diaminobenzidine as the organic complexing reagent. The separation of selenium by coprecipitation with arsenic is also possible. To achieve separation by cation exchange, an ion-exchange column 30 cm long and 2 cm in diameter is filled with cation exchange resin. The selenite solution is passed through the column; the effluent is collected and analyzed for selenium by a spectrophotometric method using 3,3'-diaminobenzidine as the complexing agent. Of these methods, the cation exchange chromatographic method gave the best separation. Coprecipitation with arsenic gave poor results. High recoveries were obtained in the case of separation as cuprous selenide. (Baker-FRC)
W82-00905

FLOC/FLOAT SYSTEM CLEANS DESALTER EFFLUENT,
Pielkenrood-Vinitex, Assendelft (Netherlands).
H. Kleen, and H. Marson.
Oil and Gas Journal, Vol 78, No 36, p 76-78, 80, September 8, 1980. 4 Fig, 1 Tab, 3 Ref.

Descriptors: *Industrial effluents, *Flocculation, *Wastewater treatment, Refinery wastes, Water treatment, Chemical coagulation, Dispersants, Emulsions, Industrial wastes, *Oil industry.

Difficult and expensive problems were caused by emulsions that formed in desalter effluent water from a Dutch refinery. The problematic emulsions formed, both water-in-oil and oil-in-water, had formerly passed through the system unseparated. They were removed with the oil and passed through a complete circuit. They built up in the cycle until on some occasions the separator system became blocked by viscous, jelly-like masses of emulsion. Solution was achieved by a design employing flocculation in a tilted plate flocculator and flotation. Alum was chosen as flocculant. Flotation was achieved by microbubbles generated from pressurized dissolved air. The treated water which flows into the main waste water treatment system is sufficiently purified to fall within the specification of 30 mg oil/kg which the refinery is expected to meet. The improvement of desalter effluent quality has reduced the frequency of plant shutdown due to exceeding the allowed population equivalent limit in the water discharge from four shutdowns to one shutdown per year. (Baker-FRC)
W82-00906

MASSIVE CULTIVATION OF MICROALGAE: RESULTS AND PROSPECTS,
Kernforschungsanlage Juelich (Germany, F.R.). Inst. fuer Biotechnologie III.
C. J. Soeder.
Hydrobiologia, Vol 72, No 1/2, p 197-209, July, 1980. 2 Fig, 10 Tab, 72 Ref.

Descriptors: *Algae, *Biological wastewater treatment, *Water reclamation, Wastewater treatment, Feeds, Reviews, Economic aspects, Bacteria, Waste treatment, Spirulina, Chlorella, Scenedesmus, Irrigation water, Manure, Animal wastes, Chemical wastes, Effluents, Lagoons, Algae harvesting, Agriculture, Protein, Tropical regions, Impaired water use.

Mass production of microalgae is reviewed with special emphasis on the most promising technology, treatment of wastewater with algae-bacteria systems to yield a proteinaceous biomass suitable as a food. These processes vary from growing Spirulina on fermented cow dung in a ditch in India to the sophisticated Japanese Chlorella factories. High rate algae ponds, which represent great improvement over sewage or effluent treatment in deep unlined ponds at long retention times, feature intensive mixing and night-time aeration. Results are aerobic wastewater treatment, reclamation of treated water for use in irrigation, and the proteinaceous algae-bacteria biomass suitable for animal feed. Least energy consuming harvesting methods are sedimentation, filtration, and flotation. Among the highest yield values reported are a mean efficiency of photosynthetic active radiation conversion of 4.8% in Bulgaria. Addition of organic substrates boosts the yields. Nutritional and toxicological aspects of algae culture are discussed. The most promising fields for increasing microalgae production are in cases where algae are obtained as byproducts from urban sewage treatment, animal wastes, mineral fertilizer wastewaters, soda manufacture from carbonate brine, and ammonia or urea manufacture. (Cassar-FRC)
W82-00913

KINETICS OF NITRATE AND AMMONIUM UPTAKE BY THE TROPICAL FRESHWATER MACROPHYTE PISTIA STRATIOTES L.,
Guam Univ., Agana. Marine Lab.
S. G. Nelson, B. D. Smith, and B. R. Best.
Aquaculture, Vol 24, No 1/2, p 11-19, May, 1981. 5 Fig, 1 Tab, 19 Ref.

Descriptors: *Nitrogen, *Kinetics, *Aquaculture, Nutrients, Macrophytes, Ammonium, Nitrates, Tropical regions, Wastewater treatment.

The kinetics of nitrogen uptake were examined for a common freshwater macrophyte Pistia stratiotes L. Nitrate-nitrogen and ammonium-nitrogen uptake were examined over a wide range of substrate concentrations gather information which would be useful in the design of aquaculture systems for ammonium and nitrate removal. Nitrate uptake rates were higher after 24 hr of exposure to the nitrate source than immediately after exposure. The rate of uptake of nitrate-nitrogen was greater in the light than in the dark. Nitrate uptake followed a pattern which could be adequately described by the Michaelis-Menten expression. Ammonium nitrogen uptake response to substrate concentration apeared to be linear. Rates of ammonium-nitrogen uptake was similar in the dark and in the light. For any given dissolved nitrogen concentration, the rate of ammonium-nitrogen uptake was greater than the rate of nitrate-nitrogen uptake. (Baker-FRC)
W82-00937

POTENTIAL FOR LAND DISPOSAL OF TWO NONBIODEGRADABLE WASTES,
Delaware Univ., Newark. Dept. of Agricultural Engineering.
W. F. Ritter, R. P. Eastburn, and M. P. Neisser.
Transactions of the ASAE, Vol 24, p 945-950, July/August, 1981. 8 Fig, 5 Tab, 14 Ref.

Descriptors: *Land disposal, *Industrial wastes, Nylon, Waste disposal, Wastewater disposal, Groundwater, Water pollution sources, Groundwater pollution, *Nonbiodegradable wastes.

A series of laboratory and greenhouse experiments was conducted to evaluate the potential for land disposal of some nonbiodegradable nylon processing wastes. Two wastewaters from experimental nylon manufacturing processes were subjected to soil column, lysimeter, adsorption, phytotoxicity and biodegradation studies. The major objectives were to determine whether the wastewaters were degradated by soil microorganisms and whether land disposal could be used for the wastewaters. Two wastes of differing chemical composition were used in the study. The chemical oxygen demand concentrations of the leachate for wastes A and B versus the amount of wastewater applied at different loading rates was determined. At a low application rate of 1.3 cm/week, no leachate samples were collected for five weeks due to evaporation. In general, the soil column profiles did not remove any more COD after about 36 to 48 cm of wastewater was applied, indicating that adsorption of the organic material to the soil particles was small. The pH of the leachate varied from 5.0 to 8.0 for wastes A and B. Samples of leachate were collected for 15 weeks from the lysimeters after the initial wastewater application. Neither waste A nor waste B adsorption could be described by the Langmuir equation or the Freundlich equation. Wastewater was applied to the pots in the greenhouse study for 18 weeks. One week after application began, the grass being treated with waste B became chlorotic. High application rates appeared to have an adverse effect on the vegetation. It was concluded that the potential for using land treatment for nonbiodegradable wastes is limited. These types of wastes could cause serious groundwater contamination. (Baker-FRC)
W82-00939

EXTRACTING HEAVY METALS AND TOXIC ORGANICS FROM SLUDGE,
A. A. Kalinske.
Water/Engineering and Management, Vol REF, No HB, p R148-R151, 1981.

Descriptors: *Sludge, *Toxicity, *Wastewater treatment, Sludge thickening, Sludge drying, *Sludge disposal, *Heavy metals, Organic compounds, *Sludge conditioning.

In order to make a sludge or residue non-hazardous, it may be necessary to reduce its heavy metal content. Municipal wastewater treatment plant sludge from primary and secondary treatments will contain various amounts of toxic organics such as chlorinated hydrocarbons and toxic heavy metals. Most of these are only slightly soluble in water and tend to adhere to the suspended solids in the wastewater. The biological organisms in the secondary plant, especially those in the sludge process, have a considerable capacity to remove heavy metals present in fine particulate form and in soluble form. Metal concentrations in the raw sewage coming to any treatment plant are relatively low. Chemical treatment, such as for phosphorus removal, will usually cause additional heavy metals to be removed from the sewage by precipitation due to increases in acidity and by coagulation of colloids. The ratio of soluble to insoluble concentration of the various heavy metals in liquid sludge can be changed by the addition of chemicals for conditioning, if the pH is changed. An elevated pH will cause precipitation, to some degree, of most of the heavy metals present in solution. There are also systems for heat-treating a liquid sludge so as to condition it in order to obtain excellent dewatering without using any chemicals. The sludge is raised to a temperature of 180-210 degrees C, under pressure conditions, and held for about 30 min. Heat drying of sludge is done at some wastewater treatment plants to prepare a saleable product for use as a soil conditioner with some fertilizing properties. (Baker-FRC)
W82-00947

CONTROL SYSTEMS FOR RETURN AND WASTE SLUDGE,
Metropolitan Sanitary District of Greater Chicago, IL.
R. L. McCarthy, and R. L. Sokol.
Water/Engineering and Management, Vol REF, No HB, p R152-154, 1981. 3 Fig, 1 Tab.

Descriptors: *Sludge, *Control systems, Equipment, Sludge excess, *Wastewater treatment, Activated sludge.

Devices, instruments, and piping arrangements which may aid in the application of processes governing the return and wasting of sludge are discussed. Sludge level sensors, air lifts, and a variety of control arrangements in use are described. While air lift with gravity return is still the primary method of returning sludge in the district of Greater Chicago, several new devices have improved the process, one of which is the sludge level sensor. There are two types of sensors; one, a sonic sensor, is based on the fact that an ultrasonic signal will attenuate to a large degree when passing through a liquid containing suspended solids as opposed to passing the signal through clear water. The second, the light sensor, uses a highly sensitive photocell and an infrared or ultraviolet light source in a probe suspended in the tank. The system is presently arranged so that the return sludge rate may be selected and the system kept in balance automatically by variation of the waste sludge rate with changing level of the sludge blanket. All sludge withdrawn from the tank is air lifted into a return sludge channel. The return sludge flow into the aeration tanks is controlled, based on varying sewage flow and a preset return sludge ratio. The amount of lift needed to return final tank sludge back to the aeration tanks is usually less than 3 feet. The back-up system for all controls is the sludge level indicator. The operator on duty makes charts which show four circles and which are penciled in whenever the sludge reaches a certain indicator pipe. If necessary this information when given to the shift operator can be used to make adjustments. (Baker-FRC)
W82-00949

AN ALTERNATIVE WASTEWATER DISINFECTANT,
Maryland Environmental Service, Annapolis.
D. J. Greene.
Water/Engineering and Management, Vol 128, No 7, p 47-48, July, 1981. 6 Fig.

Descriptors: *Bromine chloride, *Disinfectants, *Secondary wastewater treatment, Wastewater treatment, Chlorination, Fish, Toxicity.

Bromine chloride was cost competive and offered advantages over other disinfectants in field trials at an activated sludge secondary wastewater treatment plant in Sykesville, Maryland. The 5 min control point residual required was 0.8 ppm equivalent total chlorine to produce a < 200 fecal coliforms per 100 ml effluent level and low or nondetectable residual in the final effluent. In a 96-hour fish survival test with fathead minnows, no fish were killed by 8 ppm BrCl in effluent, while 100% were killed in 8 ppm C12 in effluent. Bromine chloride has several advantages over chlorine. It is liquid at room temperature, 12 times more soluble in water, and more effective at lower temperatures. Bromamines formed in the process are less stable and therefore less harmful to aquatic life. Total treatment costs in cents per 1000 gal based on a 100 mgd plant are 1.6 for chlorobromination (5 ppm) and 1.9 for chlorination/dechlorination/postaeration. (Cassar-FRC)
W82-00950

SLUDGE BLANKET IN ACTIVATED FINAL CLARIFIERS,
Envirex, Inc., Milwaukee, WI.
W. H. Boyle.
Water/Engineering and Management, Vol REF, No HB, p R124, R129-R130, 1981. 3 Fig, 3 Tab, 5 Ref.

Descriptors: *Clarifiers, *Activated sludge, Sludge, *Wastewater treatment, Clarification, Chemical precipitation, Water treatment.

Activated sludge acts as a liquid and therefore seeks its own level on entering the final clarifier of a wastewater treatment plant. The heavier mixed liquor, on entering the final clarifier basin, drops to the floor or sludge blanket. It then travels along the floor until it hits an obstruction such as the peripheral wall for the center feed clarifier. Activated sludge does not settle as a discrete particle, but rather in a hindered zone of influence, and not therefore governed solely by Stokes' law of settling. Activated sludge has no choice but to seek its own liquid mass level in a clarifier if no mechanical or hydraulic limitations are imposed on it. The sludge will not likely be a homogeneous solid mixture in the sludge blanket, nor will the sludge blanket have a constant concentration of solids per unit area of the tank floor. Since sludge in each plant is different, the relative concentration will vary, but the random pattern of the contour lines of sludge will probably not differ significantly. A theoretical removal point will pass through as many as eight different solids contours for half the basin. It would be most difficult to design a sludge collector for rapid adjustment to each different concentration point. Even if well defined radial concentration points did exist, it would be impossible to say where the heavy versus the light sludge would be at any given time. To satisfy most mass loading theories and practical applications of final clarifiers, the designer and operator must take into account that sludge will settle at a level elevation and should be removed to sustain this level. While the solids concentration in the sludge blanket is not perfectly uniform, the removal device should be designed as though it were. (Baker-FRC)
W82-00951

AUTOMATION OF NORWICH SEWAGE-TREATMENT WORKS: EARLY COST CONSIDERATIONS,
Anglian Water Authority, Norwich (England). Norwich Sewage Div.
J. Hemsley, and A. Latten.
Water Pollution Control, Vol 80, No 3, p 341-355, 1981. 2 Fig, 10 Tab, 7 Ref.

Descriptors: *Automation, *Cost analysis, *Wastewater treatment, Water treatment facilities, Maintenance, Operating costs, Maintenance costs, *Norwich, England.

The effects of automated procedures on operating costs experienced at the Norwich sewage treatment works are described. An actual savings of 25,900 pounds Sterling/year thought to be attributable to automation was realized on operation. The desludging of primary sedimentation tanks was not cost effective on automatic control. However, if the same system were to be designed today, the eight ultrasonic sludge density indicators currently employed could be reduced to two, and this fact alone would mean that the costs would approximately balance the tangible benefits. The performance of the activated sludge plant during the automatic control period was clearly superior to that during the period of manual control. In efforts to gain cost figures regarding dissolved oxygen control, the DO control system of the 27.5 tcmd design DWF six-channel diffused-air, activated-sludge plant used up to four EIL Makereth DO sensors, positioned at various points around the aeration channels. To obtain data for a manual vs. automated operation, the DO control system was shut down for a time period and the DO controlled by manual adjustments to blower speed. Records of labor, power consumption, and plant performance were kept. In both manual and automated periods of operation the plant was operating in a non-nitrifying mode, and air supplied above that required to satisfy base respiration was substantially used in carbonaceous oxidation. Comparing the final costs indicated by the systems showed a present value saving on automatic control of 122,506 pounds, which is about equal to 1.5 operators or about 64 man-hr/week. (Baker-FRC)
W82-00955

GUIDELINE TABLES TO INDUSTRIAL WASTES PROBLEMS.
Water and Pollution Control, Vol 119, No 6, p 10-12, June, 1981. 1 Tab.

Descriptors: *Wastewater treatment, *Industrial wastes, *Industrial wastewater, Water quality standards.

An extensive table is presented which outlines treatments available for industry's major problem wastes. The table lists the industry, its waste problems, possible treatments, and guidelines and standards for maximum concentrations. Industries considered include basic iron and steel, agricultural chemicals, inorganic chemicals, organic chemicals, food processing, metal working and finishing, petroleum and petrochemicals, mining and metallurgy, pulp and paper, transportation industries, and tanning and rendering. Most of these wastes are in the form of contaminated water, although solid wastes are also mentioned in the table when appropriate. (Small-FRC)
W82-00956

THE CAPE FLATS SEWAGE TREATMENT WORKS,
J. G. Brand.
Civil Engineer in South Africa, Vol 23, No 4, p 124, April, 1981.

Descriptors: *Wastewater facilities, *Water reuse, *Activated sludge process, Wastewater renovation, Potable water, Secondary treatment, Oxidation, Sedimentation, *South Africa.

The Cape Flats Sewage Works, which treats primarily domestic sewage, handles an inflow of 150 Mliters/day. The older Athlone Works treats primarily industrial wastes, which are generally too saline to be reclaimed for potable use. At the Cape Flats plant, sewage is screened and grit is removed before passing into primary settling tanks and then into aeration reactors. After secondary settling, the effluent is discharged into oxidation ponds. The sludge is ultimately sold as fertilizer. The project was started in 1977, and the final value of contracts awarded was R22 million. The architectural design of the facility won a commendation by the Concrete Society of Southern Africa. Buildings such as the inlet works and blower house comprise concrete portal frames clad in color-coated curved asbestos sheeting. Selection and design of the basic process were carried out with a view to immediate compliance with the final effluent standards, and to the utlimate objective of water reuse. (Small-FRC)
W82-00957

THE FATE OF HEAVY METALS IN THE RUHR SYSTEM AND THEIR INFLUENCE ON DRINKING WATER QUALITY,
Ruhrverband, Essen (Germany, F. R.).
For primary bibliographic entry see Field 5B.
W82-00962

FLUIDIZED BED FOR BIOLOGICAL WASTEWATER TREATMENT,
Patras Univ. (Greece). Lab. of Applied Thermodynamics.
T. C. Stathis.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE1, p 227-241, February, 1980. 1 Fig, 1 Tab, 15 Ref.

Descriptors: *Biological wastewater treatment, *Fluidized beds, Wastewater treatment, Biological treatment, Fluidized bed process, Microorganisms, *Nassau County, New York.

A fluidized bed system is described that is used in the treatment of municipal wastewater from Nassau County, New York, at its 60 mgd treatment plant at Bay Park, New York. Using a pilot plant of 72,000 gal/day, the 94 mg/liter of incoming primary soluble BOD effluent was being reduced to 11 mg/liter within a 16 minute total detention time. The recycle ratio for this case was equal to 2.2. Sand was used as the granular medium in the fluidized bed; this acts as a support surface upon which the biological population grows. Wastewater is first pumped through a pressurized oxygen mixing tank, where it is hydraulically mixed with pure oxygen gas and subsequently fed to the fluidized bed reactor. The fluidization of the media allows solids to pass through, thus overcoming the problems associated with packed bed systems, such as plugging and frequent backwashing. The fluidized bed system offers a much higher surface area per unit volume of reactor on which the microorganisms grow, and therefore it can operate with much higher concentrations of biological mass than other systems. As a result, the fluidized bed system requires considerably less space and lower construction costs than other systems, and it should be considered as a welcome addition to the variety of wastewater treatment systems available. (Baker-FRC)
W82-00968

MUTLICHAMBER SEPTIC TANKS,
Connecticut Univ., Storrs. School of Engineering.
R. Laak.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE3, p 539-546, June, 1980. 3 Fig, 29 Ref.

Descriptors: *Septic tanks, *Effluents, Design criteria, Wastewater treatment, Wastewater, Planning, Suspended solids, Biological oxygen demand, Multichamber septic tanks.

The concept of a multichambered septic tank is considered in contrast to the single chamber tank, which is conventionally used for small flows only. Multichamber tanks appear superior to single-chamber tanks in that up to 50% less suspended solids remain in the effluent. A change from a single chamber to a multi-chamber tank can mean a change in suspended solids removal from 75% to 80%. This represents a 20% suspended solids load improvement on the seepage bed. The surface area/depth ratio for each compartment, the loading intensity, and the outlet configuration show a significant effect on effluent quality. While overloaded tanks will undoubtedly fail, multichamber tanks often perform longer at a more satisfactory rate. To be effective, septic tanks should have a detention period longer than 24 hr, an outlet configuration with a gas baffle, maximized surface area/depth ratio for all chambers, and a multichamber tank with interconnections similar to the outlet design. (Baker-FRC)
W82-00969

CATION TRANSPORT IN PACKED BED REACTOR OF SOIL,
Florida University, Gainesville, Agricultural Engineering Department.
A. R. Overman, B. R. McMahon, R. L. Chu, and F. C. Wang.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE2, p 267-277, April, 1980. 16 Fig, 1 Tab, 12 Ref.

Descriptors: *Soil disposal fields, *Cation exchange, Model studies, Tertiary wastewater treatment, Wastewater treatment, Municipal wastewater, Kinetics, Waste disposal, Wastewater disposal, Land disposal, *Ion transport.

Cation exchange is an important process in the land treatment of municipal wastewater, since it influences the availability of several nutrients for crop uptake as well as the buffer capacity of the system to shock loading. A model of cation transport through a packed bed of soil is presented. Components of the model include convection, dispersion, and ion exchange. The method of finite differences as proposed by Gupta and Greenkorn is used to obtain a mathematical solution to the nonlinear system. The component for cation exchange is based on second-order kinetics in accord with the law of mass action. For the experiments conducted the packed bed reactor was packed with Lakeland fine sand to a bulk density of 1.66 g soil per cubic meter and a porosity of 0.376. After purging the soil air with carbon dioxide, the reactor was saturated with distilled/deionized water to assure total saturation so that pore velocities could be calculated. Several pore volumes of ammonium chloride were passed through to saturate exchange sites with ammonium ion. The pH was adjusted to 6.5. Samples were analyzed for ammonium ion with a spectrophotometer, for potassium by flame photometry, and by titration for chloride ion. Experiments were conducted by switching between ammonium chloride and potassium chloride of the same molar concentration and at pH 6.5. The findings indicate that the dynamics of cation exchange in packed soil depend upon water flow and ionic composition of the soil solution. Increases in ionic strength or flow velocity greatly increase the rate of cation exchange. The performance of land treatment systems depends on intricate coupling among hydraulic, chemical, and biological processes. (Baker-FRC)
W82-00970

BIOLOGICAL TREATMENT OF SYNTHETIC FUEL WASTEWATER,
Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering.
R. G. Luthy, D. J. Sekel, and J. T. Tallon.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE3, p 609-629, June, 1980. 5 Fig, 4 Tab, 20 Ref.

Descriptors: *Biological wastewater treatment, *Coal gasification, Wastewater treatment, Nitrification, Biological treatment, Ammonia, Nitrogen, Biological oxidation, Oxygen demand, Biological oxygen demand, Industrial effluents, Effluents, Gasification.

The possibility of using biological methods for the treatment of wastewater heavily laden with organic contaminants arising from a coal gasification pilot process plant was investigated. The wastewater used was obtained from the Grand Forks Energy Technology Center gasifier in Grand Forks, ND. The wastewater effluent was double decanted to remove most of the tar and oil prior to shipment. The wastewater contains on the order of 0.4 equivalents per liter total ammonia and 0.4 equivalents per liter of alkalinity. Most of the ammonia present is present as free ammonia. Wastewater was pretreated by dosing with lime to precipitate alkalinity as a calcium carbonate sludge and to raise pH when air stripping ammonia. Ammonia stripping was done to prepare influent to the biological cells. Stripping lowered ammonia concentration from an average level of 5,150 mg/liter to 330 to 580 mg/liter. Lime pretreatment and ammonia stripping removed 84% of raw wastewater alkalinity and 91% of wastewater ammonia, resulting in a significant decrease in wastewater conductivity. COD demand was reduced by 14%. Sulfide was reduced to 5 mg/liter. Biological reactors were seeded with activated sludge. Treatment of ammonia stripped wastewater at 25% strength showed very stable operating conditions. Effluent volatile suspended solids and phenolics were low, there was high removal efficiency for thiocyanate and chemical oxygen demand, and nearly complete nitrification of influent ammonia was achieved. Final studies showed wastewater could be processed at 40% strength and that nitrification was feasible with both stripped and unstripped wastewater. (Baker-FRC)
W82-00971

VACUUM FILTRATION OF METAL HYDROXIDE SLUDGES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
W. R. Knocke, M. M. Ghosh, and J. T. Novak.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE2, p 363-376, April, 1980. 9 Fig, 1 Tab, 14 Ref.

Descriptors: *Sludge, *Vacuum filtration, Sludge dewatering, Filtration, Metals, *Wastewater treatment, Industrial wastes, Separation techniques.

The characteristic response of metal hydroxide sludges to vacuum filtration was examined. Both individual and mixed-metal sludges were examined regarding sludge dewatering rates, handling properties, and filtrate quality obtained during vacuum dewatering. Sludge parameters such as mean particle size and size distribution, as well as operational

parameters such as precipitation pH, were evaluated to better define their effect on the dewatering of metal hydroxide sludges. It was concluded that most metal hydroxide sludges will yield acceptable dewatering rates when subjected to vacuum filtration. Sludges of high specific resistance can be conditioned through the addition of high molecular weight polyelectrolytes. The penetration of solids during vacuum dewatering must be dealt with for certain metal hydroxide sludges. Small additions of polyelectrolyte were helpful in minimizing the amount of solids in the vacuum filtrate. Sludge floc size had the greatest effect of those parameters tested on the rate at which metal hydroxide sludges dewater. Increases in the mean floc size of a sludge produced significant improvements in the rate of sludge dewatering, as evidenced by decreased sludge specific resistance values. Insolubilization pH and variations in metal content altered sludged specific resistance by affecting the size of flocs formed during the precipitation phase of treatment. Synthetic polyelectrolytes condition metal hydroxide sludges through increases in particle size. The mechanism of polymer action appears to be interparticle bridging. (Baker-FRC)
W82-00976

WATER QUALITY EVALUATION OF REGIONAL WASTEWATER MANAGEMENT,
Toronto Univ. (Ontario). Dept. of Civil Engineering.
B. J. Adams, and R. S. Gemmell.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE2, p 437-450, April, 1980. 6 Fig, 13 Ref.

Descriptors: *Wastewater management, *Water quality control, Urban areas, Water treatment facilities, Wastewater facilities, Design criteria, Planning, Decision making.

Regional wastewater management alternatives are discussed in relation to size, number and location of wastewater treatment plants. A two-reaction model is used in the discussion. The model assumes that the flow is uniform and steady and that there is no longitudinal dispersion. This model can predict the dissolved oxygen deficit at any time of flow downstream due to a single point discharge. The deterministic analysis reveals that for a given stream size or dilution ratio and a given stream length, an increase in the disaggregation state of wastewater treatment plants results in an improved water quality. Water quality improvement resulting from a decentralized regional wastewater treatment system is also a function of the dilution ratio. It appeared that decentralization was more beneficial in cases with relatively small streamflows. The water quality impact of regional wastewater centralization due to stochastic variability was examined with stochastic simulation models. Increasing the state of aggregation or equivalently increasing the number of wastewater discharge points resulted in minimum dissolved oxygen frequency responses with smaller variances. Thus the multiplant system resulted in a minimum stream dissolved oxygen level significantly larger than that of the single plant system. For systems of various lengths, increasing the system length not only increased the mean minimum dissolved oxygen response, but also decreased the variance of the response of multiplant systems. It was concluded that the decentralized wastewater system significantly outperformed the centralized system when the dilution was small. As the dilution ratio increased, this difference in performance decreased. (Baker-FRC)
W82-00977

CHEMICALS DISINFECT SLUDGE,
Universidad Autonoma de Nuevo Leon, Monterrey (Mexico).
A. Ramirez, and J. F. Malina, Jr.
Water and Sewage Works, Vol 127, No 4, p 52-54, April, 1980. 4 Fig, 1 Ref.

Descriptors: *Sludge disposal, *Disinfection, Ozonation, Chlorination, Land disposal, Calcium hydroxide, Lime, Ammonium hydroxide, Sludge utilization, *Wastewater treatment.

Ozone, chlorine, and calcium hydroxide plus ammonium hydroxide were considered in addition to calcium hydroxide (quickline) alone as potential disinfectants of sewage sludge to be applied to land. Tests indicated that chlorine disinfection of sludge could produce organochlorinated substances which might pose a problem for the final disposal of treated sludge. Obnoxious odors may also develop when chlorine residuals disappear if sludge is stored in the liquid form. The addition of lime killed or inhibited bacteria, although the acid-fast bacteria demonstrated more resistance to the high pH treatment than to clorination. A decrease in bacterial survival of up to 5.5 orders of magnitude could be maintained for several days at a lime dosage of 1.2-1.5 times that needed to produce an initial pH of 12.0. Ammonium hydroxide combined with a pH of 12 (achieved by lime addition) and homogenization was tested. This combination was more efficient for acid-fast bacteria removal than lime alone. Fecal streptococcus assays were similar to those produced using lime alone. Bacterial resistance to disinfection chemicals increased in the order of total coliforms < fecal coliforms < fecal streptococci < acid-fast bacteria. Thus fecal streptococcus and acid-fast bacteria are desirable indicators for sludge disinfection studies. (Baker-FRC)
W82-01003

SCOTT BRINGS UNIQUE $25-MILLION WASTE TREATMENT FACILITIES ON-LINE,
K. E. Smith.
Pulp and Paper, Vol 54, No 2, p 98-100, February, 1980. 1 Fig.

Descriptors: *Pulp wastes, *Activated sludge process, *Wastewater treatment facilities, Pulp and paper industry, Wastewater treatment, Costs, Aeration, Aerated lagoons, Water quality, Water pollution control, *Mobile, Alabama.

A recently upgraded effluent treatment facility at a paper plant in Mobile, Alabama, includes an improved existing secondary treatment plant, new sludge dewatering equipment, and the construction of a unique 115-acre stabilization and aeration basin. The 25 million dollar project was necessary to meet EPA and future requirements. A static aeration system was added to the existing plant; the plant's effluent flows by gravity to a new 115 acre aeration and stabilization pond. Nine floating agitators aerate the effluent, which is eventually discharged into the Mobile River. Removal of the effluent discharge from Chickasaw Creek improved the appearance of the creek as well as water clarity, purity, and dissolved oxygen levels. (Small-FRC)
W82-01007

MUTANT BACTERIA CONTROL FILAMENTOUS GROWTH IN MILL WASTEWATER TREATMENT,
Polybac Corp., Allentown, PA.
T. G. Zitrides.
Pulp and Paper, Vol 54, No 2, p 172-174, February, 1980. 1 Tab.

Descriptors: *Activated sludge process, *Bacteria, *Pulp wastes, *Wastewater treatment, Pulp and paper industry, Biochemical oxygen demand, Performance evaluation.

Mutant bacteria can increase BOD5 removal rates, improve sludge settling, and increase tannin and lignin removal in activated sludge plants treating pulp mill wastes. Seeding with single-cell, nonfilamentous, mutant bacteria can replace costly hydrogen peroxide and polymer treatments for the control of filamentous organisms. The mutant bacteria were tested in an integrated chemimechanical pulp and paper mill producing 160 air dry tpd of hydrogen-peroxide bleached hardwood pulp. The mill sends 6 million gal/day of wastewater to the treatment system. Successful pilot studies justified a trial of full-scale continuous control of filamentous growth. The seeding began with a dosage of 25 lb/million gal, and for the next ten days 30 lb/day were added, followed by a maintenance dosage of 9 lb/day. After 47 days, improvement in sludge settling was 41.9%, improvement in total BOD removal was 12.2%, and the biomass remained healthy with minimum filamentous growth. (Small-FRC)
W82-01008

NEW SECONDARY TREATMENT SYSTEM BROUGHT ON-LINE AT GEORGIA-PACIFIC,
H. M. Cody.
Pulp and Paper, Vol 54, No 7, p 180-182, July, 1980. 2 Fig, 1 Tab.

Descriptors: *Pulp and paper industry, *Secondary wastewater treatment, *Stabilization lagoons, Effluents, Industrial wastes, *Wastewater treatment, Aerated lagoons, Wastewater lagoons, Lagoons, Outfall, *Puget Sound, Washington.

A $20 million secondary treatment system (lagoon plus outfall/diffuser) was installed at the Georgia-Pacific Corporation's Bellingham, Washington, mill on Puget Sound to meet effluent standards. The system consists of a stabilization lagoon designed to treat 240 million gallons with continuous aeration at a flow design of 25 million gal per day. After a residence time of 7 days, effluent from the lagoon is combined with clean water in a chamber and discharged through a 60 inch i.d. outfall pipe at a design flow of 50 million gal per day. The diffuser section is 2000 ft long and has 500 1.5 inch diameter ports at 8 ft intervals, discharging at an average 55 ft below the surface. The average BOD load into the lagoon is 110,000 lb per day; the discharge limit is 22,500 lb per day. The total suspended solids output limit is 35,300 lb per day. (Cassar-FRC)
W82-01009

SIMULATION MODELING OF PRIMARY CLARIFIERS,
Paramount Engineering Ltd., Kitchener (Ontario).
For primary bibliographic entry see Field 6A.
W82-01027

REMOVAL OF VOLATILE TRACE ORGANICS FROM WASTEWATER BY OVERLAND FLOW LAND TREATMENT,
Army Cold Regions Research and Engineering Lab., Hanover, NH.
T. F. Jenkins, D. C. Leggett, and C. J. Martel.
Journal of Environmental Science and Health, Part A, Vol 15, No 3, p 211-224, 1980. 4 Fig, 3 Tab, 14 Ref.

Descriptors: *Wastewater treatment, *Land disposal, *Organic wastes, Organic compounds, Chlorination, Chloroform, Toluene, Volatility.

The effectiveness of a prototype overland flow land treatment system in reducing the levels of volatile trace organics in municipal wastewater was investigated. Chlorinated primary wastewater, water collected from the surface at various points downslope, and runoff were analyzed by GC/MS using a purge and trap sampler. The primary settled wastewater was chlorinated before application to the grass covered slopes, by adding 2.0 liters of 5.25% sodium hypochlorite solution to a 5300 liter holding tank and mixing for one hour. Wastewater was applied to the test site at five different application rates ranging from 0.40 cm/hr to 2.31 cm/hr. Average hydraulic detention times on the slope were determined by chloride tracer analysis at each flow rate used. The period of application was seven hours per day, five days per week. After a steady state flow was established, samples were collected from the applied wastewater, surface water at various downslope distances, and runoff. Results indicated that efficient removals of a number of volatile substances including chloroform and toluene were achieved by this method. Loss of these substances was found to follow first order kinetics. The observed behavior is consistent with a volatilization process. (Baker-FRC)
W82-01042

EFFECTS OF RENTON WASTEWATER TREATMENT PLANT EFFLUENT ON WATER QUALITY OF THE LOWER GREEN/DUWAMISH RIVER,
Washington State Dept. of Ecology, Olympia.
J. C. Bernhardt.

In: The Impact of Renton Wastewater Treatment Plant on Water Quality of the Lower Green/ Duwamish River, Document DOE 81-2. January 1981. Part I. 35 p. 13 Fig, 4 Tab, 17 Ref, Append.

Descriptors: *Wastewater dilution, *Stream pollution, *Wastewater facilities, Wastewater treatment, Wastewater management, Wastewater disposal, Wastewater pollution, Waste discharge, Discharge hydrographs, Water quality standards, Water quality, On-site data collections, Washington, *Seattle.

The Municipality of Metropolitan Seattle (METRO) completed the Renton Wastewater Treatment Plant (RWTP) in 1965 to improve water quality in Lake Washington and nearby areas. As the RWTP has grown, the Department of Ecology has become increasingly concerned about the possible impacts of the discharge on stream quality. Past investigators have concentrated mainly on the lower waterway and zone of salt water intrusion, while the fresh waters above have received limited attention. This report describes the dilution and dispersion of RWTP wastewaters and measurements of selected water quality constituents. Two time-of-travel surveys were conducted on the lower Green-Duwamish River to evaluate impacts of secondary-treated wastewaters discharged from the RWTP during summer low flow. The 12-mile section of the lower river between RWTP and Harbor Island at the mouth was drift-floated on two occasions. Two small surface drogues were placed in the river near the outfall. Stream quality was generally poor, and was associated mainly with RWTP. At 4:1 and 4.4:1, the stream-to-effluent dilution ratios were far below the 20:1 recommended minimum. Violations of state standards for temperature and dissolved oxygen were observed. EPA red book criteria for total residual chlorine and ammonia (un-ionized) were exceeded, while nitrite-nitrogen reached borderline levels. The ability of the Green-Duwamish River to assimilate wastewaters discharged by RWTP appears to be exceeded at the current rate of discharge. Problems associated with the plant will increase as the plant approaches the 144 MGD ultimate site capacity. (Garrison-Omniplan)
W82-01063

THE IMPACT OF EFFLUENT FROM THE RENTON WASTEWATER TREATMENT PLANT ON THE DISSOLVED OXYGEN REGIMEN OF THE LOWER GREEN/DUWAMISH RIVER,
Washington State Dept. of Ecology, Olympia.
W. E. Yake.
In: The Impact of Renton Wastewater Treatment Plant on Water Quality of the Lower Green/ Duwamish River, Document DOE 81-2. January 1981. Part II. 19 p. 8 Fig, 3 Tab, 12 Ref. Append.

Descriptors: *Wastewater treatment, *Dissolved oxygen, *Model studies, *Streeter-Phelps equation, Wastewater management, Wastewater disposal, Waste discharge, *Wastewater pollution, Sludge, Inorganic compounds, Nitrification, On-site data collections, *Seattle, Washington.

The Renton Wastewater Treatment Plant (RWTP) was completed in 1965 by the Municipality of Metropolitan Seattle (METRO) to improve water quality in Lake Washington and nearby areas. The Department of Ecology has become increasingly concerned about the possible impacts of the discharge on stream quality, especially since past investigators have concentrated on the lower waterway and zone of salt water intrusion rather than the fresh waters above. The RWTP is an activated sludge plant with an average daily dry weather flow of about 36 MGD. The flow from noon to 2 a.m. is about 50 percent greater than the average. A plant for upgrading the plant is being negotiated by METRO, DOE and EPA, and more data are needed. This report gives a detailed modeling analysis of the dissolved oxygen regime below the RWTP outfall. The model used a modification of the Steeter-Phelps equation which accounts for longitudinal dispersion. Rate constants and other variables were determined from data collected during two 24-hour drift surveys conducted in 1979. Dissolved oxygen concentrations below the plant discharge were depressed 2 to 3 mg/1. Based on model results and interpretation of survey data, nitrification of effluent ammonia was found to be responsible for about 95 percent of the observed dissolved oxygen depression. During the study there was no evidence of in-plant nitrification; all inorganic nitrogen was discharged to the Green/ Duwamish system as ammonia. Model extrapolation to 1985 suggests further substantial degradation of the lower Green/Duwamish River as plant flow increased and instream dilution ratios decrease. (Garrison-Omniplan)
W82-01064

WATER QUALITY CONDITIONS IN THE BELLINGHAM BAY AREA 1979-1980,
Washington State Dept. of Ecology, Olympia.
For primary bibliographic entry see Field 5B.
W82-01068

TREATABILITY MANUAL; VOLUME I. TREATABILITY DATA.
Environmental Protection Agency, Washington, DC. Office of Research and Development.
Available from Supt. of Documents, GPO, Washington, DC 20402 in paper copy; available from National Technical Information Service, Springfield, VA 22161 as PB80-223050, Price code: A01 in microfiche only. Report EPA-600/8-80-042a, July 1980. 1089 p, 109 Fig, 642 Tab, 51 Ref.

Descriptors: *Industrial wastewater, *Wastewater treatment, *Water pollution control, Pollutants, Effluents, Physical properties, Adsorption, Biodegradation, Toxicity, Hazardous materials, Metals, Ethers, Phthalates, Phenols, Hydrocarbons, Halogenated hydrocarbons, Pesticides.

This volume supplies treatability data on specific industrial wastewater pollutants, with physical data on the pollutants, their occurrence patterns, and methods of treatment and/or removal. Pollutants are grouped according to the following chemical categories: metals and inorganics, ethers, phthalates, nitrogen compounds, phenols, aromatics, polynuclear aromatic hydrocarbons, polychlorinated biphenyls and related compounds, halogenated hydrocarbons, pesticides, oxygenated compounds, and miscellaneous. Each pollutant is described as a pure species, with appropriate physical data, its concentrations in the wastewater streams in which it is detected, and its treatability/removability by standard treatment processes. Carbon absorption and biodegradability data are presented for organic compounds, and precipitation/coagulation properties are given for metals. The pollutants considered are the 129 toxic pollutants and 74 additional pollutants deemed a hazard to the aqueous environment. (Brambley-SRC)
W82-01073

TREATABILITY MANUAL; VOLUME II. INDUSTRIAL DESCRIPTIONS.
Environmental Protection Agency, Washington, DC. Office of Research and Development.
Available from Supt. of Documents, GPO, Washington, DC 20402, in paper copy; available from National Technical Information Service, Springfield, VA 22161, as PB80-223068, Price code: A01 in microfiche only. Report EPA-600/8-80-042b, July, 1980. 986 p, 29 Fig, 685 Tab, 65 Ref.

Descriptors: *Industrial wastewater, *Wastewater treatment, Industrial plants, Effluents, Water pollution control, *Waste characteristics, Wastewater facilities, Pollutants, Toxicity.

This volume characterizes the wastewater discharged by 22 industrial categories on a facility basis, prior to and after treatment. The pollution control methods used with the treated final effluent pollutant concentrations are also provided. Each industrial category is defined according to the Standard Industrial Classification Codes, and are divided into subcategories if the data are available. The total number of facilities in each category discharging an aqueous effluent to a receiving stream or a publicly owned treatment works is given in an industrial summary table. Wastewater characteristics are provided for each category or subcategory, and for separate processes when the data are available. The specific plant descriptions generally include a treatment system description, plant production, and wastewater flow. Removability of the 129 toxic pollutants, conventional pollutants, and others achievable by currently used treatment systems is presented, with information on treatment methods and removal efficiencies. (Brambley-SRC)
W82-01074

TREATABILITY MANUAL; VOLUME III. TECHNOLOGIES FOR CONTROL/REMOVAL OF POLLUTANTS.
Environmental Protection Agency, Washington, DC. Office of Research and Development.
Available from Supt. of Documents, GPO, Washington, DC 20402, in paper copy; available from National Technical Information Service, Springfield, VA 22161 as PB80-223076, Price code: A01 in microfiche only. Report EPA-600/8-80-042C, July, 1980. 736 p, 73 Fig, 496 Tab, 70 Ref.

Descriptors: *Industrial wastewater, *Wastewater treatment, *Water pollution control, *Effluents, *Sludge disposal, Toxicity, Hazardous materials, Pollution load, Industrial plants, Primary wastewater treatment, Secondary wastewater treatment, Tertiary wastewater treatment.

This volume presents performance data and related technical information for 56 unit operations used in industrial water pollution control. The operations include 24 sludge treatment and disposal technologies, 4 wastewater conditioning technologies, and 28 generic wastewater treatment technologies classified as primary, secondary or tertiary treatment based on the types of pollutants they are designed to remove. Emphasis is placed on the 28 water treatment technologies, with concentration and removal efficiency data given for conventional pollutants, the 129 toxic pollutants, hazardous substances, and other nonconventional pollutants of concern in specific industrial wastewaters. The treatment processes are described in general terms to provide an overview, but published information on influent and effluent pollutant concentrations, removal efficiencies, point source category, scale of treatment operation, location in overall treatment system, and design and operating parameters are given. Statistical summary tables for each primary, secondary, and tertiary wastewater treatment technology incorporate all effluent concentration and removal efficiency data contained in the plant-specific data base for that technology. (Brambley-SRC)
W82-01075

TREATABILITY MANUAL; VOLUME IV. COST ESTIMATING.
Environmental Protection Agency, Washington, DC. Office of Research and Development.
Available from Supt. of Documents, GPO, Washington, DC 20402, in paper copy; available from National Technical Information Service, Springfield, VA 22161 as PB80-223084, Price codes: A01 in microfiche only. Report EPA-600/8-80-042d, July, 1980. 402 p, 244 Fig, 166 Tab, 121 Ref.

Descriptors: *Industrial wastewater, *Wastewater treatment, *Costs, Capital costs, Operating costs, Water conditioning, Sludge disposal, Primary wastewater treatment, Secondary wastewater treatment, Tertiary wastewater treatment.

This volume presents total capital investment and annual operating cost curves for 78 industrial wastewater treatment technologies. The technologies are categorized into six groups: wastewater conditioning; primary wastewater treatment; secondary wastewater treatment; tertiary wastewater treatment; sludge treatment; and disposal. The cost curves generally show costs in millions of dollars versus flowrate, and all costs have been indexed to September 1979. The estimates are valid only for comparison purposes, as they are generalized rather than site-specific and do not include land costs. The total capital investment is estimated to be 3.6 times the purchased equipment and installation cost, while the operating cost is the sum of labor, materials, chemicals, power and fuel costs and the indirect costs of overhead, taxes and insur-

ances, administrative expenses, depreciation, and interest. (Brambley-SRC)
W82-01076

TREATABILITY MANUAL; VOLUME V. SUMMARY.
Environmental Protection Agency, Washington, DC. Office of Research and Development.
Available from Supt. of Documents, GPO, Washington, DC 20402, in paper copy; available from National Technical Information Service, Springfield, VA 22161 as PB80-223092, Price code: A01 in microfiche only. Report EPA-600/8-80-042e, July, 1980. 177 p, 1 Fig, 10 Tab, 203 Ref, 4 Append.

Descriptors: *Industrial wastewater, *Wastewater treatment, *Water pollution control, *Effluents, Toxicity, Pollution load, Indicators, Primary wastewater treatment, Secondary wastewater treatment, Tertiary wastewater treatment.

This final volume on industrial wastewater treatment technologies includes summaries of the previous volumes and outlines their potential utility to National Pollutant Discharge Elimination System permit writers. Combinations of industrial processes and control technologies for which quantitative effluent data are available are listed. The median observed effluent concentrations for primary, secondary, and tertiary control technologies for conventional, toxic, and other pollutants and the median removal efficiencies for each technology are also given. A summary table presents the highest observed removal efficiency and the lowest observed effluent concentration for various pollutants as a function of the technology used to conrol the discharge. The EPA has recently allowed the use of indicator pollutants to control toxic pollutants and hazardous substances, where, by controlling a specified pollutant, other similar pollutants are assumed to be controlled. (Brambley-SRC)
W82-01077

5E. Ultimate Disposal Of Wastes

BETTER DEWATERING IMPROVES SLUDGE RECYCLING AND GIVES SIGNIFICANT ENERGY SAVINGS,
Racine Wastewater Utility, WI.
T. J. Bunker.
Water/Engineering and Management, Vol 128, No 6, p 40-42, June, 1981. 2 Fig.

Descriptors: *Sludge drying, *Wastewater treatment, Water treatment facilities, Sludge, Sludge thickening, Dewatering, Recycling, Sludge disposal.

Belt presses were chosen to replace the vacuum filters previously used to reduce the amount of recycled solids being fed to the head of the wastewater treatment plant in Racine, Wisconsin. There were several reasons for this choice. First, the presses had the ability to remove more solids during the dewatering process. Second, their power requirements were substantially lower. The new units also produced a drier sludge cake, with a solids concentration averaging 25%, compared to 15% for the vacuum filters. As a result of drier cakes, sludge handling costs were cut. Installation speed was also a consideration because of the recycling problem. Conditioned sludge is gently fed into a 7 foot gravity drainage section of the belt. Baffling devices disperse the sludge over the belt and form additional channels in the material for removal of ponded water. This free water is removed by gravity through openings in the polyester belt. Next the sludge is gently dropped to the lower of two pressure belts and becomes sandwiched between these belts to form a moving and adjustable wedge. Increasing pressure is applied by the belts as they pass through rollers of decreasing diameters, gradually forcing water from the moving wedge. The dewatered sludge is discharged on to a conveyor for transfer to a holding area where it is loaded on to a truck for ultimate disposal. (Baker-FRC)
W82-00526

EFFECT OF LEACHATE FLOW RATE ON METAL MIGRATION THROUGH SOIL,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
B. A. Alesii, W. H. Fuller, and M. V. Boyle.
Journal of Environmental Quality, Vol 9, No 1, p 119-126, January-March, 1980. 8 Fig, 8 Tab, 28 Ref.

Descriptors: *Leachates, *Flow rates, *Metals, *Migration, Leaching, *Trace elements, Aluminum, Iron, Chromium, Beryllium, Solid wastes, Water pollution sources.

The influence of flux or flow rate of municipal solid waste leachate on the attenuation of selected trace elements was evaluated in some representative United States soils. Natural municipal solid waste leachates enriched with Be, Cd, Cr, Fe, Ni, and Zn were used in soil columns under anaerobic saturated conditions. Flow rates of leachate were regulated to deliver precise fluxes ranging from 1 to 15 ml/hr. Each hour, effluent was collected and analyzed for the metal ions studied. Generally, the slower the rate of flow of the solid-waste leachate, the greater the attenuation of metal ions. The attenuation of Al, Be, Cr(VI), and Fe(II) was significantly influenced by flux. The absolute amount retained by the soil was influenced to the greatest extent by the concentration of the metal in the leachate. Flow rate of leachates from solid waste disposal sites can be controlled by controlling flux. Renovating the soil, lining the excavation, and compacting the waste to known densities are possible control techniques. (Small-FRC)
W82-00565

THE TOXIC WASTE DUMP PROBLEM AND A SUGGESTED INSURANCE PROGRAM,
State Univ. of New York Coll. at Fredonia. Dept. of Economics.
A. Fisher.
Boston College Environmental Affairs Law Review, Vol 8, No 3, p 421-461, 1980. 138 Ref.

Descriptors: *Hazardous materials, *Waste dumps, *Insurance, Toxins, Legal aspects, Safety, Landfills, *Waste disposal, Economic aspects, Environmental effects.

A National Hazardous Waste Insurance Program is discussed, and existing and pending legislation related to toxic waste disposal is reviewed. Available knowledge about the number and location of toxic waste sites and estimates of cleanup costs is presented. The environmental policy suggested here is similar in rationale and structure to the National Flood Insurance Program. It would give potential victims the opportunity to protect themselves from hazardous waste damages through the purchase of federally subsidized insurance. This could reduce disaster relief payments and promote development planning focused on reducing the chance of toxic waste damage. New York's Love Canal, Kentucky's Valley of the Drums, and North Carolina's 210 miles of PCB-contaminated highways are examples of hazardous waste disasters. The shortcomings of dump and landfill disposal of chemical wastes are highlighted by the Love Canal episode. (Small-FRC)
W82-00591

BENTONITE LINERS FOR POWER PLANT LAGOONS,
West Virginia Univ., Morgantown.
F. J. Calzonetti.
Power Engineering, Vol 84, No 3, p 61-62, March, 1980. 1 Fig, 2 Tab.

Descriptors: *Lagoons, *Bentonite, Linings, Wastewater lagoons, *Powerplants, *Waste disposal.

Waste disposal facilities to handle power plant wastes must be designed and sited so that ground and surface water resources are not contaminated. The Resource Conservation and Recovery Act of 1976 (RCRA) designates wastes as either hazardous or solid, and defines treatments accordingly. The use of natural clays as inexpensive and effective liners to control the seepage of leachates from energy facility waste ponds and lagoons is permissible. Alternatives such as synthetic membranes are commonly used, but do not appear as effective as natural clays. One particular clay, bentonite, has been the subject of much attention due to its swelling properties and ability to increase soil impermeability. Bentonite is a variety of montmorillonite clay, which was formed from volcanic ash and occurs in commercial quantities in Wyoming, Montana and South Dakota. The clay has exchangeable sodium ions and when wetted swells 15 to 20 times in volume. It is currently used across the nation for lagoon lining purposes. Untreated bentonite sells for $50 to $60 a ton plus trransportation charges. The soil texture of the site and the transport costs incurred in shipping bentonite from Wyoming to the energy facility are prime determinants of the cost of using bentonite filters. (Baker-FRC)
W82-00617

TRACE ELEMENT ACCUMULATION, MOVEMENT, AND DISTRIBUTION IN THE SOIL PROFILE FROM MASSIVE APPLICATIONS OF SEWAGE SLUDGE,
California Univ., Berkeley. Dept. of Soils and Plant Nutrition.
D. E. Williams, J. Vlamis, A. H. Pukite, and J. E. Corey.
Soil Science, Vol 129, No 2, p 119-132, February, 1980. 7 Fig, 5 Tab, 73 Ref.

Descriptors: *Trace elements, *Land disposal, *Sludge disposal, Accumulation, Barley, Heavy metals, Cadmium, Zinc, Lead, Copper, Soils, *Path of pollutants.

Sewage sludge was applied three times annually to soil on which barley was grown. One sludge was a wet cake type with a considerable amount of heavy metals, while the second air-dried sludge was primarily domestic in origin. Application rates varied from 0 to 225 metric tons/ha/yr, and the sludges were mixed into the surface 20 cm of soil. In general, sludge application was found to increase the amounts of HNO3-extractable heavy metals. DTPA extracts indicated that Cd, Zn, Pb, and Cu were highly available; Mn, Co, and Ni were moderately to slightly available; and Fe and Cr were relatively unavailable. When sludge high in metals was added, increased metal content and metal movement were limited to a depth of 30 cm, which was 10 cm below the area of sludge incorporation. The wet sludge cake resulted in increased acidity of the soil, but metal availability was not increased by this acidity. (Small-FRC)
W82-00640

EFFECT OF IRRIGATING LOAMY SAND SOIL BY LIQUID SEWAGE SLUDGE ON ITS CONTENT OF SOME MICRONUTRIENTS,
Ain Shams Univ., Cairo (Egypt). Dept. of Soils.
F. M. Abdou, and M. El-Nennah.
Plant and Soil, Vol 56, No 1, p 53-57, 1980. 2 Tab, 12 Ref.

Descriptors: *Wastewater irrigation, Wastewater farming, *Metals, Liquid sludge, Organic matter, Zinc, Iron, Manganese, Nutrients, Land disposal.

The effect of irrigating loamy sand soil of the El-Gabal El-Asfar area near Cairo with liquid sewage sludge was investigated for some micronutrients in these soils. Levels of Zn, Fe, and Mn were determined in soils thus irrigated for 2, 25, 35, and 45 years. Sewage sludge irrigation increased both the CEC (cation exchange capacity) and organic matter content of the tested soils. There was a marked increase in the easily soluble forms of Zn, Fe, and Mn. Thus, the sludge could be used as a plant nutrient source or as a soil improver. However, the increase of these metals in soil may decrease the activity of some soil enzymes and disturb the N-mineralization. Agricultural areas irrigated with sludge must be monitored for increased levels of Pb, Cd, and Hg, even though there have been no symptoms of toxicity observed on plants growing at the current disposal site. (Small-FRC)
W82-00661

PERSISTENCE AND DISTRIBUTION OF ERYSIPELOTHRIX RHUSIOPATHIAE AND BACTERIAL INDICATOR ORGANISMS ON LAND USED FOR DISPOSAL OF PIGGERY EFFLUENT,
Victoria Dept. of Agriculture (Australia). Attwood Veterinary Research Lab.
For primary bibliographic entry see Field 5B.
W82-00686

DAIRY LIQUID WASTE DISTRIBUTION IN AN OVERLAND FLOW VEGETATIVE-SOIL FILTER SYSTEM,
Southern Illinois Univ. at Carbondale. Dept. of Agricultural Industries.
For primary bibliographic entry see Field 5D.
W82-00897

POTENTIAL FOR LAND DISPOSAL OF TWO NONBIODEGRADABLE WASTES,
Delaware Univ., Newark. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5D.
W82-00939

EXTRACTING HEAVY METALS AND TOXIC ORGANICS FROM SLUDGE,
For primary bibliographic entry see Field 5D.
W82-00947

COMPOSTING IS WORKING IN CAMDEN,
Camden County Municipal Utilities Authority, NJ.
J. D. Ochs.
Water/Enineering and Management, Vol REF, No HB, p R138-140, 1981.

Descriptors: *Composting, Pilot plants, *Sludge disposal, Land application, Camden, *New Jersey, Sludge, Bulking sludge, Cost analysis.

A pilot plant was constructed in Camden County, New Jersey, to study whether composting is a good solution for Camden's sludge disposal problem. Early in the planning stage of the composting operation, the basic objective of the program had to be defined. The process was designed to make a product for multiple uses. These uses are enhanced if the plant nutrient/soil structure properties are maximized, and attempts have been made toward that end in this particular program. The compost facility can handle 26 dry tons per day, or 104 wet tons of 25% solids, operating on a two ton shift, five days per week schedule. Raw primary sludge is accumulated in a day holding tank. Moyno sludge pumps feed the 5% solids sludge to two of three Carter belt-filter presses. The third press is for standby use. The dewatered sludge is discharged to a conveyor which transports it over an automatic scale. The scale signals an automatic woodchip feeding system to regulate the ratio of bulking material added to the sludge. The composting process involves laying down a pile of woodchip/sludge mixture onto perforated iron pipes that have been covered with a layer of new woodchips about 1.5 to 2 ft deep and about 7 ft wide. Each pile is aerated for a minimum of 21 days. One of the primary cost factors in the process is the purchase of woodchips. One of the principal users of the compost to date has been a large commercial greenhouse operation. (Baker-FRC)
W82-00948

EVALUATION OF WINTER APPLICATION OF LIQUID SLUDGE TO FARMLAND,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
For primary bibliographic entry see Field 5B.
W82-00952

TRENCHING OF DIGESTED SLUDGE,
Science and Education Administration, Beltsville, MD.
L. J. Sikora, N. H. Frankos, C. M. Murray, and J. M. Walker.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE2, p 351-361, April, 1980. 5 Tab, 18 Ref.

Descriptors: *Sludge disposal, *Trenches, Ditches, Nitrogen, Sludge digestion, Sludge cake, Sludge, Wastewater, *Leaching, Chlorides, Salts, Metals, Chemical analysis.

In trenching digested sludge, a sludge filter cake of about 20% solids is placed in trenches about 2 feet wide by 2.5 feet deep and 2 feet apart. Trenches are filled to about 80% of capacity with sludge and covered with soil from adjacent, recently dug trenches. The environmental effects of trenching were studied using varying size trenches, types of sludge and soil types. The plots containing the digested sludge trenches were located in a loamy sand of the Galestown-Evesboro series. One tillage practice studied involved leaving mounds over the trenches intact. A second treatment involved leveling and disking the area. A third treatment involved leveling and cross ripping perpendicular to the trenches with ripper shanks. Much of the chloride initially present in the sludge was leached into the profile during the first year. After 4 years nearly all the chloride was leached. More nitrogen was leached during the first two years than during the next two, with the predominant nitrogen form found in the soil being ammonia-nitrogen. After four years the sludge in the trench was near or at stabilization. The amount of mineralizable nitrogen in the sludge was low, with soil profiles having low levels of inorganic nitrogen and chloride. Zinc was the only metal found in detectable levels in the soil beneath the trenches. The amount of zinc leached was minor compared with the total zinc concentration in the entrenched sludge. Environmental effects would be primarily felt on the groundwater. The severity of the effect would be site specific, depending on soil type, depth of ground water, infiltration rate, and sludge type. (Baker-FRC)
W82-00974

A SIMULATION MODEL FOR SLUDGE DECOMPOSITION IN SOIL,
Arkansas Univ., Fayetteville. Dept. of Agronomy.
J. T. Gilmour, and C. M. Gilmour.
Journal of Environmental Quality, Vol 9, No 2, p 194-199, April/June, 1980. 5 Fig, 3 Tab, 14 Ref.

Descriptors: *Model studies, *Sludge disposal, *Decomposition, Mathematical studies, Waste disposal, Simulation analysis, Soil amendments, Sludge, Soil water, Soil temperature, Sludge digestion, *Carbon, Carbon dioxide.

A computer model called SLUDGE was designed to calculate the amount of sludge carbon compounds converted to C02-C as a function of time for a single sludge addition incorporated into a medium-textured soil. As the type of C source undergoing decomposition varied and the temperature and water content changed, the rate constant of the expression was modified. During the rapid decomposition phase, the paradigm computes decomposition on a daily basis, and during the slow phase, on a monthly basis. The model was tested using synthetic sludge decomposition data and decomposition data for municipal sludge. Fifty percent of the municipal sludge was decomposed over a 32- to 57-month period. Yearly soil temperature and water content averages gave less accurate predictions than monthly data when used in the model. Laboratory optimum conditions ggave shorter sludge half-life times than did field conditions. When the model was modified to include annual June additions of sludge, the ratio of accumulated sludge to an annual addition was from 4.3 to 7.9 after 50 yr. These ratios were greater than those computed by equations designed to calculate such ratios under constant soil conditions. (Geiger-FRC)
W82-01001

CHEMICALS DISINFECT SLUDGE,
Universidad Autonoma de Nuevo Leon, Monterrey (Mexico).
For primary bibliographic entry see Field 5D.
W82-01003

DISSOLUTION OF SALT DEPOSITS BY BRINE DENSITY FLOW,
New Mexico Univ., Albuquerque. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W82-01016

DREDGING AND DISPOSAL OF TOXIC MATERIAL USING JAPANESE TECHNOLOGY SUGGESTED FOR UNITED STATES,
F. T. Wooton.
World Dredging and Marine Construction, Vol 16, No 4, p 14-15, April, 1980.

Descriptors: *Dredging, *Hazardous materials, *Technology, Toxins, Japan, Spoil banks, Ocean dumping, Waste management.

The maintenance of navigation channels and harbors in Virginia is becoming extremely difficult due to the lack of dredging technology in the United States. Dredging activities will continue to be limited unless dredging and disposal methods which comply with existing environmental standards are developed. Currently, the extent and type of dredging which can be performed is determined by the pollutants in the rivers and harbors. Dredging and disposal methods used in Japan were investigated as part of an effort to develop alternative strategies for this project. The Japanese have made significant advances in the dredging field in order to eliminate severe pollution problems in their harbors. A dredge called the 'Oozer' has been developed which dredges about 80 percent solids and 20 percent water, compared to almost exactly opposite proportions dredged by a typical hydraulic dredge in the United States. In Japan, polluted dredged material is treated prior to disposal. A soil fixation process has also been developed which locks pollutants to the material being dredged and solidifies the dredged material in only a few days. This process, called the Takenaka Sludge Treatment, can be performed in a disposal area which can later be used for industrial development. The 'Oozer' appears to be capable of dredging most areas of the James River and its tributaries, as well as other areas polluted by toxic substances. (Carroll-FRC)
W82-01026

5F. Water Treatment and Quality Alteration

WHAT CAUSED THE BAD ODOR IN THE DRINKING WATER,
Williamsport Sanitary Authority, PA.
M. H. Gerardi, and M. B. Gerardi.
Water/Engineering and Management, Vol 128, No 6, p 63-65, June, 1981. 3 Tab.

Descriptors: *Drinking water, *Odors, Chemical analysis, Organic compounds, Water analysis, Bacteria, Temperature effects, Reservoirs, Potable water, Acidity, Heated water, *Odor removal, *Home water heaters, Williamsport, Pennsylvania.

Drinking water supplies for about 60,000 people in the Williamsport, PA area and several adjacent communities come from two 350 mg capacity reservoirs and a well field. During February of 1980 numerous complaints were made about a fishy or rancid odor present in the tap water supply. The odor was associated with the Hagerman Reservoir, was present only in hot water, was most objectionable in water drawn from hot water tanks which had a thermostat setting of at least 140 degrees F, and was most evident to consumers who drew from their hot water tanks in the morning and then not again until the evening, allowing the hot water in the tank to stand for 8-10 hr before use. Investigation indicated that a rancid odor was produced by Nocardia species of bacteria at pH 8.5 and 140 degrees F on Standard Methods Agar and Dextrose Tryptone Agar. Samples containing the rancid odor were analyzed. Organics identified included unsaturated and saturated aliphatic esters and ketone, amide, and carboxylic acid salts. To correct the problem customers were asked to reduce their thermostat settings to 120 degrees F. Within two days a reduction in odor was noted by

customers who complied with this request. To control Nocardia growth the pH of Hagerman Reservoir water was decreased by discontinuing the addition of soda ash. (Baker-FRC)
W82-00527

CHRYSOTILE ASBESTOS FIBER REMOVAL DURING POTABLE WATER TREATMENT. PILOT PLANT STUDIES,
Ontario Ministry of the Environment, Toronto.
R. B. Hunsinger, K. J. Roberts, and J. Lawrence.
Environmental Science and Technology, Vol 14, No 3, p 333-336, March, 1980. 2 Fig, 2 Tab, 10 Ref.

Descriptors: *Water treatment, *Asbestos, Turbidity, Filtration, Coagulation, Sedimentation, *Drinking water, Water analysis, Potable water.

Various pretreatment and filtration processes for chrysotile asbestos fiber removal from surface water were evaluated at a pilot scale treatment facility equipped with full process control. In the majority of cases filtration significantly reduced the amount of asbestos in the water from that which was encountered in the postsedimentation samples. Fiber concentrations in the finished waters were below 1,000,000 fibers/liter in all but two of the cases and below 500,000 fibers/liter in 76% of the cases. The dual media filters produced an effluent that was superior to the sand filter effluent in terms of turbidity. The actual asbestos fiber counts also reflected the superiority of the dual media filters. There does not appear to be any direct relationship between the initial and final asbestos fiber concentrations across the process. However, from a general examination of the data it is apparent that the asbestos concentrations in the filter effluents are lower than those in the raw or postsedimentation water, indicating that conventional treatment processes are effective in reducing chrysotile concentrations. The lack of a specific relation between initial and final concentrations could be due to either inconsistencies in the unit processes or inherent inaccuracies in the analytical methodology. It was concluded that objective predictions and/or decisions regarding treatment efficiency are presently impossible given the current state-of-the-art in counting technology. Consistent quantitative analysis of chrysotile asbestos fibers in river water following fortification with a concentrated chrysotile asbestos suspension could not be obtained. (Baker-FRC)
W82-00613

COAL TAR COATINGS OF STORAGE TANKS. A SOURCE OF CONTAMINATION OF THE POTABLE WATER SUPPLY,
New York State Dept. of Health, Albany. Div. of Lab. and Research.
For primary bibliographic entry see Field 5B.
W82-00616

WATER-TREATMENT CHEMICALS,
S. Miller.
Environmental Science and Technology, Vol 14, No 8, p 914-915, August, 1980.

Descriptors: *Water treatment, *Chemical treatment, Wastewater treatment, Chemical properties, Chemical reactions, Toxicity, Coagulation, Disinfection, Oxidation, Dispersants, Chemical coagulation, Catalysts, Water softening, *Water supply, Drinking water.

Nine experts from various areas of water supply, water treatment, toxicology, chemistry, engineering, analytical testing, and manufacturing procedures have been called upon by the National Academy of Sciences (NAS) to serve as a committee to examine the approximately 60 bulk chemicals used in the treatment of drinking water. The chemicals used in water treatment can be roughly divided into four major categories: coagulants and flocculants, disinfectants and oxidizers, precipitants and softeners, and miscellaneous reagents. The committee will attempt to establish guidelines for the use of these chemicals and to establish analytical tests for impurities in the bulk chemicals themselves. The ultimate product from this committee is envisioned to be a manual something like the Food Chemical Codex of 1974. Potential health problems are posed by the presence of chloroform in chlorine used for disinfection, presence of fluorides and arsenic in phosphates, heavy metal contamination, manganese and lead impurities in iron salts, and organic contaminants in polymeric coagulant aids. (Baker-FRC)
W82-00618

ADSORPTION ON CARBON: SOLVENT EFFECTS ON ADSORPTION,
S. Miller.
Environmental Science and Technology, Vol 14, No 9, p 1037-1040, 1042, 1045-1049, September, 1980. 8 Fig, 8 Tab.

Descriptors: *Solvents, *Adsorption, *Carbon, Solvophobic theory, *Water treatment, Wastewater treatment, Pollution control, Activated carbon, Adsorbents, Surface tension.

Attempts to include the solvent and its surface tension in equilibrium adsorption formalism are discussed. A semiempirical quasitheoretical approach based on partial solubility parameters called the net adsorption energy approach is presented. A general comprehensive solution interaction approach recently adapted to the adsorption of organic homologues from dilute aqueous solutions is presented. The ability to predict the effects of even simple structural modifications on the adsorption of organic molecules from dilute aqueous solutions onto activated carbon or other adsorbents could be of great value in the design and operation of large-scale commercial water or waste water treatment plants. At present attempts are being made to apply the solvophobic theory for correlating the removal of homologous organic compounds by widely different unit processes such as adsorption, hyperfiltration, and biological metabolism. Solvent interactions are significant in these as well as many other processes. (Baker-FRC)
W82-00619

MANAGEMENT TRAINING IS THE KEY TO GOOD OPERATOR PERFORMANCE,
For primary bibliographic entry see Field 5D.
W82-00623

ENVIRONMENTAL HEALTH HAZARDS,
S. Miller.
Environmental Science and Technology, Vol 14, No 6, p 648-651, June, 1980. 1 Fig.

Descriptors: *Drinking water, *Public health, Organic compounds, Disinfection, Chlorine, Activated carbon, Toxicity, Epidemiology, Human diseases, Cancer, Regulations, *Hazardous materials.

The National Academy of Sciences (NAS) has organized a Board on Toxicology and Environmental Health Hazards. This board serves the federal government, particularly regulatory agencies, by providing comprehensive documents on pollutants and risk assessments of hazardous agents and studies of scientific concepts underlying interpretation of toxicologic and epidemiologic data. The Safe Drinking Water Committee started its review of adverse health effects attributable to contaminants in drinking water in the fall of 1975. In late 1977 the first NAS report, 'Drinking Water and Health,' a 939 page document, was published. Volumes II and III have since appeared. Volume II deals with disinfection of drinking water, chemistry of disinfectants in water, and an evaluation of granular activated carbon for drinking water treatment. Volume III considers epidemiological studies of cancer frequency and certain organic constituents of drinking water, problems of risk assessment, toxicity of selected drinking water contaminants, and contributions of drinking water to mineral nutrition of humans. (Baker-FRC)
W82-00625

ANTIBIOTIC-RESISTANT BACTERIA IN DRINKING WATER,
Oregon State Univ., Corvallis. Dept. of Microbiology.
J. L. Armstrong, D. S. Shigeno, J. J. Calomiris, and R. J. Seidler.
Applied and Environmental Microbiology, Vol 42, No 2, p 277-283, August, 1981. 4 Fig, 1 Tab, 35 Ref.

Descriptors: *Drinking water, *Bacteria, *Drugs, Water quality, Public health, Pathogenic bacteria, Raw water, Water distribution.

The prevalence of drug-resistant bacteria in treated drinking waters and their relationships to multiple antibiotic resistant (MAR) bacteria in the raw source water were investigated. Drinking water from seven communities was sampled and analyzed for MAR bacteria. The MAR bacteria isolates obtained were screened against five antibiotics by replica plating. MAR bacteria made up 33.9% of 2653 standard plate count bacteria from the treated water. In two of the raw water supplies, MAR standard plate count bacteria were carried at frequencies of 20.4 and 18.6%, while levels in the respective treated waters were 36.7 and 67.8%. The following were more common in treated than untreated waters: gram-positive cocci and gram-negative, nonfermentive rods. Site-to-site variations indicated that the shedding of MAR bacteria living in pipelines may influence the populations found in tap water. The treatment of raw water and its subsequent distribution select for standard plate count bacteria exhibiting the MAR phenotype. (Small-FRC)
W82-00645

EFFECT OF OZONATION AND CHLORINATION ON THE MUTAGENIC POTENTIAL OF DRINKING WATER,
Florence Univ. (Italy). Inst. of Pharmacology.
For primary bibliographic entry see Field 5A.
W82-00649

ACUTE AND CHRONIC EFFECTS OF ALUM TO MIDGE LARVA (DIPTERA: CHIRONOMIDAE),
Kennedy (Michael), Spokane, WA.
D. S. Lamb, and G. C. Bailey.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 1, p 59-67, 1981. 1 Fig, 18 Ref.

Descriptors: *Alum, *Aquatic insects, *Toxicity, *Water treatment, Mortality, Fish food, Lakes, Assay, *Eutrophic lakes.

In view of the increasing use of alum to precipitate phosphorus in highly eutrophic lakes, the acute and chronic effects of alum to Tanytarsus dissimilis, important fish food organisms, were determined. Acute tests used alum concentrations of 80, 160, 240, 320, 400, 480, 560, 720, and 960 mg/liter. Chronic test solutions contained 10, 80, 240, 480, and 960 mg/liter of alum. In acute tests there was no apparent effect of alum on either second or third instar T. dissimilis at does between 80 and 960. Mortalities in the chronic assay were found at all alum doses. Fifty percent mortality was reached with 480 mg/liter at four days. The 50% mortality time for 80 and 240 mg/liter was between 8 and 10.5 days. At 960 mg/liter, 50% of the larvae were dead after 23 days. Heavy alum floc at 960 mg/liter appeared to cause a stress by impeding movements and feedings. Possible chemical and physical toxicity of alum must be considered when planning lake treatments. A well planned alum treatment will avoid adverse effects on the benthic insect population. (Small-FRC)
W82-00650

FLOCCULATION OF CLAY PARTICLES WITH A SYNTHETIC ANIONIC POLYMER,
Amsterdam Public Works (Netherlands).
R. R. Kruize.
Effluent and Water Treatment Journal, Vol 21, No 5, p 205-209, May 1981. 5 Fig, 9 Ref.

Descriptors: *Flocculation, *Polymers, *Clays, Turbidity, *Water treatment, Salts, Coagulation, Superfloc A-100, Adsorption, Particulate matter.

A synthetic anionic polymer, Superfloc A-100, was tested in the coagulation step of drinking water treatment using a model suspension of Winsumclay

in jar tests. Maximum flocculation (78%) occurred at 0.2-0.3 mg polymer per liter. Salt is necessary for the flocculation process. Speed of stirring higher than G = 60 per sec destroys already-formed flocs. At higher concentrations of clay, less polymer is needed to achieve the same results. At low clay concentrations sludge recirculation can improve flocculation. Higher cation valency (NaCl, CaCl2, and La (N03)3) decreases the amount of salt necessary and increases maximum coagulation. Decreasing pH improves flocculation and adsorption. (Cassar-FRC)
W82-00773

REMOVAL OF NITRATE FROM PUBLIC WATER SUPPLY ABSTRACTIONS,
Anglian Water Authority (England).
L. A. Greene.
Effluent and Water Treatment Journal, Vol 21, No 4, p 161-165, April, 1981. 10 Ref.

Descriptors: *Nitrates, *Ion exchange, *Denitrification, Reverse osmosis, *Water treatment, Rivers, Sludge disposal, Pretreatment, Anglia, *Great Britain.

A review is presented on research being carried out in Anglia on treatment methods for the control of nitrate levels in public water supplies. Continuous ion exchange plants operating under optimal conditions can effectively reduce nitrates, but skilled maintenance is required in these plants. Fixed-bed nitrate removal plants operating under counter flow regeneration conditions can produce water with acceptable nitrate levels. If the shells are regenerated before nitrate breakthrough, sulfate, bicarbonate, and chloride can be removed sufficiently. Effluent disposal has been a problem; reverse osmosis can be employed to reduce the volume of effluent by 35-40%. Spiral wound reverse osmosis can concentrate effluent by 85%. Application of biological denitrification to full-scale river abstraction is being studied. Denitrification can be monitored by an automated monitor system preceded by a continuous sample system. The pretreatment plant can use methanol as the carbon source or ion exchange pilot columns. These techniques can also be applied to pumped storage impoundments. (Small-FRC)
W82-00774

MANGANESE DIOXIDE AS AN ADSORBANT FOR HEAVY METALS,
West Kent Water Co. (England).
M. J. Gray.
Effluent and Water Treatment Journal, Vol 21, No 5, p 201-203, May, 1981. 1 Tab, 32 Ref.

Descriptors: *Manganese dioxide, *Adsorption, *Heavy metals, Metals, Zinc, Cadmium, Cobalt, Nickel, Cations, Radioactive wastes, *Wastewater treatment, Water treatment, Monitoring, Chemical properties.

The surface properties, adsorption of cations, and possible uses of manganese dioxide in water treatment are discussed in this review. In natural waters Mn02 has a strong negative charge, capable of adsorbing cations, and a large surface area, up to 800 sq meters per g. Heavy metal ions are adsorbed in decreasing order: Mn(2+)>Zn(2+)>Cd(2+)>Co(2+)>Ni(2+). Adsorption is greater and less reversible for heavy metals than for alkaline earth metals. Adsorption of cations increases with increasing pH and increasing temperature. Possible applications of the properties are: monitoring trace elements in water distribution systems through nodule and deposit formation; removal of Cs137, Ce131, Sr90, and Ra from aqueous solutions; co-precipitation with radioactive wastes to minimize leaching; and removal of Cd in water and wastewater treatment. (Cassar-FRC)
W82-00775

INTERACTION OF ORTHOPHOSPHATE WITH IRON (III) AND ALUMINUM HYDROXIDES,
Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 2H.
W82-00783

POINT-OF-USE WATER TREATMENT...AN ENLARGING REALITY,
For primary bibliographic entry see Field 10D.
W82-00784

ASSESSMENT OF SOME AQUEOUS RESIDUAL CHLORINE MEASUREMENTS,
Environmental Health Directorate, Ottawa (Ontario).
R. Otson, and D. T. Williams.
Bulletin of Environmental Contamination and Toxicology, Vol. 24, No. 2, p 251-256, 1980. 1 Fig, 2 Tab, 6 Ref.

Descriptors: *Chlorine, *Water sampling, *Monitoring, *Water treatment, *Residual chlorine, *Potable water, Organic carbon, Carbon, Experimental design, Dringking water, Water purification, Sewage effluent, Residual chlorine, Storage.

Sodium hypochlorite solutions, filter, plant effluent, and tap water were analyzed by the amperometric titration, residual chlorine electrode, and ferrous titrimetric methods, and the results were compared for the range 0.2 to 2.0 ppm residual chlorine. Overall precision for measurements by all three methods and in three laboratories was within 20 percent. Amperometric titration is the preferred method because of precision of measurements, simplicity of operation, and capability for multiple determinations. (Titus-FRC)
W82-00867

THE REMOVAL OF ORGANIC MATTER FROM DEMINERALISED WATER,
Central Electricity Generating Board (England). Northwestern Region.
G. Knowles, and K. Tittle.
Effluent and Water Treatment Journal, Vol 20, No 7, p 317-319, 321-322, July, 1980. 4 Fig, 5 Tab.

Descriptors: *Ion exchange, *Organic matter, *Condensates, Water treatment, *Water purification, Anion exchange, *Powerplants, Activated carbon, Water quality, Fouling, Pretreatment of water.

Organic fouling of ion exchange resins caused serious reduction in efficiency in a powerplant condensate purification plant. The source of organic matter was makeup water with levels of 0.2-1.0 mg per kg total organic carbon. Organic removal was studied at 4 stages of purification--pretreatment, anion resin beds, scavenger beds at the water plant inlet, and polishing beds at the outlet. An attempt to pretreat the makeup water with sand filtration and alum achieved only a 14.3% removal and placed an extra burden on the anion exchange unit. In the anion beds organic matter was anion exchanged onto the resin and subsequently was displaced by stronger anions. Retained organic matter was on the order of 0.42-0.46 kg per cu Cm of resin, as expected. No real difference was seen in the performance of the presently used anion resin, FFIP, and the 2 possible alternatives, IRA 900 and IRA 458. Use of scavengers, IRA 904 (a strong base anion resin) followed by Zerolit 225 (a cation bed), prior to the anion exchange was disappointing because removal efficiency was 78-80% at the anion outlet compared with 88% when the scavenger was bypassed. Although activated carbon as a scavenger removed 95% of organic matter up to the passage of 1800 bed volumes, its efficiency deteriorated to 50% after 6000 bed volumes. Polishing beds of activated carbon produced 50% removal or less after about 3000-15,000 bed volumes. A Type 1 resin, OH(-) form IRA 938, removed 60-67% of organic matter with regeneration every 4000 bed volumes. The advantages, disadvantages, and cost estimates of the 3 most likely options (activated carbon at the treatment plant inlet, activated carbon at the mixed bed outlet, or IRA 938 at the mixed bed outlet) were evaluated. Tests are underway to determine if IRA 938 has an operating life of at least 1.5 years, the breakeven point. (Cassar-FRC)
W82-00888

DIRECT FILTRATION STUDIES AT TRAVERSE CITY WATER TREATMENT PLANT,
Water Treatment Plant, Traverse City, MI.
R. Bowen.
Water/Engineering and Management, Vol 128, No 7, p 30-33, July, 1981. 1 Fig, 2 Tab.

Descriptors: *Turbidity, *Filter media, *Direct filtration, Water treatment, Alum, Raw water, *Traverse City, Michigan, Lake Michigan, Coagulation, *Filtration, Water treatment facilities.

A detailed study at the Traverse City, Michigan, water treatment plant led to the conclusion that treating the stable, low turbidity (average 0.6 NTU) raw water by direct filtration was superior to conventional treatment. Filters in the plant were: two dual-media (coal and sand) and one mixed-media (coal, sand, and garnet). Without alum addition, the mixed-media filter was superior. As alum dosage neared the optimum, mixed-media filtration was only slightly better than that with the dual-media filter. It was difficult to determine the optimum alum dosage, and residual alum was a problem. Temperature was critical to the filter run length. Runs were shorter at 36-38 F than at higher temperatures. (Cassar-FRC)
W82-00945

LOW TURBIDITY WATER FROM FAST PROCESSES,
Burlington Water Dept., VT.
T. Atherton,, and J. Goss.
Water/Engineering and Management, Vol 128, No 7, p 40-43, July, 1981. 3 Fig, 4 Tab.

Descriptors: *Turbidity, *Filtration, *Clarification, *Water treatment, *Burlington, Vermont, Pilot plants, Sand, Filter media, Flocculation, Water quality, Super-Pulsator clarifier.

The water treatment plant for the City of Burlington, Vermont, used microstraining followed by low-head automatic backwash filtration to treat low turbidity (5-15 NTU) Lake Champlain water. The flocculation and sedimentation steps were not considered necessary to meet the drinking water standards of 5 NTU in force in 1959. When turbidity maximum standards were reduced to 1 NTU in 1977, the plant was unable to meet the requirements on some occasions. A search for process modifications eliminated in-line filtration, direct filtration, and a new plant in favor of the Super-Pulsator process, which combines flocculation and clarification. A sludge blanket is formed and raw water with added chemicals is gently pulsed upward through the blanket using a vacuum process. Flocculation occurs within the sludge blanket, part of which is skimmed off the top with each pulsing cycle. Eighteen pilot filter tests on 5 media (sand at different depths and particle sizes and sand-coal) gave information on effluent turbidity, terminal headloss, and run length. Run No. 12, using single sand media, 30 inches deep, effective size 0.65-0.75 mm, at a loading of 4.0 gpm per sq ft produced a 0.21 NTU effluent from a 0.51 NTU influent with terminal headloss of 51 inches and run length of 7.2 hours. Color and Na were unaffected, and Fe was reduced by 50%. The upgraded facilities, scheduled for start of construction in fall 1981, will process 9 mgd more than the current capacity of 10 mgd. (Cassar-FRC)
W82-00946

REMOVING TRIHALOMETHANES FROM DRINKING WATER,
Environmental Protection Agency, Cincinnati, OH.
J. M. Symons, A. A. Stevens, R. M. Clark, E. E. Geldreich, and O. T. Love, Jr.
Water/Engineering and Management, Vol 128, No 7, p 50, 52, 53, 56, 61-64, July, 1981. 1 Tab, 11 Ref.

Descriptors: *Trihalomethanes *Chlorination, *Disinfectants, Standards, Drinking water, *Water treatment, Chlorinated hydrocarbons, Organic compounds, Humic acids, Ozonation, Chlorine dioxide, Aeration, Activated carbon, Adsorption, Clarification, Filtration, Costs, Residual chlorine.

Eleven treatment techniques for controlling trihalomethanes in drinking water are summarized in tabular form, listing treatment name, degree of

precursor removal, degree of trihalomethanes removal, other byproducts formed, degree of disinfection, and cost estimates for 20, 50, and 80% removal. According to EPA regulations, trihalomethanes, primarily formed by chlorination of humic materials in raw water, must not exceed 0.10 mg per liter in drinking water. Of the three unit processes--oxidation, aeration, and adsorption--each has advantages and disadvantages. Granular activated carbon, when fresh, is most effective in removing precursors, but this excellent performance is not long-lasting. Clarification, source control, oxidation, adsorption, biological degradation, and pH lowering also significantly lower precursor concentrations. The advantages and disadvantages of alternative disinfectants are discussed. Ozonation is very effective but has no residual action within the distribution system. Chloramines are easy to use and produce residual disinfection but are suspected of being toxic. Chlorine dioxide is very desirable as a disinfectant, but residuals in drinking water may exceed the 0.5 mg per liter limit. Four examples of treatment systems using chlorine as a disinfectant are discussed in detail to illustrate the evaluation process. (Cassar-FRC)
W82-00953

FERRIC CHLORIDE TAKES OVER,
Snell Environmental Group, Inc., Lansing, MI.
K. J. Guter, J. L. Mills, and P. G. Eberz.
Water/Engineering and Management, Vol 128, No 7, p 34-39, July, 1981. 1 Fig, 2 Tab.

Descriptors: *Ferric chloride, *Turbidity, *Coagulation, *Water treatment, Sludge excess, Clarification, East Lansing, *Michigan, Water treatment facilities.

Sludge buildup and turbidity problems in the water produced at the East Lansing-Meridian Township (Michigan) Water Treatment Plant were solved by replacing the ineffective alum coagulation system with ferric chloride at a concentration of 1.2 mg per liter Fe plus sludge recirculation. The liquid alum storage and feed system required only minor changes to accommodate the charge in chemicals. Hydrants are used to monitor the effectiveness of the process changes by noting the time required for turbidity to clear after opening the test hydrant. (Cassar-FRC)
W82-00954

ECONOMIC ANALYSIS OF GRANULAR-BED FILTRATION,
Syracuse Univ., NY. Dept. of Civil Engineering.
R. D. Letterman.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE2, p 279-291, April, 1980. 5 Fig, 13 Ref.

Descriptors: *Filtration, *Economic justification, Economic aspects, Filters, Design criteria, *Water treatment, Cost analysis, Costs.

Factors and limitations that determine whether or not a particular alternative will be cost effective for granular-bed filtration are presented. Equations are reviewed which are used to illustrate the effect of filter design and operating variables on the total annual cost of filtration, which is taken to be the sum of the annualized capital cost of the filter and the annual cost of operation. In order to compare the economic benefits of various alternatives, such as dual- and mixed-media beds, the analysis must include the effect of each on capital and operating costs. Whether the effluent quality is acceptable in both cases is determined by both the absolute and the relative magnitudes of the filter run lengths. High rate filtration appears to be economically justifiable for all practical filtration rates when the filter loading is within conventional limits. When direct filtration is used and higher solids loading rates occur, shorter run lengths, higher backwash frequency, and resulting higher operating costs may set an economic limit on the filtration rate that is near the range of current practice. Declining-rate filtration appears to have inherent characteristics that make it generally more economical than the constant-rate approach. Using the same design average filtration rate, the lower filtration rate at the end of the run in the declining-rate filter results in a greater water production per filter run. Combined with what is essentially the elimination of downtime per backwash, this effectively reduces both capital and operating costs. (Baker-FRC)
W82-00975

DISTRIBUTION SYSTEM LIABILITY,
Waukesha Water Utility, WI.
J. H. Kuranz.
Water and Sewage Works, Vol 127, No 7, p 40-41, 52, July, 1980. 1 Ref.

Descriptors: *Legal aspects, *Municipal water, Water quality, *Utilities, Water distribution, Water conveyance, *Metropolitan water management, Public health, Leakage, Liability, Negligence, Remedies, Regulations.

Both publicly owned and investor owned water utilities must face the question of the extent of their liabilities. There do not appear to be any definitive legal answers to this question at the present time. Although water utilities are not generally considered as insurers of the purity of the water furnished for public consumption, they are required to use reasonable care and diligence in providing pure and wholesome water and may be liable for resulting injuries if they do not. Water utilities have a duty and an obligation to provide quality water and service. They should protect their interests by carrying good insurance coverage and by conducting programs to ensure proper construction and maintenance of the distribution system. When water mains or laterals fail, the utility will be in a better position to defend itself if it can prove that adequate maintenance was performed and that the response to the failure was prompt. Various measures can be taken to strengthen the utility's position with respect to injury or property damage resulting from fire, thawing frozen laterals, overflowing storage tanks, and shutting off a water supply. Open excavations, blasting, and other activities related to the construction and repair of distribution system facilities place the utility and/or its contractor in a particularly vulnerable position. Benefits of litigation may include reduction of the number of claims as a result of placing the burden of proof upon the complainant, serving public notice that the utility will fight claims against it, and enhancing the public image and internal relations of the utility when negligence cannot be proved. (Carroll-FRC)
W82-01028

HOME WATER SOFTENERS, WATER SOFTNESS AND POSSIBLE HEALTH IMPLICATIONS,
Illinois Univ. at the Medical Center, Chicago. School of Public Health.
G. R. Brenniman, W. H. Kojola, and A. H. Wolff.
Journal of Environmental Health, Vol 43, No 1, p 19-21, July/August, 1980. 2 Tab, 17 Ref.

Descriptors: *Water softening, *Human diseases, Cardiovascular disease, Water treatment, Sodium, Magnesium, Calcium, Minerals, Chemical composition, Chemical analysis, Water analysis, Water quality, *Home water softeners.

This study investigates the degree to which home water softeners alter the concentrations of sodium, calcium and magnesium in drinking water and the relationship of these findings to cardiovascular disease. Water samples (615) were collected in West Dundee and McHenry, Illinois, from households which had ion exchange home water softeners. Identical studies were conducted on samples from 596 households without home water softeners. Home water softeners increased mean sodium concentrations 3.4 to 5 fold and reduced calcium and magnesium concentrations between 1.6 and 1.8 fold among the households sampled in West Dundee and McHenry. If the homeowner does not recharge the softener with salt or replace wornout resins, the efficiency of the softener in removing calcium, magnesium, and other divalent metallic cations is greatly reduced. Over 40% of the tap water from homes with softeners from either West Dundee or McHenry had mean sodium concentrations of 128.9 mg/liter or greater, and mean calcium and magnesium concentrations of 2.6 mg/liter or less. It is suggested that a study of the relationship between home water softener use and cardiovascular disease be made. (Baker-FRC)
W82-01045

DESIGN AND CONSTRUCTION OF THE DANVERS, MASSACHUSETTS WATER PROCESSING PLANT,
Jordan (Edward C.) Co., Inc., Portland, ME.
S. Medlar.
Journal of the Institution of Water Engineers and Scientists, Vol 34, No 2, p 175-179, March, 1980. 5 Ref.

Descriptors: *Design criteria, *Construction materials, Odor control, *Water supply, Color removal, Turbidity, Reservoir, Water treatment, Filtration, Adsorption, Cost effectiveness, Water quality, Chloroform, Mixing, Flocculation, Chemical coagulation, Chlorine, Lime, *Water treatment facilities, *Danvers, Massachusetts.

The design and construction of a water treatment plant in Danvers, Massachusetts is described. The water had high color, odor, iron, turbidity, and sediment, causing many consumer complaints, prior to treatment. The treatment process used was two-stage flash mixing, tapered flocculation, sedimentation, sand filtration, and granular activated carbon adsorption. Construction of the plant began in 1974 and was completed in 1977 at a cost of 4,400,000 dollars. The water supply was palatable for the first time in 100 years, as a result of the treatment plant. (Titus-FRC)
W82-01088

ASBESTOS CEMENT PIPE AND CANCER IN CONNECTICUT 1955-1974,
Yale Univ., New Haven, CT.
For primary bibliographic entry see Field 5C.
W82-01094

5G. Water Quality Control

POTENTIAL MANAGEMENT OF FLORIDA RED TIDE THROUGH SELECTIVE PHOTODYNAMIC ACTION,
University of South Florida, Tampa. Dept. of Chemistry.
J. Barltrop, B. B. Martin, and D. F. Martin.
Journal of Environmental Science and Health, Part A, Vol 15, No 2, p 163-171, 1980. 1 Fig, 1 Tab, 10 Ref.

Descriptors: *Red tide, *Water quality management, Dinoflagellates, Eutrophication, Chemical reactions, Photodynamic action, Hematoporphyrin, Porphyrin.

The effectiveness of the photodynamic action of hematoporphyrin was tested using the unarmored dinoflagellate, Gymnodinium breve. Four systems were compared: light control and dark control with the organisms in light or dark, respectively, for 24 hr versus dark and light test in which the organisms plus .00008M porphyrin are left in dark and light, respectively, for 24 hr. Essentially total destruction was noted for the last system (light test), while no statistically significant differences were noted among the other three systems. The effect of the concentration of porphyrin was tested in preliminary experiments. The percentage of red tide survival was not a linear function of porphyrin concentration. The porphyrin probably is not effective at 0.001 of the totally destructive concentration under the conditions of this experiment. However, 0.01 of the totally lethal concentration destroyed about 25% of the cells. These findings indicate the potential application of photodynamic action in the management of red tide blooms. (Baker-FRC)
W82-00515

THE DISTRIBUTION OF THE COSTS OF FEDERAL WATER POLLUTION CONTROL POLICY,
Resources for the Future, Washington, DC.

For primary bibliographic entry see Field 6B.
W82-00537

A PROCEDURE USING MODELING AND ERROR ANALYSIS FOR THE PREDICTION OF LAKE PHOSPHORUS CONCENTRATION FROM LAND USE INFORMATION,
Michigan State Univ., East Lansing. Dept. of Resource Development.
K. H. Reckhow, and J. T. Simpson.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 9, p 1439-1448, September, 1980. 2 Fig, 6 Tab, 17 Ref.

Descriptors: *Model studies, *Water quality management, *Lakes, *Phosphorus, *Land use, Trophic level, Eutrophication, Mesotrophy, Oligotrophy, Mathematical studies, Watershed management, Error analysis, Prediction.

Recent studies on empirical lake modeling and error analysis have provided valuable methods for evaluating limnologic trophic quality. A technique is presented which utilizes previous models and land use data to predict lake phosphorus levels to aid in watershed management. The phosphorus flux from major types of land use is estimated along with the trophic state of the lake from the predicted phosphorus concentration. To supplement the prediction of phosphorus levels, a nonparametric error analysis is incorporated into the model. Uncertainty levels show the value of the model data generated. The procedure is applicable to most north temperate lakes, and an example of its use on Higgins Lake, Michigan is given. (Geiger-FRC)
W82-00546

DETOXIFICATION OF RESIDUAL QUATERNARIES,
Chemed Corp., Cincinnati, OH. (Assignee).
J. T. Jacob.
U.S. Patent No 4,204,954, 3 p, 3 Tab, 8 Ref; Official Gazette of the United States Patent Office, Vol 994, No 4, p 1362, May 27, 1980.

Descriptors: *Patents, *Water treatment, *Industrial water, *Biocontrol, Chemical reactions, Neutralization, Toxicity, Water quality control, *Detoxification, Biocides, Quaternaries.

Several quaternaries are being used at the present time as biocides for the control of microbiological growth in aqueous systems. The residual quaternaries when discharged into waste streams will interfere in the biological treatment processes by inhibiting the growth of biomass. It has now been discovered that the toxic effect of the residual quaternary compounds can be removed by treating the aqueous solutions with anionic substances to neutralize the activity of the quaternaries by forming stable complexes and thus render them inactive towards aquatic life. (Sinha-OEIS)
W82-00562

TEMPORAL AND SPATIAL SCALES IN PHYTOPLANKTON ECOLOGY. MECHANISMS, METHODS, MODELS AND MANAGEMENT,
McMaster Univ., Hamilton (Ontario). Dept. of Biology.
G. P. Harris.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 5, p 877-900, May, 1980. 2 Fig, 339 Ref.

Descriptors: *Literature reviews, *Model studies, *Phytoplankton, Fluctuations, Ecology, Nutrients, Water quality management, Water quality control, Plankton, Lakes, Eutrophication, Phosphorus, Aquatic populations, Biomass, Aquatic productivity, Marine environment, Reviews, Freshwater environment.

The temporal and spatial scales of variability in marine and freshwater planktonic environments and the algal responses to them are reviewed. Problems exist with interpreting the results of nutrient model studies under nonsteady conditions. Evidence for the existence and importance of small scale, high frequency and large scale, low frequency variation in the planktonic environment is presented. Insufficient knowledge of planktonic processes may hinder the management of water quality. A new model of community structure and processes in variable environments is proposed which corrects for the algal scales of perturbation and response and permits certain predictions to be made. When the new paradigm is used, certain problems and controversies in the literature may be rectified and an enhanced ability to manage planktonic systems should result. (Geiger-FRC)
W82-00594

SYSTEM FOR OIL AND WATER SEPARATION,
For primary bibliographic entry see Field 5D.
W82-00611

THE NONFUEL MINERALS INDUSTRY: REGULATORY IMPACTS,
Mitre Corp., McLean, VA. METREK Div.
For primary bibliographic entry see Field 5B.
W82-00612

GROUNDWATER STRATEGIES,
J. Josephson.
Environmental Science and Technology, Vol 14, No 9, p 1030-1035, September, 1980. 4 Fig.

Descriptors: *Groundwater, *Pollution control, Groundwater management, Reviews, Decision making, Regulations, Administrative regulations, *Legal aspects.

Efforts underway by the Environmental Protection Agency and the United States Geological Survey to control and protect groundwater against pollution are reviewed. The EPA is conducting a three phase program. Phase I called for gathering information on water use, contamination, federal/state laws, programs, and the groundwater protection state of the art. Phase II involved workshops comprising representatives of government, business/industry, and professional and environmental advocacy groups. Phase III will be the strategy-determination phase. A clear statement of problems and issues being addressed, a national program with fully defined federal and state roles, a comprehensive EPA policy to apply to all programs concerned with groundwater, tighter relationships among cognizant federal, state and local government bodies, and a short-term action plant will all be a part of the final strategy. One topic of major interest has been the contamination plume which normally follows the direction of groundwater flow, but has been known in certain cases to deviate. Containment of these plumes comprises three principal concepts: complete horizontal and vertical blockage of plume migration, partial blockage wherein the migration is reduced, and removal of the plume through excavation or pumping out. Types of installations are briefly considered, and some attention is directed toward remedial measures. (Baker-FRC)
W82-00620

PRELIMINARY POLLUTANT LIMIT VALUES FOR HUMAN HEALTH EFFECTS,
Army Medical Bioengineering Research and Development Lab., Fort Detrick, MD.
J. C. Dacre, D. H. Rosenblatt, and D. R. Cogley.
Environmental Science and Technology, Vol 14, No 7, p 778-780, 782-784, July, 1980. 1 Fig, 3 Tab, 14 Ref.

Descriptors: *Water pollution control, *Human diseases, Regulations, Administrative regulations, Standards, *Water quality standards, Specifications.

A preliminary pollutant limit value (PPLV) concept has been developed to predict probable environmental limits for pollutants. The PPLV is a temporary, nonregulatory value based on information currently available in the literature and that relates primarily to human health effects. PPLVs are determined in six steps: pollutants and pathways of exposure are identified; an acceptable daily dose of toxicant and partition coefficients are determined; relevant data are gathered; single pathway PPLVs are calculated for all pathways possible; critical pathways for each pollutant are selected; and the PPLV is derived by normalization of the single-pathway PPLV. The whole approach must be understood in a conceptual framework within which to provide environmental decisions. It is totally possible for two environmental engineers to obtain different results from the analysis of an identical situation. These differences may be the result of valid differences in judgement. The present treatment is only a start for critical examinations of other areas such as air pollution derived from sources in soil and water, and effects on aquatic organisms. (Baker-FRC)
W82-00628

THE DESIGN AND INTERPRETATION OF MARINE POLLUTION SURVEYS,
Clyde River Purification Board (Scotland).
For primary bibliographic entry see Field 6E.
W82-00700

GREAT LAKES INTERNATIONAL SURVEILLANCE PLAN,
International Joint Commission-United States and Canada, Windsor (Ontario). Great Lakes Water Quality Board.
For primary bibliographic entry see Field 6E.
W82-00701

PHOSPHORUS MANAGEMENT FOR THE GREAT LAKES: FINAL REPORT OF THE PHOSPHORUS MANAGEMENT STRATEGIES TASK FORCE,
International Joint Commission-United States and Canada, Windsor (Ontario).
For primary bibliographic entry see Field 6E.
W82-00702

HEALTH IMPLICATIONS OF NON-NTA DETERGENT BUILDERS,
International Joint Commission-United States and Canada, Windsor (Ontario).
Report from the Task Force on the Health Effects of Non-NTA Detergent Builders. October, 1980. 80 p. 6 Tab, 100 Ref, 4 Append.

Descriptors: *Lakes, *Water quality, *Phosphorous removal, *Detergents, *Carbonates, Soaps, Phosphates, Phosphorus compounds, Wastewater treatment, Algal growth, Wastewater pollution, Algal blooms, Wastewater analysis, Data collection, *Great Lakes, International waters.

Under the 1972 Great Lakes Water Quality Agreement between Canada and the United States, measures were taken to reduce the input of phosphorus to the lakes from municipal sewage; phosphate contained in household detergents had been identified as a major contributors. Restrictions on the use of phosphate in detergents have led to an increase in the use of alternative detergent builders. The task force to study non-nitrilotriaacetic acid detergent builders came to the following health effects conclusions related to these builders: (1) Carbonates, which occur naturally in water, have a long history of use as food additives, are classified as Generally Recognized as Safe (GRAS), and pose no human health hazard through their contribution of carbonate to drinking water. (2) Carboxymethyloxysuccinate (CMOS), which has been studied by Lever Brothers, is reported essentially non-toxic in those studies. (3) Carboxymethyltartronate (CMT) has been toxicologically studied by the Monsanto Company; however, the lack of primary data precludes a full assessment of its potential prolonged health effects. Based on its chemical structure and properties, CMT is not expected to pose undue health hazards. (4) Citrates ingested in drinking water have not revealed any health hazard, nor have mutagenic or teratogenic effects been reported. (5) Phosphates, soluble silicates, and Type A Zeolite are also considered to be safe to human health. (Garrison-Omniplan)
W82-00703

ECOLOGICAL EFFECTS OF NON-PHOSPHATE DETERGENT BUILDERS: FINAL REPORT ON ORGANIC BUILDERS OTHER THAN NTA,
International Joint Commission-United States and Canada, Windsor (Ontario).
Report from Task Force on Ecological Effects of Non-Phosphate Detergent Builders, July, 1980. 71 p. 7 Tab, 89 Ref, 1 Append.

Descriptors: *Lakes, *Water quality, *Phosphorous removal, *Detergents, *Phosphates, *Wastewater treatment, Soaps, Phosphorus compounds, Wastewater pollution, Algal growth, Wastewater analysis, Algal blooms, Data collection.

The Task Force on Ecological Effects of Non-Phosphate Detergent Builders was created because restrictions on detergent phosphates have been used increasingly with the result that alternate materials used by detergent manufacturers are released to the environment. The first report in this series, published in 1978, deals with the organic builder NTA (nitrilotriacetic acid). The three builders studied in this report are citrates, carboxymethyloxysuccinate (CMOS), and corboxymethyltartronate (CMT). Citrate is a natural product which is readily biodegradable by many organisms under aerobic and anaerobic wastewater treatment conditions. The Task Force believes that its use as a detergent builder will not be detrimental to the environment. However, its ability to stimulate algal growth by chelating heavy metals, its interference with the chemical precipitation of phosphate, and its removal during physiochemical treatment need to be studied further. CMOS, which does not occur in nature, is not likely to be detrimental to the environment, but investigations should be undertaken concerning (1) the effect of CMOS on dosages of chemicals used to precipitate phosphate; (2) the removal of CMOS during physiochemical treatment of wastewater; (3) the ability of CMOS to stimulate algal growth; and (4) the degradation of metal chelates of CMOS. CMT is not endorsed as a builder at this time. (Garrison-Omniplan)
W82-00704

REPORT OF THE AQUATIC ECOSYSTEM OBJECTIVES COMMITTEE,
International Joint Commission-United States and Canada, Windsor (Ontario).
November, 1980. 127 p. 6 Fig, 17 Tab, 306 Ref.

Descriptors: *Lakes, *Ecosystems, *Hazardous materials, *Aquatic populations, *Water quality, Toxicity, Viruses, Enteroviruses, Lead, Coliforms, Bacteria, Nutrient removal, *Great Lakes.

The 1972 Great Lakes Water Quality Agreement was expanded in 1978 with its emphasis on ecosystem quality rather than the narrower focus of water quality. The Aquatic Ecosystem Objectives Committee of the Science Advisory Board was charged with developing objectives, defined as the criteria for describing a desired state of an ecosystem, a concentration of a substance, or a description of a condition that is considered protective of the most sensitive use. Objectives have been chosen as minimum goals by the governments of Canada and the U.S. as a part of the 1978 Agreement. The Committee's recommendations include the following: (1) pentachlorophenal in water should not exceed a concentration of 0.4 micrograms per liter; (2) 2,3,7,8-tetrachlorodibenzoparadioxin (TCDD) should be absent from the entire ecosystem; (3) waters used for body contact recreational activities should be substantially free from bacteria, fungi or viruses that cause enteric disorders and infections; (4) fecal coliform bacteria should not exceed a logarithmic mean of 200 fecal coliforms per 100 mL of sample; and (5) the concentration of total lead in an unfiltered water sample should not exceed 2 micrograms per litre in Lake Superior, 3 in Lake Huron, 4 in Lakes Erie and Michigan, and 5 in Lake Ontario. Additional recommendations are made regarding previous proposals concerning residual chlorine, silver, cyanide, temperature, and nutrients. Specific recommendations on nutrient objectives include limits of 5 micrograms per liter of total phosphorus concentrations in Lake Superior, Lake Huron, Georgian Bay, and the North Channel. (Garrison-Omniplan)
W82-00705

WATER MOVEMENT FOR WATER QUALITY IN CATFISH PRODUCTION,
Alabama Agricultural Experiment Station, Auburn.
C. D. Busch, and C. A. Flood, Jr.
Transactions of the ASAE, Vol 23, No 4, p 1040-1042, July/August, 1980. 1 Tab. 13 Ref.

Descriptors: *Water quality control, *Water circulation, *Fish populations, Aeration, *Fish farming, Oxidation, *Catfish, fish, Dissolved oxygen, Oxygen.

There are two categories of approaches to providing adequate dissolved oxygen levels through water movement for fish production ponds. The first is replacement, which involves introducing freshwater from an outside source to the fish production location in exchange for some or all of the existing water. The second is aeration, which involves using some mechanical treatment method to renew or maintain the dissolved oxygen level necessary for fish production. The use of mechanical means to maintain or improve water quality, either by furnishing partial water replacement or by using aerators, is of limited value when compared to photosynthetic oxygen supply. The aerators, is of limited value when compared to photosynthetic oxygen supply. The efficiency of aerators decreases as saturation is approached, and the aerator will remove oxyen from super-saturated water. The topographical components necessary for continual water exchange through gravity flow from an ample supply of good quality water are seldom encountered. Using paddle wheels or other means to move the water for the purpose of mixing may complement the naturally-created dissolved oxygen supply, preventing the buildup of high oxidation demands and near anaerobic conditions at the lower levels of ponds. (Carrol-FRC)
W82-00866

EVALUATION OF STRIPMINE SEDIMENT DETENTION BASINS IN KENTUCKY,
Kentucky Univ., Lexington. Inst. for Mining and Minerals Research.
A. D. Ward, and C. T. Haan.
Transactions of the ASAE, Vol 23, No 4, p 854-858, 865, July/August, 1980. 4 Fig, 1 Tab, 14 Ref.

Descriptors: *Sedimentation basins, *Strip mine wastes, *Monitoring, *Kentucky, Sediments, Coal mining, Industrial wastes, Detention reservoirs, Basins, Sediment control, Sedimentation ponds, *Water pollution control.

The Surface Mine Reclamation Act of 1977 requires surface coal mining and reclamation operations to use sedimentation ponds to help control the discharge of high sediment concentrations to receiving waters. Although such ponds have been used for several decades, very little data on their performance is available, and design methods have generally proved to be inadequate. This monitoring project was designed to evaluate the effectiveness of sediment basins in controlling runoff and downstream sediment loading at two stripmine coal operations in eastern Kentucky and to develop design criteria for predicting sediment detention basin performance. Establishing a monitoring program at a sedimentation pond for strip mining operations requires the purchase and installation of a sampling unit, a stilling tower, tower instrumentation, dock, and relay cables. The research team for two or three ponds should be composed of an engineer and two technicians. The ponds monitored, which were small and inadequate to meet proposed Federal regulations, at times exhibited high trap efficiencies, but had low overall efficiencies. Simulation studies with the Deposits Model indicated that both ponds exhibit efficiencies of less than 20 percent for a 10-year, 24-hour storm. It is recommended that design plans include provision of a permanent pond capable of storing all the runoff from a 2-year, 2-hour event, installation of a mechanical dewatering device to dewater part of this stored sediment, and installation of a mechanical physical/chemical treatment system to be used during larger events. Such a design should provide pond trap efficiency approaching 100 percent while requiring chemical treatment of runoff only a few times each year. (Carroll-FRC)
W82-00893

REVIVING ACIDIFIED LAKES,
Uppsala Univ. (Sweden). Dept. of Limnology.
For primary bibliographic entry see Field 2H.
W82-00933

DRYLAND MANAGEMENT FOR SALINITY CONTROL,
For primary bibliographic entry see Field 2G.
W82-01018

SALINE SEEP DEVELOPMENT AND CONTROL IN THE NORTH AMERICAN GREAT PLAINS - HYDROGEOLOGICAL ASPECTS,
Montana Bureau of Mines and Geology, Butte.
For primary bibliographic entry see Field 5B.
W82-01022

IMPACT OF WATER RESOURCE DEVELOPMENT ON SALINIZATION OF SEMI-ARID LANDS,
California Univ., Davis. School of Civil Engineering.
For primary bibliographic entry see Field 5B.
W82-01024

EFFECTS OF NITRAPYRIN ON NITRATE MOVEMENT IN SOIL COLUMNS,
Science and Education Administration, Coshocton, OH. North Appalachian Experimental Watershed.
L. B. Owens.
Journal of Environmental Quality, Vol 10, No 3, p 308-310, July-September, 1981. 2 Fig, 2 Tab, 12 Ref.

Descriptors: *Leaching, *Soil columns, *Nitrates, Nitrification, Inhibitors, Ureas, Groundwater pollution, Water pollution prevention, Path of pollutants, *Nitrapyrin, *Water pollution control.

The increasing cost of fertilizers and growing concern with nonpoint source water pollution has led to increased interest in more efficient use of fertilizer nitrogen. Nitrapyrin (2-chloro-6-(trichloromethyl) pyridine), which is the active ingredient of N-Serve, has specific toxicity to Nitrosomonas spp., which is the main microorganism responsible for the nitrification of ammonium to more leachable nitrogen forms in soil. This study investigated the possible benefits of a nitrification inhibitor in terms of retardation or reduction in the amounts of nitrate leaching through the soil profile into the groundwater. Nitrapyrin treated urea of an untreated urea was incorporated into the top 10 centimeters of prewetted sandy loam soil cores. The soil columns were leached periodically with distilled water. After 91 days, only 1 percent of the applied nitrogen had leached from the nitrapyrin-treated cores, while 9.7 percent had leached from the untreated cores. After 144 days, 53.0 percent of the applied nitrogen had leached from the untreated cores, while only 41.9 percent had leached from the nitrapyrin-treated cores. Examination of the cores after 144 days showed that the mineral nitrogen concentration was greater at all depths in the soil treated with nitrapyrin than in the untreated soil and that the total mineral nitrogen remaining in the untreated soil was only 70 percent of that remaining in the nitrapyrin treated soil column. These short-term results indicate that nitrification inhibitors such as nitrapyrin may have an important role to play in controlling nonpoint source pollution problems by reducing both the rate of entry and the total quantity of nitrate-nitrogen leached into subsurface waters. (Carroll-FRC)
W82-01048

WATER CHEMISTRY CHANGES DURING ARTIFICIAL AERATION OF SPRUCE KNOB LAKE, WEST VIRGINIA,

West Virginia Univ., Morgantown. Dept. of Biology.
J. W. Labaugh.
Hydrobiologia, Vol 70, No 3, p 201-216, May, 1980. 9 Fig, 6 Tab, 41 Ref.

Descriptors: *Water quality, *Aeration, *Nutrients, Nitrogen, Phosphorus, Lakes, Reservoirs, Chemical properties, *Spruce Knob Lake, West Viginia, Chlorophyll, Primary productivity, Alaklinity, Chemical reactions.

Artificial aeration in Sprice Knob Lake using a modified full lift aerator increased water temperature below 3.5 meters from 13.6 to 15.6-16.5 C without causing destratification. No aeration was done in 1973, intermittent compressed air was used from July to September 1974, and continuous mechanical aeration using a propeller and aeration box, from May to September 1975. Below 3.5 meters' depth, total inorganic C, total alkalinity, nitrite, soluble reactive P, and total P were lower during aeration than during the summer of no aeration. There was no significant impact on the P budget of the impoundment. Nitrate levels were higher, 315 mg per cu meter, in 1975 than in previous years, which averaged 109-125 mg per cu meter. In early June 1975 a brief destratification caused by weather conditions increased H+ concentrations and lowered chlorophyll concentrations. Aeration produced no temperature or water chemistry changes in the epilimnion, chlorophyll, or primary production. (Cassar-FRC)
W82-01049

GROUNDWATER QUALITY MODELS - STATE OF THE ART,
Wisconsin Univ.-Madison. Dept. of Geology and Geophysics.
M. P. Anderson.
In: Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, Cincinnati, April 28-29, 1981. Purdue University, Water Resources Research Center, West Lafayette, IN. p 90-96, 3 Fig, 20 Ref.

Descriptors: *Groundwater pollution, *Model studies, Hydrologic models, Data collections, Hydrologic data collections, Advection, Mathematical models, Chemical reactions, Field investigations, Model testing, Waste disposal, Public policy, Public participation.

Concern over groundwater pollution has been voiced by scientists, government officials, and the general public, and has brought about a desire for increasing monitoring, techniques to predict the consequences of waste disposal on groundwater, and effective remedial measures to restore polluted groundwater. While monitoring and remedial measures are often expensive to implement, the use of a groundwater model is relatively inexpensive and is an efficient means of characterizing a field setting. However, of the three basic types of models---advection, advection-dispersion, and geochemical---only the advection type is applicable to regulation, planning and management in its present form. Advection models may be useful in instances where the contaminant is not affected by dispersion and chemical reactions, or to estimate the worst possible case for contaminant transport. The applications of advection-dispersion models and geochemical models to groundwater systems are currently in the research stages. Incorporating chemical reactions into both advection and advection-dispersion models is a difficult problem. The theoretical development of contaminant transport models is ahead of field knowledge of the processes themselves, and refinement of the models must await input from field studies. In particular, ways of correctly quantifying the dispersion process and the types and rates of chemical reactions that occur in the subsurface must be developed. (Garrison-Omniplan)
W82-01061

MANAGING OIL AND GAS ACTIVITIES IN COASTAL ENVIRONMENTS: REFUGE MANUAL,
RPC, Inc., Austin, TX.
W. L. Longley, R. Jackson, and B. Snyder.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-117508, Price codes: A20 in paper copy, A01 in microfiche. Fish and Wildlife Service Report FWS/OBS-81/22, September, 1981. 466 p, 11 Fig, 192 Ref, 2 Append. 14-16-0008-2152.

Descriptors: *Ecosystems, *Coastal marshes, *Wildlife refuges, *Fuel, *Exploration, Environmental effects, Salt marshes, Levees, Spoil banks, *Oil industry, Oil spills, Protection, Wildlife management, Texas, Louisiana.

The impacts of all aspects of oil and gas development on coastal ecological systems were investigated and the safeguards used in protecting refuge lands were assessed. Five wildlife refuges along the Texas and Louisiana coasts (Aransas, Brazoria, San Bernard, Delta, and Sabine National Wildlife Refuges) were selected for intensive study. They were characterized by a diversity of ecosystems; oil exploration, extraction and transport; and oil and gas development periods of various durations. Six ecosystems were identified: coastal uplands, salt marsh, brackish marsh, fresh marsh, delta marsh, and levees and spoil banks. For each ecosystem systematic impact and methods assessments were determined for the successive phases of development, seismic preexploration, access to site, well-site preparation and operation, installation and maintenance of lines, placement and operation of production facilities, spills and cleanup, and site shutdown and restoration. Successful and proposed stipulations are given for each of these categories. A wide variety of protective measures are in use, developed from the observations and experimentation of refuge managers, often on the basis of site-specific conditions. (Brambley-SRC)
W82-01081

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

RISK AND THE DEMAND FOR SUPPLEMENTAL IRRIGATION: A CASE STUDY IN THE CORN BELT,
Kentucky Univ., Lexington. Dept. of Agricultural Economics.
J. Apland, B. A. McCarl, and W. L. Miller.
American Journal of Agricultural Economics, Vol 62, No 1, p 142-145, February, 1980. 1 Fig, 2 Tab, 11 Ref.

Descriptors: *Supplemental irrigation, *Corn belt, *Economic aspects, Mathematical models, Agriculture, Risks, Corn, *Crop production, Irrigation, Planning.

There has been a rapid increase in irrigated acreage in the Corn Belt in recent years as a result of the considerable sensitivity of corn plant growth and associated grain yield to moisture stress during pollination. Increased irrigation has resulted in renewed interest in questions relating to water resource management and to the economic feasibility of supplemental irrigation. Most studies of the economic feasibility of irrigation have focused on the relationship of increases in crop revenues to the costs of irrigation. However, no thorough analysis has been made of the impact of risk aversion on the demand by farm firms for supplemental irrigation. A mathematical programming model of a Corn Belt grain farm was used to evaluate the implications of risk aversion for the derived demand for supplemental irrigation of corn. The model, which was a slightly altered variant of the MOTAD model developed by Hazell, considered riskiness of alternative production activities. Expected profit less a cost of bearing risk was maximized by the model, subject to the technology specified and an endowment of fixed resources. The production model used in the study was an adaptation of a research and extension model of farm production in which the time characteristics of farming were critical. The results of the analysis indicate that the influence of a manager's risk posture has a marked impact on the firm's demand for irrigation. Rational farm managers who are averse to risk may use irrigation technologies even when irrigation costs are high and corn prices are low. When risk aversion is evident, the demand for irrigation as a factor of production becomes increasingly inelastic. The implications of risk aversion should be considered in descriptive analyses of the adoption of irrigation. In addition, the question of risk should be addressed in assessments of aggregate demand for irrigation. (Carroll-FRC)
W82-00522

INTERPRETING DYNAMICS OF AQUATIC RESOURCES: A PERSPECTIVE FOR RESOURCE MANAGERS,
Great Smoky Mountains National Park, Gatlinburg, TN.
G. L. Larson.
Environmental Management, Vol 4, No 2, p 105-110, March, 1980. 9 Fig, 4 Ref.

Descriptors: *Parks, *Water resources management, *Ecological effects, Planning, Aquatic environment, Lakes, *National parks, Trophic level, Environmental effects, Productivity, Biomass, Fish, Aquatic plants, Insects.

The Leopold Report (1963) recommended that the biological associations of national parks be managed in the condition existing at the time of the first visits by Europeans. Management of natural processes on the ecosystem level is suggested in this report. It is necessary to consider the effects of making changes in natural resources and to differentiate between natural and unnatural changes. This paper presents, for the resource manager, some graphical approaches to viewing the complex interactions in aquatic systems. Some of the relationships depicted are consumer biomass vs. prey biomass at high, medium, and low productivity; consumer biomass vs. growth and production of the consumer at high and low levels of productivity; and insect biomass vs. fish biomass at high and low yield and at high and low plant biomass. (Cassar-FRC)
W82-00539

TOWARDS A PREDICTIVE MODEL FOR THE ECONOMIC REGULATION OF COMMERCIAL FISHERIES,
British Columbia Univ., Vancouver. Dept. of Mathematics.
C. W. Clark.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 7, p 1111-1129, July, 1980. 3 Fig, 34 Ref.

Descriptors: *Commercial fishing, *Fisheries, *Regulations, Fishing, *Model studies, Economic impact, Prediction, Taxes, Licensing.

A model for predicting the consequences of various methods of regulating commercial fisheries is developed. Alternatives considered were total catch quotas, vessel licenses, taxes on catch, allocated vessel quotas, and regulation of fishing effort. The model predicted that taxes and allocated transferable catch quotas are theoretically equivalent to each other in terms of economic efficiency and both can optimize exploitation of the common-property fishery. However, quotas provide a more direct control over the fish stock. Total catch quotas and closed seasons cause expansion of fleet capacity and shortening of the fishing season. Without additional controls, such as total catch regulation, vessel licensing could intensify fishing effort and shorten the fishing season. (Cassar-FRC)
W82-00549

LAND TREATMENT OF MUNICIPAL WASTEWATER IN SMALL COMMUNITIES,
Economics, Statistics, and Cooperatives Service, Washington, DC. Natural Resources Economics Div.
For primary bibliographic entry see Field 5D.
W82-00588

MODELING THE TRANSFORMATION OF NITROGEN COMPOUNDS FOR WATER-QUALITY MANAGEMENT IN STREAMS,
O. F. Vasil'ev, and E. V. Eremenko.
Water Resources (English Translation), Vol 7, No 5, p 437-442, September/October, 1980. 12 Ref. Translated from Vodnye Resursy, No 5, p 110-117, September/October, 1980.

Descriptors: *Mathematical models, *Water quality management, *Nitrogen compounds, Water conservation, Streams, Prediction, Water quality, Biological oxygen demand, Dissolved oxygen, Mathematical equations, Management planning, Planning.

Mathematical models are being used increasingly to make the evaluations of water quality used for water pollution control decisions, but certain improved models are not generally used in models designed to optimize the cost of conservation measures because they are poorly adapted for linking up with optimization models. The model of transformation of nitrogen compounds makes it possible to determine the concentration of standardized substances contained in wastewaters and being formed in receiving water bodies as a result of the transformation of nitrogen-containing substances. Solutions to this model, represented in the form of simple linear dependences for the concentrations of nitrogen compounds and characteristic sites of the stream, are presented which are suitable for predicting water quality and convenient for use when solving optimization problems. Linear dependences convenient for solving management problems can be obtained by examining the concentrations of substances at boundary sites of prismatic sections of the investigation channel stream. Equations for accomplishing this describe the effect of the concentration of some substances on the concentration of other, indicating the possibility of managing water quality through regulating the concentration of one substance by changing the discharge of another. The mathematical model of the formation of water quality can then be linked to the optimization model in terms of the magnitudes of wastewater discharges. (Carroll-FRC)
W82-00598

USING ECOLOGICAL KNOWLEDGE FOR DEVELOPMENT PLANNING,
East-West Environment and Policy Inst., Honolulu, Hawaii.
R. A. Carpenter.
Environmental Management, Vol 4, No 1, p 13-20, January, 1980. 1 Fig, 1 Tab, 18 Ref.

Descriptors: *Decision making, *Ecology, *Developing countries, Planning, Legal aspects, Natural resource development, Research priorities, Water resources development, Cost-benefit analysis, Economic aspects.

A multinational collaborative project has been developing natural systems assessments for developing countries. These nations, now more aware of the effects of resource exploitation, are passing legislation and organizing agencies for environmental protection. This produces channels for transferring ecological knowledge into political and administrative decision making. A satisfactory classification system considers the natural systems (terrestrial--crop, grazing, and forest lands; and aquatic--rivers, lakes, and coastal zones) as a whole and the various development sectors such as industry, agriculture, water impoundment, irrigation, domestic water supply and sewage disposal, and fisheries. Benefit-cost analysis is valuable in integrating ecological knowledge into economic development decision making. The list of priorities for ecological research includes the benefits of a healthy landscape, long term uses, results of intensified agriculture and forestry in tropical countries, and the assimilative capacity of water bodies. (Cassar-FRC)
W82-00671

RICHARDS BAY: AN ECOLOGICAL DILEMMA,
Department of Environmental Planning and Energy (South Africa).
N. Viljoen.
Civil Engineer in South Africa, Vol 22, No 4, p 84-90, April, 1980. 4 Fig, 45 Ref.

Descriptors: *Water resources development, *Planning, Management planning, Decision making, Administrative decisions, Water demand, *Harbors, *Construction, *Ecological effects, *Richards Bay, South Africa.

At Richards Bay, South Africa, planning was begun for the construction of a future harbor city of metropolitan size, and it was intended to tie in the planning with that of other projects in the area so as to conserve the natural environment. This preservation was incorporated into the policy making, program designing, and financing of the growing complex. The ecological dilemma and the vastness of the situation were resolved into areas where sufficient expertise and background knowledge already existed to ensure sound policy making, and other areas where the status of appreciation ranged from rational deductions to total ignorance. Specific studies were made of the climate and atmosphere, plant ecology, agriculture of the area, hydrogeophysical considerations, the estuarine and marine environment, freshwater ecosystems, and recreation and conservation. (Baker-FRC)
W82-00679

PLAN OF STUDY FOR THE REGIONAL AQUIFER-SYSTEM ANALYSIS OF THE SNAKE RIVER PLAIN, IDAHO AND EASTERN OREGON,
Geological Survey, Boise, ID. Water Resources Div.
G. F. Lindholm.
Available from the OFSS, USGS Box 25425., Denver, CO 80225, Price: $2.75 in paper copy, $3.50 in microfiche. Geological Survey, Open-File Report 81-689, June 1981. 21 p, 4 Fig, 17 Ref.

Descriptors: *Aquifer management, *Project planning, *Regional analysis *Geohydrology, Aquifer characteristics, Drawdown, Groundwater movement, Surface-groundwater relations, Groundwater recharge, Groundwater availability, Irrigation, Water supply, Model studies, Water quality, Geochemistry, *Idaho, *Orgeon, *Snake River Plain, Regional Aquifer System Analysis.

The 15,600-square-mile Snake River Plain is largely in southern Idaho and includes one of the Nation's major regional aquifers. A comprehensive investigation of the area's ground-water resources will be made as part of the U.S. Geological Survey's Regional Aquifer-System Analysis (RASA) program. Basaltic and sedimentary rocks in the Snake River Plain yield large quantities of water that are vital to the area's agricultural economy. Basaltic rocks predominate in the eastern Snake River Plain and have especially high water-yielding capabilities. Surface water, largely from the Snake River, is extensively used for irrigation and is a major source of recharge to the ground-water system. Springs issuing from basaltic rocks that form the Snake River Canyon wall near Twin Falls are the major points of ground-water discharge. Increased use of ground water for irrigation is causing concern as to the effect of large-scale withdrawals on spring flow. Ground-water flow models will be used to improve understanding of the hydrologic system, and, if feasible, to aid in evaluating management alternatives. Groundwater quality will be defined and geochemical techniques used to determine the effects of water-rock reactions on water quality. Several reports are planned on different phases of the project, concluding with a summary report. (USGS)
W82-00730

MANAGEMENT PROVOKED CONFLICT IN FISHERIES,
Oregon State Univ., Corvallis. Dept. of Anthropology.
C. L. Smith.
Environmental Management, Vol 4, No 1, p 7-11, January, 1980. 4 Fig, 10 Ref.

Descriptors: *Fisheries, *Management, *Social aspects, Plannning, *Fish management, Safe yield, Yield, Economic aspects, Regulations, Resources management.

The conflicts seen in the management of many U.S. fisheries result from the way in management concepts are applied. Managing with maximum sustainable yield means managing on the fringe of conflict because attempts to reduce yields cause different groups (public, fisherman, and consumers) to complain. Although management can constrain the ability to catch fish, it has little impact on expectations of greater catches and more profit. Social goals should be incorporated into fishery management and evaluated against management goals. A planning process adapted from the Water Resource Council is: (1) specify relevant objectives, (2) evaluate resource capabilities, (3) formulate alternative plans, (4) analyze differences among alternatives, (5) review and revise, and (6) select plan. Steps 3 and 4 are the points where these public goals need to be considered. (Cassar-FRC)
W82-00780

GAME THEORY ANALYSES APPLIED TO WATER RESOURCE PROBLEMS,
Iowa Univ., Iowa City. Inst. of Urban and Regional Research.
M. Sheehan, and K. C. Kogiku.
Socio-Economic Planning Sciences, Vol 15, No 3, p 109-118, 1981. 1 Fig, 8 Tab, 31 Ref.

Descriptors: *Water resources development, *Negotiations, *Water allocation, Economic aspects, Communication, Remedies.

The theory of cooperative games involving two or more actors is applied to various water resource problems. The practical problem to be considered is how to apportion fairly the reduced costs and increased benefits which result when individuals join together to reap the gains of collective action. Most large resource development projects are collective in nature, and waste treatment projects usually involve at least two parties. Recently, standard-setting government agencies have participated. Scenarios are developed to illustrate the theory of cooperative games and to point out the problems and complexities involved. Recent applications of game theory are described, including optimum development of the Ganges and its tributaries for flood control, hydroelectric generation, and irrigation. Game theory can be used to help negotiators see the benefits of cooperative solutions in many situations of conflict. (Small-FRC)
W82-00802

NUMERICAL SIMULATION OF POTENTIOMETRIC SURFACE CHANGES CAUSED BY A PROPOSED OPEN-PIT ANTHRACITE MINE,
Stone and Webster Engineering Corp., Cherry Hill, NJ.
E. S. Bair, and R. R. Parizek.
Ground Water, Vol 19, No 2, p 190-200, March/April, 1981. 11 Fig, 20 Ref.

Descriptors: *Computer models, *Groundwater movement, *Mining engineering, Land use, Subsidence, *Potentiometric level, Permeability coefficient, Baseline studies, Mathematical models, Projections.

Hydrologic and hydrogeologic data were obtained, assessed, and incorporated into a groundwater flow model designed to forecast changes in a groundwater flow system caused by a proposed mining operation. The Trescott, Pinder, and Larson finite-difference flow model was modified and used to simulate potentiometric surface changes caused by the first eight years of development of an open-pit anthracite mine at Wabash Creek, Pennsylvania. The coefficient subroutine was modified to allow the value of hydraulic conductivity to vary with depth. The data input subroutine was changed to allow the number, location, and hydraulic head of constant-head nodes to vary with the time period. Also, the mass balance subroutine was altered to print out the flux into each constant-head node at the end of each time period, thus permitting calculation of changes in the rate of groundwater flow into the mine. Using

site specific values for hydraulic conductivity and other parameters, the simulations predicted that in eight years a cone of depression approximately 20,000 feet long, 8000 feet wide, and 1000 feet deep would form around the proposed mine. The numerical model demonstrated the ability to model the flow system in a complex geological terrain and change the magnitude, location, and type of stress imposed on the flow system. (Small-FRC)
W82-00819

ANSWERS: A MODEL FOR WATERSHED PLANNING,
Purdue Univ., Lafayette, IN. Dept. of Agricultural Engineering.
D. B. Beasley, L. F. Huggins, and E. J. Monke.
Transactions of the ASAE, Vol 23, No 4, p 938-944, July/August, 1980. 9 Fig, 3 Tab, 18 Ref.

Descriptors: *Watershed management, *Management planning, *Computer programs, Simulation analysis, Simulation, Mathematical studies, Mathematical models, Watersheds, Planning, Land use, Water quality management, Water pollution effects, *Nonpoint pollution sources, Runoff, Overland flow, Inflow.

The ANSWERS (Areal Nonpoint Source Watershed Environment Response Simulation) program was developed as a planning model to assess the effects of land uses, management schemes, and cultural practices on the quality of water leaving the watershed; to assess pollution problems from nonpoint sources; and to define cost-effective solutions for primarily agricultural watersheds. The overall structure of the ANSWERS program comprises a hydrologic model, a sediment detachment/transport model, and several routing components necessary to describe the movement of water in overland, subsurface, and channel flow phases. A distributed parameter concept is used in the attempt to model the spatially varying processes of runoff, infiltration, subsurface drainage, and erosion. Application of the program to ungaged watersheds should result in at least comparative results for various treatment or management strategies. Experience has demonstrated the ability of the program to model observed hydrologic events on agricultural watersheds with good agreement. ANSWERS can become a valuable tool in planning cost-effective measures for controlling nonpoint source pollution when it is driven with hypothetical storms of known return interval. (Carroll-FRC)
W82-00898

TAMPA BAY WATER GUARDED BY COMPUTER,
Camp, Dresser and McKee, Inc., Clearwater, FL.
For primary bibliographic entry see Field 4B.
W82-00934

EFFECTIVENESS OF RIVER MODELS,
Nevada Univ. System, Las Vegas. Desert Research Inst.
R. H. French, and P. A. Krenkel.
Water Science and Technology, Vol 13, No 3, p 99-113, 1981. 5 Fig, 1 Tab, 17 Ref.

Descriptors: *Model studies, *Water quality, *Rivers, Sensitivity analysis, Planning, Mathematical models, Willamette River, Calibration, Model testing, Data interpretation.

Modeling of river water quality is a practical tool in water resources planning and water quality management, but only if used correctly. Eight factors affecting the effectiveness of models are discussed. Some processes are not easy to model, e.g., erosion, eutrophication, and toxicity relationships. Dissolved oxygen, temperature, and dissolved solids are relatively easy to model. Indicator bacteria, sediment transport, algal growth, metal transport, nutrient transport, and pesticide transport are intermediate in complexity. General case models are not always applicable to specific rivers. The model should be chosen to fit the river, not vice versa. Concentration on a critical time period may suffice to answer the study question. For example, low dissolved oxygen may only occur during summer. Calibration and verification are necessary for good results. The two are independent, and different data sets should be used for each. Any drastic change in the river system may require recalibration and verification. Proper sampling and monitoring are important for a statistically reliable data base. The model results must be presented in nontechnical language, understandable by managers and planners. The model should be developed well in advance of actual need, so that calibration, verification, sampling, etc, can be designed and executed in an optimum fashion. The validity of the model's basic assumptions needs periodic re-evaluation. A significant use of models is sensitivity analysis, showing the effect of variation of a given parameter on the output if all other factors are constant. This is illustrated with a study on the Willamette River. (Cassar-FRC)
W82-00961

WATER QUALITY EVALUATION OF REGIONAL WASTEWATER MANAGEMENT,
Toronto Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W82-00977

SIMULATION MODELING OF PRIMARY CLARIFIERS,
Paramount Engineering Ltd., Kitchener (Ontario).
R. L. Alarie, E. A. McBean, and G. J. Farquhar.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE2, p 293-309, April, 1980. 8 Fig, 4 Tab, 21 Ref.

Descriptors: *Clarifiers, *Simulation analysis, *Model studies, Clarification, Chemical precipitation, *Wastewater treatment, Filtration, Mathematical studies.

A simulation model is derived for circular primary clarifiers. Predictions from the model are compared with results from existing regression, based on models for a case study applied to the Waterloo Water Pollution Control Plant, Ontario, Canada. The simulation model was used to produce general results indicating the relationship between suspended solids removal and the parameters of overflow rate, detention time, and initial suspended solids (SS) concentrations. Two initial SS concentrations were used in conjunction with the settling property data obtained from the plant. Varying overflow rates and clarifier depths were also used. Effluent SS concentrations increased with increasing overflow rates. The performance of the clarifier deteriorated rather rapidly once an overflow rate of 39,100 liters/day/square meter was exceeded. Percent removal was usually greater at higher initial SS concentrations because of a higher proportion of settleable solids than at lower initial SS concentrations and because of a greater frequency of interparticle contact. Additional depth beyond 3.7 meters produced little improvement in the percentage of SS removal at the above overflow rate. While this may not be true for all types of wastes, it was felt to be accurate for domestic sewage. The simulation model allowed accurate predictions of the performance of the clarifier at various chemical dosages with only minimal laboratory experimentation to determine settling properties. The ability of the model for accurately predicting short-term variations in effluent characteristics may be valuable to a plant operation or to the sanitary engineer studying impact of effluent on a receiving stream. (Baker-FRC)
W82-01027

MATHEMATICAL MODELING TECHNIQUES FOR GROUNDWATER MANAGEMENT,
Prickett (Thomas A.) and Associates, Urbana, IL.
For primary bibliographic entry see Field 4B.
W82-01062

6B. Evaluation Process

THE WATERWAY THAT CANNOT BE STOPPED,
For primary bibliographic entry see Field 6E.
W82-00510

EVALUATION OF THE OLDMAN RIVER BASIN IRRIGATION PROPOSALS: IMPLICATIONS FOR INTERBASIN TRANSFERS,
Department of Agriculture, Lethbridge (Alberta). Irrigation Div.
W. Phillips, M. McMillan, and T. Veeman.
Canadian Water Resources Journal, Vol 6, No 2, p 54-61, 1981. 4 Ref.

Descriptors: *Water resources development, *Planning, *Irrigation, River basins, Irrigation efficiency, Economic aspects, *Oldman River, Interbasin transfer, Water transfer, Alberta, Canada.

The Oldman River Basin Study, Phase II, an economic evaluation, is reviewed. The role and importance of economic evaluations for water resources planning and the implications for interbasin transfers are discussed. Two issues which cast doubt upon the purported economic merits of development alternatives in the Oldman Basin are the improper inclusion of secondary benefits arising from increased regional employment, and the assumed zero opportunity cost of extra capital and labor required when shifting from dryland to irrigated agricultural land use. When these two factors are adjusted for, the benefit-cost ratio is rendered less than one, thus raising some question about the merits of the Oldman irrigation proposals in terms of economic efficiency. It is suggested that any assessment of future water development or diversion proposals should take these two factors into account. (Baker-FRC)
W82-00519

THE DISTRIBUTION OF THE COSTS OF FEDERAL WATER POLLUTION CONTROL POLICY,
Resources for the Future, Washington, DC.
L. P. Gianessi, and H. M. Peskin.
Land Economics, Vol 56, No 1, p 85-102, February, 1980. 9 Tab, 14 Ref.

Descriptors: *Water pollution control, *Public policy, *Federal jurisdiction, *Cost allocation, Economic aspects, Political aspects, Pollution control, Cost analysis, Social aspects, Costs.

In comparing the costs and benefits of a program, it is probably inaccurate to assume that dollar costs provide a reasonable approximation of the true opportunity costs of the program. A first step towards identification of the real opportunity costs and of the distributional consequences of full implementation of the Clean Water Act in its 1972 version involves description of the short-run costs as felt by families because of their tax burdens and initial increases in the costs of goods they consume. The results of investigation of these short-run costs are presented by particular income, racial, and geographic classifications. The costs used in this study assumed perfectly inelastic demands throughout the economy; were incremental in that they represented the costs to be incurred by industries and municipalities to meet the law's objectives over and above pollution control expenditures already made; and were annualized in order to permit presentation of all costs in per annum terms. Analysis of these costs indicates that the costs of industrial and federal government pollution control policies are largely felt outside of the geographical areas in which they are initially incurred; that average per family control cost burden percentages decline with increases in income; that water pollution control policy is less regressive than the clean air policy; and that whites have a greater absolute burden for pollution control, while non-whites generally have a slightly greater proportional burden. These results suggest that federal government subsidies may tend to alleviate the regressive burdens which result from shifting of polluters' costs to consumers and from relatively regressive state and local tax structures. (Carroll-FRC)
W82-00537

SMALL HYDRO INSTALLATIONS SPUR UNIQUE ENGINEERING SOLUTIONS,

Tudor Engineering Co., Riverton, WY.
D. C. Willer.
Power Engineering, Vol 84, No 1, p 62-64, January, 1980. 2 Fig.

Descriptors: *Hydroelectric plants, *Capital costs, Powerplants, Economic aspects, Decision making, Design criteria.

Capital costs of small hydropower installations range from $685 to $1400 per kW at the 1978 base cost level. The resulting energy costs varies from 13 to 25 mills/kWh. Location of a new power plant is a major engineering consideration. Various configurations must be considered to determine the one best suited to the needs at hand. Box Canyon Dam in California is a typical example of numerous dams, constructed primarily to impound water for irrigation or recreation during a period when it was not feasible economically to install generation capacity. Plans are now underway to build a 4000 kW power plant at that location, which will cost about $3 million. One interesting innovation here is the placement of the power plant under an extension of the spillway apron, which is economical and offers the least adverse visual and environmental impact. Many small hydro plants under consideration will utilize irrigation impoundments and canal drops. (Baker-FRC)
W82-00538

THE U.S. GEOLOGICAL SURVEY FEDERAL-STATE COOPERATIVE WATER RESOURCES PROGRAM,
Geological Survey, Reston, VA. Water Resources Div.
B. K. Gilbert, and T. J. Buchanan.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $4.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-691, 1981. 27 p, 2 Fig, 5 Tab, 4 Ref.

Descriptors: *Water management, *Cooperatives, *Hydrologic data, *Evaluation, Water supply, Water quality, Water use, Planning, Costs, *Federal-State cooperation, Geological survey.

The U.S. Geological Survey Federal-State Cooperative Water Resources Program is a partnership between the Geological Survey and State and local agencies for the collection of the hydrologic information needed for the continuing determination and evaluation of the quantity, quality, and use of the Nation's water resources. The Cooperative Program has served the Nation for more than 80 years, and in 1981 more than 800 State and local agencies have cooperative programs with the Geological Survey with total funding over $80 million. The process of project selection in the Cooperative Water Resources Program is a mutual effort in which Geological Survey represents national interests, including the needs of other Federal agencies, and the cooperator represents State and local interests. The result is a balanced program that involves careful evaluation of needs, priorities, and resources. The cost sharing ratio of 50-50 is examined and determined to be the best ratio to effectively assess the Nation's water resources. The Cooperative Program is and has been relevant to the problems of the day. Much of the current technology in ground-water management, ground-water quality, and flood-plain management--to name a few--was developed as part of the Cooperative Program. (USGS)
W82-00735

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING: JORDAN RIVER BASIN, UTAH.
Federal Energy Regulatory Commission, Washington, D.C. Office of Electric Power Regulation.
For primary bibliographic entry see Field 6D.
W82-00736

EVALUATING IRRIGATION SYSTEMS,
B. McLellan.
World Farming, Vol 23, No 1, p 12-15, January/February, 1981.

Descriptors: *Irrigation systems, *Cost-benefit analysis, *Evaluation, Economic evaluation, Labor, Farm equipment.

The most appropriate irrigation system for a given situation can be chosen by comparing cost-benefit ratios. All values must be calculated in terms of money, on a per person basis, on a yearly basis, and with all possible costs and benefits included. Some examples of costs often improperly ommited are: pollution and erosion of farmland, installation of electrical and other services, and value of food crops lost to growing of cash crops. Examples of benefits often left out are: earnings of workmen freed from farming and working as craftsment and value of bartered food crops. Formulas are given for calculating benefits, costs of irrigation systems, annual cost of each irrigation worker, annual costs of machinery, and yearly labor cost savings. (Cassar-FRC)
W82-00772

WATER QUALITY MANAGEMENT IN RIVER BASINS: US NATIONAL EXPERIENCE,
North Carolina Dept. of Natural Resources and Community Development, Raleigh.
For primary bibliographic entry see Field 6E.
W82-00800

ECONOMIC ANALYSIS OF GRANULAR-BED FILTRATION,
Syracuse Univ., NY. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W82-00975

TREATABILITY MANUAL; VOLUME IV. COST ESTIMATING.
Environmental Protection Agency, Washington, DC. Office of Research and Development.
For primary bibliographic entry see Field 5D.
W82-01076

AN INTANGIBLE BENEFIT OF WATER POLLUTION CONTROL PROGRAMS,
Rockwell International, Pittsburgh, PA.
L. L. Moore.
Journal of Environmental Health, Vol 42, No 5, p 254-257, March/April, 1980. 5 Ref.

Descriptors: *Water quality control, *Cost-benefit analysis, *Public health, Cost analysis, Economic aspects, Costs, Decision making, Planning, Water pollution control.

Benefit analysis is discussed in the context of problems which confront environmental regulatory agencies in placing a dollar value on water pollution control measures, specifically on benefits related to improved health. Applying theoretical concepts to practical problems is difficult, time-consuming, and may require an extensive data base. Often the policy maker who expects exact information concludes that cost-benefit analysis does not deal adequately with probiems. The ability to identify problems and quantify the benefits of water pollution control must be improved. One reasonable manner to include intangible benefits in the decision making process is to describe them in nonmonetary but quantitative units. These explicit descriptions may provide information on the importance of the impact, even though their monetary value may still be beyond measurement. Economic assessment of human illness associated with drinking water is highly subjective. It is also difficult to place a value on a person's change in life expectancy. Disruption of the use of time is the most costly of all effects caused by illness. Some researchers have estimated the national benefits that would accrue from the reduction of waterborne communicable diseases such as hepatitis and typhoid fever. The major advantage of cost-benefit analysis may be in learning how to justify the value placed on particular outputs of a proposed policy or program. Such attempts will encourage debate and facilitate the evolution of improved analytical approaches. (Baker-FRC)
W82-01092

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

PRICE ELASTICITIES FOR WATER: A CASE OF INCREASING BLOCK RATES,
Arizona Univ., Tucson. Dept. of Economics.
R. B. Billings, and D. E. Agthe.
Land Economics, Vol 56, No 1, p 73-84, February, 1980. 4 Fig, 1 Tab, 16 Ref.

Descriptors: *Water demand, *Water rates, *Mathematical models, Economic aspects, Prices, Pricing, Prediction, Mathematical equations, Municipal water, Elasticity of demand.

The presence of block rates in rate schedules has been ignored in several previous studies of price elasticity of demand for residential water. When block rates appear in the rate schedule, use of average price as the only price variable in the estimating equation tends to result in excessively large estimates of the price elasticity of demand, especially when the marginal price increases while the intramarginal rates remain constant. When marginal price is used alone in the presence of block rates, the income effects of a change in intramarginal rates with marginal price constant cannot be accounted for properly. Two studies have suggested an alternative method utilizing two price-related variables in the estimating model when rate schedules contain block rates. Several alternative versions of the model for price elasticity of demand for water when increasing block rates and/or availability of service charges appear in the rate schedule were tested using both nominal and deflated price and income data. The model uses two price-related variables: the marginal price of water and a second price variable defined by Nordin as the difference between the consumer's actual utility bill and what would have been paid if all units of the commodity had been purchased at the marginal price. Estimation of the price elasticity of demand for residential water in Tucson, Arizona, using both double logarithmic and linear equations demonstrated that the two-price variable model produces better predictions of consumer response to rate schedule changes than those resulting from a single price model. The use of real monetary values produced substantially stronger statistical results than the use of unadjusted prices and incomes, indicating that water consumers responded to the real price of water and real income levels rather than to their nominal counterparts. (Carroll-FRC)
W82-00536

FUNDAMENTAL ECONOMIC ISSUES IN THE DEVELOPMENT OF SMALL SCALE HYDRO.
Franklin Pierce Law Center, Concord, NH.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/RA/04934-02, Price codes: A03 in paper copy, A01 in microfiche. Department of Energy Report DOE/RA/04934-02, May 1980. 26 p.

Descriptors: *Institutional constraints, *Hydroelectric plants, *Economic feasibility, *Regulations, *Cost analysis, Construction costs, Operating costs, Dams, Resources development, Profits.

The costs of construction and revenues from operation of a small scale hydroelectric site have been identified, along with a range of estimates which included a profitable operation for sites with the given characteristics. Surveys of several sites show that these characteristics do exist, yet these sites have not been developed. By residual analysis, the cause was attributed to instutional costs. A rough look at the relative prices associated with hydroelectric generation reached the same conclusion. Since regulatory costs are unknown, it is difficult to place much confidence in an analysis attributing the impediment to hydro development to such regulatory costs. The present information on regulatory costs imposed on the small scale hydroelectric developer is insufficient to aid policy formation. It is neither feasible nor desirable to remove all regulation, but it must be determined where in the regulatory environment these costs can be reduced with a net benefit to society. The relevant

questions are: where the regulation is inefficient at obtaining its stated goals; and what policy options are available to remedy this instutional problem. (Moore-SRC)
W82-00722

POTENTIAL POLITICAL INFLUENCES AFFECTING THE WATER INDUSTRY,
R. C. Marini.
Journal of the New England Water Works Association, Vol. 94, No. 2, p 170-179, June, 1980.

Descriptors: *Political aspects, *Utilities, *Public participation, Public policy, Administrative decisions, *Water policy, Public relations, Policy making, Attitudes, Financing, *Pricing, Water rates, Massachusetts.

Increasing consumer awareness and federal involvement are putting new political pressures on local water industries. The Boston Water and Sewer Commission raised its rates 48% in 1978 to clear a long standing deficit. When rates were rolled back in 1979, there was geat public and news media involvement pressing for an even greater rate decrease. Small town public works officials feel even greater effects from public pressure to reduce costs or defer expansion in spite of the truth that most projects must be carried out eventually, either turned back to the individual or deferred into the future. In some cases absence of leadership in the utility has caused service to deteriorate to the extent that customers refuse to pay their bills, further decreasing revenue. The water industry must take political leadership by having sound plans and budgets and providing detailed information to consumers. Aiding this process are the focus on inflation and cost of living, separation of water and sewer charges from property taxes, and the visibility of water issues in the federal government. (Cassar-FRC)
W82-00861

6D. Water Demand

EUROPEAN COMMUNITIES DIRECTIVE RELATING TO THE QUALITY OF WATER INTENDED FOR HUMAN CONSUMPTION,
Commission of the European Communities, Brussels (Belgium).
J. Smeets, and R. Amavis.
Water, Air, and Soil Pollution, Vol 15, No 4, p 483-502, May, 1981. 8 Tab.

Descriptors: *Water quality control, *Standards, Quality control, *Potable water, Regulations, Planning, International agreements, International commissions, Water supply.

The Council of Ministers in the Action Programme of the European Communities of the environment presented a directive to the Council of Ministers of the European Communities on July 22, 1975, concerning the maintenance of a specific quality of water for human consumption. The directive contained a choice of a series of parameters, the numerical values given to them, and the measures relating to the monitoring and supervision needed to establish this degree of water quality. The parameters involved are classified in five classes: organoleptic parameters, physicochemical parameters, parameters concerning substances undesirable in excessive amounts, parameters concerning toxic substances, and microbiological parameters. The technical aspects of the directive are described. (Baker-FRC)
W82-00506

THE AZOV SEA PROBLEM,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 6G.
W82-00651

ENVIRONMENTAL ASPECTS OF RURAL DEVELOPMENT WITH PARTICULAR REFERENCE TO THE KEISKAMMA RIVER BASIN STUDY,
Secretary for Agriculture and Forestry, Ciskei (South Africa).
G. F. Godden, S. M. Nicol, and A. C. Venn.
Civil Engineer in South Africa, Vol 22, No 5, p 111-116, May, 1980. 3 Fig, 1 Tab.

Descriptors: *Water resources development, *Planning, Water demand, Rivers, River basins, Catchments, Keiskamma River Basin, *South Africa.

The Keiskamma River rises at an elevation of 1,500 meters in the Amatole Mountains, at the southern tip of the Drakensberg Range of Southern Africa, where it drains into a number of minor tributaries towards the more arid coastal plateau. Two distinct river valleys are formed at this lower elevation. The total area of the river basin is 2700 square kilometers of which about 85% experiences an annual rainfall less than 700 mm and about 60% in the lower and middle reaches has about 400 to 600 mm per year. The highest precipitation, 1400 mm, falls in the mountainous areas forming the northern preiphery of the catchment area. The need arose for a new water supply scheme to serve the developing industrial growth points at Dimbaza and Middledrift. The Keiskamma River was the logical choice. However, the potential inundation of 400 ha of valuable agricultural land by the dam, the effects of the new irrigation scheme and possible further afforestation in the upstream catchment, the effects of the dam runoff and irrigation withdrawals in the lower catchment, and the obvious potential for new irrigation development immediately downstream of the dam were factors to be considered. The Keiskamma River Basin Study should serve as an example of the type of investigation required to ensure that development of rural areas is achieved in the most efficient manner and in harmony with the environment. (Baker-FRC)
W82-00685

WATER - ITS USE AND THE IMPLICATIONS FOR ARKANSAS AGRICULTURE.
1981. 190 p. 29 Fig, 18 Ref, 3 Append.

Descriptors: *Agricultural hydrology, *Water use, *Competing use, *State jurisdiction, Interbasin transfers, Water shortage, Water management, Multiobjective planning, Long-term planning, Water use efficiency, Alternative planning, Groundwater management, *Arkansas.

In view of an intense interest in water use and the potential impact of public decisions on the agricultural use of water, the Arkansas Farm Bureau board of directors authorized an in-depth review of water resources, water rights law, and allocation procedures, for use by Farm Bureau members in formulating policy on the water issue. The report includes information on water sources, quality, supply, and management; an overview of water law; a list of agencies with responsibilities in water; and discussions of special issues involving Arkansas water. Arkansas has had an abundant supply of water in the past, and few conflicts over use. However, pressures may be mounting that will change this situation in the future. Agriculture must plan its role in possible future controversies. In determining the course of action for agriculture, it is important to decide whether or not water laws will provide protection for agriculture's needs. Arkansas needs a comprehensive water plan that will show statistically where the water exists in Arkansas; show present and future needs for this water, including agriculture trends; ensure that the quality of the water remains intact; and develop a procedure to help relieve acute water shortages. Regardless of decisions concerning the use of water within the state, there is the threat of exporting water to deficit areas outside the state. The principal objection to interbasin transfer is not its legality but its tremendous cost. State interests in this matter must be protected by the congressional delegation. (Garrison-Omniplan)
W82-00714

ARKANSAS WATER POLICY.
Water Policy Task Force, Little Rock, AR.
Report, December, 1980. 34 p. 51 Ref, Append.

Descriptors: *Water resources development, Groundwater management, *Allocation of resources, Water demand, Long-term planning, *Administrative regulations, Regional development, Water use, Competing use, Federal jurisdiction, State jurisdiction, Planning, Flood plain management, Water law, Legal aspects, *Arkansas, *Water policy.

As Arkansas' population grows and places new demands on finite resources, the need for effective resource management becomes increasingly critical. Decline of surface water and groundwater quality, depletion of groundwater supplied, pollution and hazardous waste disposals, and lack of coordination of water responsibilities among government agencies are all increasingly critical issues in Arkansas. A State Water Policy Task Force recommended that there be: (1) a Water Resources Council to monitor water policy implementation; (2) coordination with federal funding sources to serve community needs efficiently; (3) regional water supply systems; (4) use of Corps of Engineers lakes and natural impoundments; (5) water conservation; (6) monitoring of water quality of the Arkansas River to correct problems related to river disinfection; (7) a rate structure for new water systems that supports the project's operation and maintenance; (8) a permanent water operator training section in the Department of Health's training and licensing program; (9) routine and emergency well drilling permitted only after a community acquires a description of local aquifers from the Arkansas Geological Commission; (10) more groundwater studies; (11) legislation to give the state authority over surplus waters of the state and make decisions about interbasin transfers; (12) indepth studies of Arkansas water law. Additional recommendations were made regarding the quality of surface water, toxic and hazardous wastes, thermal discharge by industry, floodplain management, wetlands, stream preservation, and non-consumptive uses including transportation, recreation, and energy production. (Garrison-Omniplan)
W82-00715

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING: JORDAN RIVER BASIN, UTAH.
Federal Energy Regulatory Commission, Washington, D.C. Office of Electric Power Regulation.
Report FERC-0084, August 1981. 70 p, 8 Fig, 18 Tab, 1 Append.

Descriptors: *Hydroelectric plants, *Water resources development, *River basin development, *Water demand, Diversion, Licensing, Municipal water, Irrigation water, Water supply, Jordan River basin, *Utah.

The Jordan River basin covers approximately 3,450 sq mi in north central Utah, and extends southeasterly from the Great Salt Lake for about 86 mi. Mean annual precipitation varies from 10 in. in the valley to over 35 in. in the high Wasatch Mountains. Water is a scarce commodity in the basin and stream flows are heavily regulated. Flows are diverted to the Jordan River basin for irrigation, municipal and industrial purposes. There are 26,550 kw of installed hydroelectric capacity in the basin in 14 plants, but the dependable capacity is very low as each is subject to flow reduction due to a lack of water during the dry season and irrigation diversions. Over half of the capacity is in the Olmsted project and in the Deer Creek plant. The Olmsted project is the largest hydroelectric plant in the basin and is presently the subject of an application for a major license. Two competing applications have also been filed. The applications are similar in that each proposes to continue project operation as in the past and none proposes significant modicications. Power generation may ultimately yield to water supply in the use of the Olmsted project flows. After development of the Jordanelle Reservoir, other Bonneville Unit features, and increased demands in the Salt Lake City metropolitan area, the flow regime which provides water to the Olmsted project will change. It is expected that high winter flows to the project will be stored upstream. It is estimated that the Olmsted project can continue to operate for 20 years before its flow is reduced for water supply purposes to

the point where continued project operation becomes infeasible. (Moore-SRC)
W82-00736

STATE WATER USE AND SOCIOECONOMIC DATA RELATED TO THE SECOND NATIONAL WATER ASSESSMENT,
Oak Ridge National Lab. TN.
A. D. Shepherd, M. E. Hodgson, J. Stewart, and K. A. Hake.
Water Resources Council Report, October 1980. 154 p, 8 Fig, 34 Tab, 30 Ref, 4 Append.

Descriptors: *Water use, *Water supply, *Water demand, *Social aspects, *Economic aspects, Public policy, Agriculture, Steam generation, Industrial water, Domestic water, Prediction.

Data generated in the Second National Water Assessment was organized by 106 hydrologically oriented Assessment Subregions (ASR's). The ASR data have been converted to state boundaries to make them more suitable for use in state and federal policy analysis. The converted Second Assessment projections of water-use and related socioeconomic data are presented by state. Water use is divided into six functional areas, agriculture, steam electric, manufacturing, domestic, minerals, and commercial, in decreasing order of volume in 1975. In 2000 the order will be the same but for reversion of manufacturing and domestic. Manufacturing is the only sector to show a decline in use. Total consumption is predicted to increase about 26% by 2000, to a daily total consumption of 133015 mgd. (Brambley-SRC)
W82-00739

LONG DISTANCE MASS TRANSFER OF WATER,
Biswas and Associates, Oxford (England).
A. K. Biswas.
Water Supply and Management, Vol 5, No 3, p 245-251, 1981. 5 Ref.

Descriptors: *Water transport, *Water supply development, *Water transfer, Conveyance structures, Water demand, Water resources development, Water allocation, Resource allocation.

Water use per capita has been increasing worldwide as the standard of living rises. The large scale artificial mass transfer of water from a water surplus region to a water deficient region in order to further the economic development of the latter is an important fact of modern life. A comprehensive assessment of available water resources, both surface and ground, must be made before entering into long distance transport. A second important consideration is the assessment of water demands for various purposes. Efficiency of water use is the third important consideration. Significant improvements could be made in the agriculture use of water, as it is sometimes extremely inefficient. The North American Water and Power Alliance has offered a program for mass transfer of water. The plan calls for the collection of surplus water from the high precipitation areas in northwestern North America and its distribution to water-scarce areas of Canada, the US and Mexico. A series of dams and power stations in Alaska and northern British Columbia would collect water and provide power to pump it up to the Rocky Mountain Trench Reservoir in southeastern British Columbia. Here the water would be lifted by pumps to the Sawtooth Reservoir in Central Idaho. From there it would flow by gravity to the western US. (Baker-FRC)
W82-00858

STATE OF WASHINGTON WATER QUALITY ASSESSMENT REPORT 1980.
Washington State Dept. of Ecology, Olympia.
For primary bibliographic entry see Field 6E.
W82-01067

6E. Water Law and Institutions

THE WATERWAY THAT CANNOT BE STOPPED,
R. J. Smith.
Science, Vol 213, No 4509, p 741-742, 744, August 14, 1981.

Descriptors: *Inland waterways, *Water transport, *Costs, *Construction, Tennessee River, Tombigbee River, Canals, Water policy, Water resources development, Judicial decisions, Legislation, Regulations, Political aspects, *Legal aspects, Economic aspects, Mississippi River, Governmental interrelations, Waterways, Channel improvement, Corps of Engineers, Water quality, Erosion, *Tennessee-Tombigbee waterway.

Construction of the Tennessee-Tombigbee waterway, now over half complete, has been challenged by Congress and court suits as too costly for the expected benefits. Congress is almost evenly divided on the issue of terminating the project, which has cost $1 billion thus far, and suffering embarassment or continuing it at costs of several more billion dollars and producing a waterway with questionable ability to save time and money in shipping. There are many hidden costs in the project--fish and wildlife impact, improvements to the Tombigbee River to remove bottlenecks, replacement of highways and bridges, and construction of facilities in the port of Mobile. A hurdle which may stop the project is the July 15 ruling that the Corps of Engineers had violated the National Environmental Policy Act and its own regulations by not preparing an impact statement showing that water quality, land erosion, and water stagnation problems would result. (Cassar-FRC)
W82-00510

THE TOXIC WASTE DUMP PROBLEM AND A SUGGESTED INSURANCE PROGRAM,
State Univ. of New York Coll. at Fredonia. Dept. of Economics.
For primary bibliographic entry see Field 5E.
W82-00591

GROUNDWATER STRATEGIES,
For primary bibliographic entry see Field 5G.
W82-00620

THE CONTROL OF BACTERIAL POLLUTION CAUSED BY SEA DISCHARGES OF SEWAGE,
Wessex Water Authority (England).
For primary bibliographic entry see Field 5D.
W82-00699

THE DESIGN AND INTERPRETATION OF MARINE POLLUTION SURVEYS,
Clyde River Purification Board (Scotland).
D. Hammerton, A. J. Newton, and T. M. Leatherland.
Water Pollution Control, Vol 80, No 2, p 189-203, 1981. 1 Tab, 23 Ref.

Descriptors: *Pollution control, *Estuarine environment, Surveys, *Scotland, River Clyde, Coasts, Estuaries, Wastewater pollution, Heavy metals, Industrial wastes.

This paper reports on experience gained in marine pollution control in Scotland and in particular on the extensive studies carried out by the Clyde River Purification Board during the past fifteen years, approximately 1960-1975. Surveys were made of estuaries, coastal waters, bacteriological sampling conditions, outfalls, and spcial techniques used in monitoring studies. Detailed accounts are offered of the Irvine Bay survey. This area has become the target of major urban and industrial development, with the result that significantly greater lodings of domestic and industrial effluents now enter the bay. Pollution from the land included suspended solids and heavy loadings of nitrogen, phosphate, chromium, zinc, cadmium, and synthetic detergents, along with dieldrin, aldrin and BHC. Silicates, manganese,nickel, mercury and DDT were also identified. The impact was naturally dependent on the mixing processes operating in the receiving waters. Pollution levels were analyzed on the beaches, in the sea water, in sediments, and in samples of biota. Monitoring programs were established. (Baker-FRC)
W82-00700

GREAT LAKES INTERNATIONAL SURVEILLANCE PLAN,
International Joint Commission-United States and Canada, Windsor (Ontario). Great Lakes Water Quality Board.
November 1980. 522 p, 85 Fig, 92 Tab, 44 Ref, 3 Append.

Descriptors: *Lakes, *Comprehensive planning, *International agreements, *Water quality standards, *Water quality management, *Data collection, Water quality control, Hydrologic data collections, Pollution load, Pollution control, Eutrophic lakes, Eutrophication, Tributaries, Pollution abatement, *Great Lakes.

Numerous agencies in Canada and the United States are responsible for determining the effectiveness of the Great Lakes' point source pollution abatement programs and the impacts of man's activities on the Lakes' ecosystem. The Great Lakes International Surveillance Plan, which presents the basic framework for surveillance activities in the Great Lakes basin as required by the 1978 Water Quality Agreement between the United States and Canada, was developed by the Surveillance Subcommittee over several years. The Surveillance Plan is a long-term strategy to coordinate the monitoring activities of the participating agencies in a cost-effective manner. It is characterized by quality assurance programs and the rapid exchange of comparable data among the various jurisdictions. Excessive inputs of nutrients and toxic substances have been and continue to be viewed with concern. The use of pesticides and toxic industrial compounds has, in many cases, been severely restricted or abolished. Further preventive measures aimed at screening new compounds and handling hazardous materials are being taken. This six-part document describes the overall plan in Section I, and the plan for each specific lake in Sections II through VI. Among the topics covered in each section are environmental Issues, Tributary Surveillance, Point Sources, Atmospheric Inputs, Connecting Channels, Nearshore Surveillance, Water Intakes, Public Perceptions, Beach Monitoring, Levels and Trends in Open Lake Waters, Fish and Wildlife Contaminants, Radioactivity, and Data Quality. (Garrison-Omniplan)
W82-00701

PHOSPHORUS MANAGEMENT FOR THE GREAT LAKES: FINAL REPORT OF THE PHOSPHORUS MANAGEMENT STRATEGIES TASK FORCE,
International Joint Commission-United States and Canada, Windsor (Ontario).
July, 1980. 129 p, 6 Fig, 9 Tab, 97 Ref, 2 Append.

Descriptors: *Lakes, *Water quality, *Phosphorus removal, *Chemical wastes, *Phosphates, Mathematical studies, Wastewater treatment, Data collection, Ecosystems, Aquatic populations, Phosphorus compounds, International commissions, International agreements, *Great Lakes basin.

By signing the 1978 Great Lakes Water Quality Agreement, the United States and Canada reaffirmed their intentions to restore and maintain the chemical, physical, and biological integrity of the Great Lakes basin ecosystem. As part of this agreement, the parties established tentative total phosphorus target loads. If these loads are confirmed by the State and Provincial Governments, they will be used as a basis for load allocations and compliance schedules for the two countries. To verify target loads and estimate lake responses to changes in phosphorus loads, various mathematical models were used. Using these data, the report suggests that improvements are needed in the estimates from point sources and tributaries, and in the methods of reporting the data. The strategies listed for assessing social and economic impacts of phosphorus control measures include regular collec-

tions of data on municipal and industrial water supplies, hydropower generation, property values, recreational use, and waterfowl habitat; establishing an Advisory Committee to provide program input and a coordinated mechanism between the U.S. and Canada to develop a comprehensive design system; and developing a social profile to record knowledge, beliefs, media reports, and leadership of the public involved. A staged-approach phosphorus management program is also outlined. (Garrison-Omniplan)
W82-00702

WATER - ITS USE AND THE IMPLICATIONS FOR ARKANSAS AGRICULTURE.
For primary bibliographic entry see Field 6D.
W82-00714

EXECUTIVE SUMMARY; LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POTENTIAL IN THE SEVEN MID-WESTERN STATES.
Franklin Pierce Law Center, Concord, NH.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/RA/04934-08, Price codes: A05 in paper copy, A01 in microfiche. Department of Energy Report DOE/RA/04934-08, May, 1980. 92 p.

Descriptors: *Water rights, *Hydroelectric plants, *Riparian rights, *Dams, *Legal aspects, Regulations, State jurisdiction, Federal jurisdiction, Navigable waters, Liability, Taxes, *Midwestern States, Illinois, Indiana, Kentucky, Michigan, Ohio, West Virginia, Wisconsin.

The relationship of federal law and regulation to state law and regulation of small scale hydroelectric facilities was determined for Illinois, Indiana, Kentucky, Michigan, Ohio, West Virginia and Wisconsin. Of these, Illinois, Kentucky, Michigan, West Virginia, and Wisconsin follow the riparian theory of law. In Indiana, the title of abutting land owners on non-navigable watercourses extends to the center of the watercourse. On navigable waters, title to the bed is vested in the state. In Ohio, the title of abutting land owners on both navigable and non-navigable watercourses extends to the middle of the watercourse and includes the subaqueous soil. Direct and indirect regulation, taxation, liability, and the availability of loans are also covered for each state. For each of the seven mid-western states, a flow diagram of regulations for small dams is provided. Federalism permits both the federal government and the state government to regulate and license certain aspects of a developer's project. Principles of federalism often support a finding that the federal regulation in question will be superior to comparable state regulation, divesting the state of regulatory authority in a given area. (Moore-SRC)
W82-00718

LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POTENTIAL IN ILLINOIS.
Franklin Pierce Law Center, Concord, NH.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/RA/04934-09, Price codes: A05 in paper copy, A01 in microfiche. Department of Energy Report DOE/RA/04934-09, May, 1980. 80 p, 95 Ref.

Descriptors: *Hydroelectric plants, *Dams, *Legal aspects, *Water law, Riparian rights, Dam failure, Flood damage, Jurisdiction, Regulations, Liability, Utilities, Taxes, Natural flow doctrine, *Illinois.

Illinois follows the riparian theory of water law, so that the right to utilize the flowing water at a proposed site is dependent upon the acquisition of property interests in the abutting land on both sides of the waterway, and the title to the stream bed. The title to all navigable lakes and bodies of water is vested in the state. In Illinois, to be navigable, a stream must furnish a common passage capable of carrying commerce of practical utility to the public. Use of the water is governed by the natural flow doctrine, tempered by allowing for a reasonable use of the water. A dam owner may be held liable for all damage which results from dam breach or backflooding, unless it was caused by a reasonably unforseeable act of God. Hydroelectric dams are not directly regulated by the state of Illinois as individual entities, but the state regulates the construction and operation of dams in general, and all public utilities are regulated. In addition, municipalities, water districts, and counties also have certain powers over the use of water and watercourses within their jurisdiction. There are many other agencies and regulations which may, in certain circumstances, affect or be of interest to small scale hydroelectric development. Financial considerations in development in Illinois include: property taxes, real estate transfer tax, public utilities tax, corporate franchise tax, corporate income tax, and financial assistance programs. (Moore-SRC)
W82-00719

LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POWER IN RHODE ISLAND.
Franklin Pierce Law Center, Concord, NH.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/RA/04934-11, Price codes: A04 in paper copy, A01 in microfiche. Department of Energy Report DOE/RA/04934-11, May, 1980. 49 p, 83 Ref.

Descriptors: *Hydroelectric plants, *Dams, *Legal aspects, *Water law, Taxes, Construction, Riparian law, Licensing, Wetlands, Utilities, *Rhode Island.

Rhode Island appears to follow the reasonable use theory of reparian law. Title to the bed of a stream turns upon a determination of whether or not the stream is navigable. Navigable streams in Rhode Island are limited to those which are subject to the ebb and flow of the tide. If a stream is navigable, title to the bed is held by the state. Under the Mill Dam Act, a riparian proprietor is entitled to construct a dam for the purpose of generating power. There are no Rhode Island cases that address liability for dam breach. The Department of Environmental Management (DEM) is the most significant administrative agency with regard to dam construction, alteration and operation in the state. DEM approves all plans and specifications for the construction or substantial alteration of dams and reservoirs. Since DEM is the central administrative agency with respect to these statutes, the consequence has been an essentially one-stop licensing procedure. Wetlands, historic sites and archaeological resources are protected in Rhode Island. The Public Utilities Commission is vested with the judicial attributes of ratemaking and regulation, while the Division of Public Utilities and Carriers handles the remaining administrative functions. The extensive regulation of public utilities presents a significant cost to the developer. Owners and developers of dams will be required to pay property taxes based on the full and fair cash value of the dam, dam site, and machinery used to operate the dam. (Moore-SRC)
W82-00720

LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POWER IN NEW HAMPSHIRE.
Franklin Pierce Law Center, Concord, NH.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/RA-04934-12, Price codes: A03 in paper copy, A01 in microfiche. Department of Energy Report DOE/RA/04934-12, May 1980. 48 p, 100 Ref.

Descriptors: *Hydroelectric plants, *Legal aspects, *Water law, *Dams, Riparian rights, Regulations, Construction, Fish ladders, Eminent domain, Permits, Assessments, *New Hampshire.

The regulatory system for construction and operation of low-head hydroelectric dams in New Hampshire is comparatively simple. Provided the developer avails himself of the 5 megawatts exemption, his main regulatory agency will be the Water Resources Board. The developer must acquire both river banks, the river bed and the land needed for the impoundment. Methods of acquisition include eminent domain and the Mill Dam Act. In New Hampshire, it is the set of common law principles of riparianism that will determine the developer's rights in the water. The developer contemplating the construction of a dam with a developed output capacity of not more than 5 megawatt is exempt from all rules, regulations and statutes applying to public utilities. Exemption results in avoidance of a complex and costly regulatory process. Alterations to the watercourse require a permit from the special board. In addition the placement of the dam may constitute an obstruction in the watercourse, requiring a determination of the need for a fishladder. Once construction is complete and the dam is operational, the entity will be subject to investigations, inspections, rate setting, and liability that will span the life of the dam. There does not appear to be any rigid formula which can be used to arrive at the full and true value of a hydroelectric facility for tax assessment purposes. (Moore-SRC)
W82-00721

STATE WATER USE AND SOCIOECONOMIC DATA RELATED TO THE SECOND NATIONAL WATER ASSESSMENT.
Oak Ridge National Lab. TN.
For primary bibliographic entry see Field 6D.
W82-00739

LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POWER IN NEW JERSEY.
Franklin Pierce Law Center, Concord, NH.
Department of Energy Report DOE/RA/04934-16, May 1980. 73 p, 1 Fig, 84 Ref, 4 Append.

Descriptors: *Hydroelectric power, *Institutional constraints, *Legal aspects, *Regulations, Economic aspects, Legislation, Taxes, Utilities, Dams, State jurisdiction, *New Jersey, Water rights, Permits.

The state laws and regulations affecting hydroelectric power development are reviewed in the context of Federal regulations and the power of the Federal government to pre-empt state regulations. The Public Utility Regulatory Policies Act of 1978 is expected to remove some hydroelectric projects from Federal jurisdication, and also from state law. New Jersey follows the riparian theory of water law, but the rights to use of the water seem to follow both the natural flow theory and the reasonable use theory. There is no Mill Dam act but common law generally affords the same protection. Only in the case of negligence will a dam owner be held liable for damage resulting from a breach. Once a developer has obtained the requisite property rights, a dam construction permit must be obtained from the Division of Water Resources within the Department of Environmental Protection, although this requirement may be waived in certain circumstances. Small-scale hydro projects are subject to the Department of Energy and the Board of Public Utilities, which regulates the finances and sets rates for public utilities. Projects may be affected indirectly by other regulations of the Department of Environmental Protection. The Delaware River Basin Commission has jurisdiction over hydroelectric development within the basin, and issues permits for development. Small-scale hydro projects are subject to franchise, excise, gross receipts and local real estate taxes, but are eligible for loans from the New Jersey Economic Development Authority. (Brambley-SRC)
W82-00742

SUMMARY OF THE MID-ATLANTIC CONFERENCE ON SMALL-SCALE HYDROPOWER IN THE MID-ATLANTIC STATES: RESOLUTION OF THE BARRIERS IMPEDING ITS DEVELOPMENT.
Franklin Pierce Law Center, Concord, NH.
Department of Energy Report DOE/RA/04934-04, May 1980. 95 p, 6 Append.

Descriptors: *Hydroelectric power, *Legal aspects, *Institutional constraints, *Economic aspects, Financing, Licensing, Investment, Jurisdiction, Taxes, *Mid-Atlantic States.

Legal and institutional obstacles and the lack of rational incentives for development are considered to be the major impediments to small scale hydroelectric development at this time. One of the major problems in financing a project is the negative cash flow shown for the pre-operating and early operating stages of the project. Ways to make hydroelectric projects more attractive to a developer and potential investors include: allowing a shorter amortization period; increasing the investment tax credit to 20%; and allowing investment tax credit for environmental enhancement devices. There is a need for a simplified and expeditious licensing process by state regulatory agencies. The lead agency concept is preferable to other methods if one permit form could be developed, and all other state agencies make full and significant contributions. One-stop licensing created permit delay, and states using the one-stop procedure had problems in implementing the process. The importance of identifying the interests of all parties affected by small scale hydro development was underscored in view of the time delays occasioned by litigation and administrative mediation of disputes. Federal incentives to small scale hydro development are financial, including feasibility grants, construction grants, low-interest loans and investment tax credits. It is proposed that the federal jurisdiction over small scale hydro be delegated to the states. (Moore-SRC)
W82-00743

LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POWER IN VIRGINIA,
Franklin Pierce Center, Concord, NH.
Department of Energy Report DOE/RA/04934-15, May 1980. 50 p, 1 Fig, 43 Ref.

Descriptors: *Hydroelectric power, *Institutional constraints, *Legal aspects, *Regulations, Legislation, Economic aspects, Taxes, State jurisdiction, Riparian rights, Utilities, Dams, Licenses, *Virginia.

The state laws and regulations affecting hydroelectric power development are reviewed in the context of Federal regulations and the power of the Federal government to pre-empt state regulations. The Public Utility Regulatory Policies Act of 1978 is expected to remove some hydroelectric projects from Federal jurisdiction, and also from state law. The theory of riparian rights follwed in Virginia is one of reasonable use, to the mean low-water mark on navigable waters. The Milldam Act allows a riparian owner to build a dam across non-navigable waters. Only public utilities may use the power of eminent domain. Before constructing a dam for hydroelectric power generation, a developer must obtain a license from the State Corporation Commission, and if the developer is a public utility, a certificate of convenience and necessity. Public utilities are subject to the Commission for rate setting. Numerous state regulations have an indirect impact on hydroelectric power projects because of the impact of the project on the environment, as do the Potomac River Basin Compact, the Ohio River Valley Water Sanitation Commission, and the Ohio River Basin Commission. A negligence theory has been followed, but there is a trend toward use of the strict liability theory for dam breaches. Taxing of a small-scale hydroelectric project depends on its classification as a public service corporation or as a private business enterprise. Financial incentives include the availability of loans from the division of Industrial Development and the Virginia Industrial Building Authority. (Brambley-SRC)
W82-00744

LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POWER IN MARYLAND.
Franklin Pierce Law Center, Concord, NH.
Department of Energy Report DOE/RA/04934-18, May 1980. 68 p, 1 Fig, 79 Ref.

Descriptors: *Hydroelectric power, *Institutional constraints, *Legal aspects, *Regulations, State jurisdiction, Utilities, Water rights, Economic aspects, Taxes, Planning, Dams, Legislation, *Maryland.

The state laws and regulations affecting hydroelectric power development are reviewed in the context of Federal regulations and the power of the Federal government to pre-empt state regulations. The Public Utility Regulatory Policies Act of 1978 is expected to remove some hydroelectric projects from Federal jurisdiction and also from state law. In Maryland title to all navigable waters and to the soil below the high-water mark is vested in the state, but owners of adjoining land have riparian rights. Riparian rights extend to the center of a non-navigable stream. There is no public trust doctrine but the power of eminent domain may be used to obtain land for public use. Hydroelectric plants are regulated and supervised by the Public Service Commission and the Department of Natural Resources. These agencies are required to conduct long range studies of power plant sites and estimate future electric power demand. Hydroelectric power development may be affected by subagencies of the Department of Natural Resources through its regulations concerning wetlands, flood control, sediment and erosion control, pollution control and abatement, scenic and wild rivers, and archeological protection. The Public Service Commission sets rates for public utilities. There is no Mill Dam Act, and the theory of strict liability is used in cases involving breaches of dams. Hydroelectric projects are eligible for loans from the Department of Economic and Community Development, and subject to gross receipts, sales, use, real and personal property taxes. The Potomac River Basin Commission and the Susquehanna River Basin Commission are the two interstate compacts affecting Maryland's waters. (Brambley-SRC)
W82-00745

LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POTENTIAL IN WISCONSIN.
Franklin Pierce Law Center, Concord, NH.
Department of Energy Report DOE/RA/04934-19, May 1980. 78 p, 1 Fig, 53 Ref.

Descriptors: *Hydroelectric power, *Institutional constraints, *Legal aspects, *Regulations, Economic aspects, Legislation, Water rights, Utilities, Taxes, Dams, *Wisconsin.

The state laws and regulations affecting hydroelectric power development are reviewed in the context of Federal regulations and the power of the Federal government to pre-empt state regulations. The Public Utility Regulatory Policies Act of 1978 is expected to remove some hydroelectric projects from Federal jurisdiction and also from state law. In Wisconsin a riparian owner owns to the middle of the bed of both navigable and non-navigable streams although on navigable streams the title is subject to the public right of navigation. Riparian owners have a right to reasonable use of the water, and dam owners are subject to the neglience theory in cases of damage resulting from dam breaches. The Department of Natural Resources regulates hydroelectric projects through 6 District offices which are responsible for all environmental concerns, and the Public Service Commission sets rates and supervises the financial affairs of those projects designated public utilities. Small scale hydroelectric projects are subject to municipal and county zoning powers, and may be affected by environmental regulations, the Public Intervenor's office, historic preservation orders, and Regional Planning Commissions. Hydroelectric projects are subject to property, income, franchise, corporate organization, gross revenue, sales, and use taxes depending upon their designation as public utilities. Financial assistance may be obtained from Industrial Development Agencies or municipalities through the Promotion of Industry Act. (Brambley-SRC)
W82-00746

A CASE STUDY ANALYSIS OF THE LEGAL AND INSTITUTIONAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF THE HYDROLELECTRIC POWER OF THE BOARDMAN RIVER AT TRAVERSE CITY, MICHIGAN.
Franklin Pierce Law Center, Concord, NH.
Department of Energy Report DOE/RA/04934-33, May 1980. 149 p, 83 Ref. 3 Append.

Descriptors: *Hydroelectric plants, *Legal aspects, *Institutional constraints, *Economic aspects, *Dams, Regulations, Public opinion, Fish ladders, Cost analysis, Financial feasibility, *Michigan.

In order to meet the need for expanded power sources, the Boardman River is being considered by Traverse City and surrounding Grand Traverse County as a hydroelectric generating resource. Development of the Boardman River would occur at five dam sites: two existing dams previously generated hydroelectricity, as did a third before being washed out; one has never been used for generation, and the fifth is presently supplying power. A lack of public awareness of hydroelectric potential may be a barrier to hydroelectric development. Developers, particularly new developers such as the joint venture participants in this study, have a vital need for complete and reliable information about any intended hydroelectric development. When, as here, the developers experience substantial difficulty in becoming informed about what data is needed and how to obtain it, the project may incur substantial delay, opposition, and cost. If fish ladders are required for the dams in this system, the cost of the project will increase appreciably. In view of the perceived intensity of local public opposition to installation of the ladders, it is unlikely that development will be pursued if ladders are required. Inadequate legislative guidelines for review of hydroelectric projects in Michigan may produce permitting delays, licensing conditions and other impediments. Incentives to hydroelectric development in this case include: the feasibility grant program, the Michigan Energy Employment Act, municipal developer advantages, and the advantages of using existing dams. (Moore-SRC)
W82-00747

LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POWER IN INDIANA.
Franklin Pierce Law Center, Concord, NH.
Department of Energy Report DOE/RA/04934-27, May 1980. 65 p, 102 Ref.

Descriptors: *Hydroelectric plants, *Legal aspects, *Water rights, *Dams, Reasonable use, Riparian rights, Liability, Economic aspects, Taxes, Utilities, *Indiana.

Indiana law follows the doctrine of riparianism. On navigable waters, a riparian only has title to the high water mark of the stream; title to the bed is vested in the state. Navigability is determined by the navigable in fact test. Indiana now follows the reasonable use doctrine. The right to use water may be gained by prescription. Both a Mill Dam Act and the power of eminent domain can be used to appropriate private property. There is confusion as to the liability of a dam owner for dam breach. The Division of Water issues construction permits for dams, except dams draining less than one square mile, less than 20 ft high, with less than 100 acre feet of water impounded. The Division of Fish and Wildlife may require a downstream minimum flow, fish ladders, and small boat passages under certain circumstances. The Division of Lakes and Streams has jurisdiction over lake levels of all public water lakes. Indirect regulation includes: environmental regulation; nature preserves; natural and scenic rivers; historic preservation; soil and water conservation; river valley compacts and river basin commissions; and municipal regulations. The Public Service Commission is an administrative board which regulates public utilities operating within the state. With the exception of municipal utilities, no power utility may operate in any municipality where a public utility is providing a similar service without obtaining a certificate of public convenience and necessity from the Commission. In Indiana, public utilities are not taxed much differently than private business enterprises. There is little incentive for hydroelectric development through state loans and funding. (Moore-SRC)
W82-00748

LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POWER IN OHIO.
Franklin Pierce Law Center, Concord, NH.
Department of Energy Report DOE/RA/04934-26, May 1980. 82 p, 111 Ref.

Descriptors: *Hydroelectric plants, *Dams, *Legal aspects, *Water rights, Eminent domain, Riparian rights, Economic aspects, Liability, Regulations, Natural flow doctrine, Reasonable use, *Ohio.

The title of abutting land owners on both navigable and non-navigable streams extends to the middle of a stream and includes the subaqueous soil. If the stream is classified as navigable, title and ownership is subject to the public right of navigation. A river is classified as navigable based upon its capacity for use in transportation and commerce. The Ohio courts have combined the theories of natural flow and reasonable use. Ohio gives the power to appropriate private property to any company organized for the purpose of erecting or building dams across rivers or streams to raise and maintain a head of water for the generation of electricity. Giving an electric company the power of eminent domain greatly reduces the legal barriers to developing small scale hydroelectric power. A defendant is liable for negligence for the breach of his dam, but is strictly liable for water percolation and seepage, regardless of negligence. No dam may be constructed unless a permit has been issued by the Chief of the Division of Water, or the dam is exempt from a construction permit. A major utility facility cannot be constructed unless a developer has first obtained a certificate from the Power Siting Commission. Dam developers may also be subject to regulations regarding water pollution control, conservancy districts, watershed districts, and zoning. Indirect considerations include: endangered species; wild, scenic and recreational rivers; natural resources; historic preservation, Great Lakes Compact; Ohio River Sanitation Compact; Sanitary Districts; and the removal of mill dams. Small scale hydroelectric will be taxed as a public utility if it is classified as a public utility; otherwise it will be taxed as a private business enterprise. Loans may be available from the Department of Energy, the Ohio Development Financing Commission, or the Ohio Water Development Authority. (Moore-SRC)
W82-00749

ANALYSIS OF LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF LOW-HEAD HYDROELECTRIC POWER IN MAINE.
Franklin Pierce Law Center, Concord, NH.
Department of Energy Report DOE/RA/04934-20, May 1980. 69 p, 1 Fig, 81 Ref.

Descriptors: *Hydroelectric power, *Hydroelectric plants, *Legal aspects, *Regulations, Dam construction, Water rights, State jurisdiction, Inspection, Taxes, Economic aspects, *Maine.

The purpose of this paper is to guide the developer of low-head hydroelectric dam construction and operation through the de facto regulatory system as it exists in Maine. Maine follows the riparian theory of water rights, so a developer must obtain rights to both river banks, by sale, lease, or use of the abandoned dam law or Mill Dam Act. These rights are subject to the public trust doctrine. It is suggested that the developer start the regulatory process with the Public Utilities Commission, which supervises power plants of more than 1,000 kw, and which will issue a certificate of public convenience and necessity. The Board of Environmental Protection must next give approval, and if the development is to be in an unorganized or deorganized township, a certificate is required from the Land Use Regulation Commission. Notice must be filed with the Department of Inland Fish and Wildlife or the Department of Marine Resources, as appropriate. Stream alteration, coastal wetlands, or great ponds permits are then required, before construction starts. Once the project is built it is subject to inspections and regulations by these agencies. Taxes are assessed by local assessors for property tax purposes. Financial assistance is available from the Office of Energy Resources, and technical assistance from the State Development Office. It is suggested that a one-step procedure be developed within the Board of Environmental Protection to simplify the regulatory process. (Brambley-SRC)
W82-00750

A CASE STUDY ANALYSIS OF LEGAL AND INSTITUTIONAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF THE HYDROELECTRIC POTENTIAL AT GOOSE RIVER, MAINE.
Franklin Pierce Law Center, Concord, NH.
Department of Energy Report DOE/RA/04934-32, May 1980. 85 p, 62 Ref.

Descriptors: *Hydroelectric plants, *Legal aspects, *Institutional constraints, *Dams, *Economic aspects, Water level fluctuations, Reservoirs, Regulations, Site selection, Environmental effects, Public participation, *Goose River, Maine.

The Goose River hydroelectric project is located on the Goose River in Maine, which flows from Swan Lake in the Town of Swanville through the city of Belfast to the sea. The project comprises a five dam system. A private developer proposes to use the 7,500 acre-feet of storage capacity of Swan Lake to run the four downstream power stations, generating 430 KW of total capacity which could then be sold to Central Maine Power. The impact of federal regulation on the project has been relatively minor. The Town of Swanville has intervened in the federal licensing process to express its concern regarding fluctuations in the level of Swan Lake. The Public Utilities Regulatory Policies Act (PURPA) mandate has not been significant because the purchasing utility has a history of small power purchases. Maine has two specific regulatory systems which produce a de facto regulatory system for small dams: a water management system and an energy regulatory system. The development of the Goose River Project has capitalized on the nonspecific nature of the regulatory system, bypassing most of the system by use of statutory exemptions and an artful selection of the project site. The process selected for resolving the lake level issue and its subsequent environmental effects is that of environmental mediation. Its primary advantage is the avoidance of a costly resolution through the courts. The Goose River Project is expected to show a profit for tax purposes in each year of operation. (Moore-SRC(
W82-00751

LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POWER IN PENNSYLVANIA.
Franklin Pierce Law Center, Concord, NH.
Department of Energy Report DOE/RA/04934-17, May 1980. 67 p, 179 Ref.

Descriptors: *Hydroelectric plants, *Legal aspects, *Dams, *Water rights, Riparian rights, Dam construction, Utilities, Regulations, Taxes, Financial aspects, *Pennsylvania.

There are three methods by which rights in water may be acquired in Pennsylvania: riparian ownership, prescription, and condemnation. A conbination of the riparian doctrines of natural flow and reasonable use is used to determine the rights of riparian owners. The right to use water of any watercourse other than a navigable stream may be acquired by prescriptive rights, which are absolute and exclusive. Streams and rivers are held to be navigable in law if they are used as public traderoutes. Title to the beds of navigable rivers and lakes is held by the Commonwealth in trust for the public. The Commonwealth may grant title to the beds of navigable streams to private persons, subject to the public trust and public rights. The Public Utility Commission and the Department of Environmental Resources directly regulate dam construction and hydroelectric power production and distribution. The power of eminent domain is limited to those public utilities which have been granted a certificate of public convenience by the Public Utility Commission. Virtually all existing environmental control authority is exercised exclusively by the Department of Environmental Resources. Indirect regulation by the state is in the form of zoning, historic preservation, the Scenic Rivers Act, water pollution control, and river basin commissions. Hydroelectric developers are subject to a multitude of taxes and fees both prior to and after the hydro facility is operating. (Moore-SRC)
W82-00752

LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POWER IN WEST VIRGINIA.
Franklin Pierce Law Center, Concord, NH.
Department of Energy Report DOE/RA/04934-22, May 1980. 126 p, 1 Fig, 66 Ref, 3 Append.

Descriptors: *Hydroelectric power, *Institutional constraints, *Legal aspects, *Regulations, Water rights, Taxes, Utilities, Permits, State jurisdiction, Dams, *West Virginia.

The state laws and regulations affecting hydroelectric power development are reviewed in the context of Federal regulations and the power of the Federal government to pre-empt state regulations. The Public Utility Regulatory Policies Act of 1978 is expected to remove some hydroelectric projects from Federal jurisdiction, and also from state law. West Virginia follows the riparian theory of water law and reasonable use of the water by the riparian owner. There is no Mill Dam Act and it is not clear whether a hydroelectric development has power of eminent domain. A small-scale hydroelectric project developer must obtain approval from the Department of Natural Resources, specifically from the Coal Refuse and Dam Control Section. The Division of Fish and Game may require the construction of fish ladders. The Public Service Commission may require a certificate of public convenience and necessity, and will set rates upon completion. On some specified rivers, permits may be required under the Natural Streams Preservation Act. A state water quality certificate may be necessary. Indirect regulation may result from requirements for water pollution control, special districts, local and wetlands regulations, energy resources programs and historic preservation. After construction the project will be inspected on a continuing basis and the owner will be held liable under the negligence theory for breaches of the dam. Hydroelectric projects are subject to property, business and license taxes, and may be eligible for loans through industrial development agencies. The Potomac River Basin Compact, the Ohio River Valley Water Sanitation Commission and the Wheeling Creek Watershed Protection and Flood Prevention District Compact impact hydroelectric projects indirectly. (Brambley-SRC)
W82-00753

LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POWER IN NEW YORK.
Franklin Pierce Law Center, Concord, NH.
Department of Energy Report DOE/RA/04934-14, May 1980. 122 p, 1 Fig, 101 Ref.

Descriptors: *Hydroelectric power, *Institutional constraints, *Legal aspects, *Regulations, Permits, Economic aspects, Legislation, State jurisdiction, Water rights, Dams, Taxes, Utilities, *New York.

The state laws and regulations affecting hydroelectric power development are reviewed in the context of Federal regulations and the power of the Federal government to pre-empt state regulations. The Public Utility Regulatory Policies Act of 1978 is expected to remove some hydroelectric projects from Federal jurisdiction, and also from state law. In New York land may be obtained by purchase, lease or grant by the state, or by the use of the eminent domain power of the state. A reparian owner has rights to reasonable use and diversion of flow of the water. The Public Trust Doctrine allows the state to require permits to be obtained by small-scale hydro developers; such permits are issued by the Department of Environmental Conservation. The owner of a dam is responsible only for negligence if the dam is breached. All hydroelectric projects are subject to the State Environmental Quality Review Act and require either an

environmental impact statement or a negative declaration. The Public Service Commission regulates electric power facilities with respect to construction, finances and rates. Small-scale hydro projects are subject to consideration indirectly from a number of state agencies concerned with environmental protection and energy development, and five interstate compacts. Projects are subject to initial fees, income taxes, administrative expenses and real property taxes, and may obtain development funds from the state's Industrial Development Agencies. (Brambley-SRC)
W82-00754

LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POWER IN DELAWARE.
Franklin Pierce Law Center, Concord, NH.
Department of Energy Report DOE/RA/04934-13, May 1980. 108 p, 1 Fig, 75 Ref.

Descriptors: *Hydroelectric power, *Legal aspects, *Institutional constraints, *Regulations, Legislation, State jurisdiction, Water rights, Taxes, Economic aspects, Utilities, *Delaware.

The state laws and regulations affecting hydroelectric power development are reviewed in the context of Federal regulations and the power of the Federal government to pre-empt state regulations. The Public Utility Regulatory Policies Act of 1978 is expected to remove some hydroelectric projects from Federal jurisdiction, and also from state law. Delaware law recognizes riparian owners rights to reasonable use of water between high and low water marks of navigable rivers, with the state having rights to the river bed between low water marks. The Mill Dam Act implies that there is a reasonable use approach to non-navigable waters. The Public Service Commission regulates public utilities with respect to construction, operation, rate setting, and financial reporting. There is no general provision granting utilities the power of eminent domain. The Department of Natural Resources and Environmental Control is responsible for granting permits for small-scale hydro projects, and enforcing their provisions. These projects will be subject to review by the Delaware River Basin Commission, to local zoning regulations, to Soil and Water Conservation District regulations, and to the Coastal Zone Act. Small-scale hydro projects may be affected indirectly by plans of the Office of Management, Budget and Planning, the Delaware Energy Office, the State Conservation Plan, and historical site locations. Financial considerations include the payment of a license fee, gross receipts tax, real property tax, income taxes, franchise tax, and additional taxes, but projects may be eligible for loans when substantial employment opportunities may result. (Brambley-SRC)
W82-00755

FEDERAL PARTICIPATION IN LAND USE DECISION-MAKING AT THE WATER'S EDGE--FLOODPLAINS AND WETLANDS,
Economic Research Service, Washington, DC. Natural Resource Economics Div.
B. H. Holmes.
Natural Resources Lawyer, Vol 13, No 2, p 351-410, 1980. 338 Ref.

Descriptors: *Land use, *Wetlands, *Flood plains, Legal aspects, Decision making, Governmental interrelations, Water resources management, Local governments, Regulations, Legislation, Judicial decisions, Flood control, Water quality standards, Water pollution control, Nonstructural alternatives, Aquatic habitats, Flood insurance, Channel improvement, Dredging, Water law, Water policy, Coastal zone management.

Land use regulation, traditionally the prerogative of states and local governments, is increasingly a federal concern, particularly in the sphere of water resources. The National Environmental Policy Act and the Coastal Zone Management Act of 1972 are examples of the Congress' more recent attitudes toward protection of water resources. In the past the federal government has exerted control over shoreland land use through the statutes on navigable waters, over which it has jurisdiction. The Federal Water Pollution Control Act Amendments of 1972 provide one example of this. Judicial decisions have promoted the extension of federal control over land use as it affects water quality. Uses of flood plains are also controlled by the National Flood Insurance Act of 1968, the Flood Disaster Protection Act of 1973, other legislation, and executive orders. Flood control projects, assistance in flood plain management, disaster relief, and flood plain acquisition are means of implementing these laws and regulations. A unified national wetlands protection management program is emerging from the piecemeal and fragmented jurisdictions, involving many federal agencies. Wetlands preservation is currently carried out through wetlands acquisition, providing migratory bird habitats through the Water Bank Program, the Corps of Engineers permit policy for construction activities (including dredging), small watershed management (discouraging channel improvement), the National Environmental Policy Act, and the Endangered Species acts. (Cassar-FRC)
W82-00799

WATER QUALITY MANAGEMENT IN RIVER BASINS: US NATIONAL EXPERIENCE,
North Carolina Dept. of Natural Resources and Community Development, Raleigh.
N. S. Grigg, and G. H. Fleming.
Water Science and Technology, Vol 13, No 3, p 31-42, 1981. 18 Ref.

Descriptors: *Water quality control, *Regulations, *River basins, *Nonpoint pollution sources, Water management, Water policy, Water law, Water pollution control, Rivers, Effluent standards, Economic aspects, Cost effectiveness, Industrial wastes, Sewage charge, Urban runoff, Construction, Agriculture, Administrative agencies.

Since the 1970's the U.S. water quality management program has been a matter of debate between supporters of the regulatory approach and supporters of the economics-based approach. However, the great attention paid to wastewater dicharges has resulted in ignoring some of the major water quality problems non-point sources such as agriculture, storm water and construction. Water quality standards and effluent standards are used to determine the conditions of a dicharge permit (NPDES) for all dischargers. The U.S. regulatory system features uniform minimum requirements, no fee for discharge in permitted amounts, and non-transferability. A major criticism of the regulatory approach is the large amount of administrative effort required, some of which is misdirected or ineffective. However, it is unlikely that the economics-based approach could achieve the control now desired in the U.S. In its purest form the economic approach equates marginal costs and benefits. While eliminating much office work in determining effluent limitations, it would require much more field work to determine the possible damages from various discharges. The economic incentive approach charges an amount which induces dischargers to treat effluent to the limits that would achieve the water quality objective. In the United States, water quality management has passed the point where major improvements would result from modest regulatory actions. Future concerns are nonpoint sources and disposal of toxics, sludges and treatment residuals. (Cassar-FRC)
W82-00800

INTERSTATE CONFLICT OVER GROUND WATER: WISCONSIN-ILLINOIS,
Wisconsin Univ.-Oshkosh. Dept. of Geology.
C. W. Fetter, Jr.
Ground Water, Vol 19, No 2, p 201-213, March/April, 1981. 10 Fig, 6 Tab, 13 Ref.

Descriptors: *Computer models, *Aquifer management, *Groundwater depletion, Groundwater reservoirs, Groundwater management, *Wisconsin, *Illinois, Legal aspects, Interstate groundwater use.

A computer model of an aquifer system was used to model the drawdown effects resulting from pumpage in Illinois and Wisconsin as well as to predict the impact of different management plans on groundwater levels. The practical sustained yield from the Cambrian-Ordovician aquifer is 46 million gal/day in Illinois and 34 million gal/day in Wisconsin. Pumpage in Illinois has exceeded practical sustained yield every year since 1958, while practical sustained yield was reached in Wisconsin in 1975. Greater drawdown in the Chicago pumping cone has changed the regional hydraulic gradient, and 9.3 million gal/day of groundwater is currently being drained from beneath Wisconsin. Model results indicated that at the Illinois-Wisconsin border in 1973, there was 265 feet of drawdown, of which 94 feet were due to Wisconsin pumpage and 171 feet due to Illinois pumpage. To reduce Illinois pumpage, Lake Michigan water could be allocated to groundwater users in Illinois. This could result in a reduction of Illinois pumpage to less than 46 million gal/day by 1985, and the rate of groundwater decline in the aquifer would decrease substantially. (Small-FRC)
W82-00818

WESTERN COAL MINING IN THE 1980S: A STUDY IN FEDERAL/STATE CONFLICTS,
Dechert, Price and Rhoads, Denver, CO.
D. H. Israel.
Natural Resources Lawyer, Vol 13, No 3, p 581-612, 1981. 123 Ref.

Descriptors: *Coal mining, *Legal aspects, Watershed protection, Watersheds, Regulations, Federal jurisdiction, Governmental interrelations, Groundwater, Surface water, State jurisdiction.

The preservation of surface and ground water resources of mining areas is considered as it relates to the new federal requirements concerning coal mining and reclamation. Coal mining is the first mining industry required by federal law to show affirmatively that its activities would not materially injure the hydrologic balance of both off-site and on-site areas. The circumstances and legislative history behind the call for hydrologic balance rules are reviewed. Under the new regulations, the application or permit must contain the name of the watershed and location of the surface stream or tributary into which surface and pit drainages will be discharged. Cross-section maps or plans showing the location of any subsurface water and its quality, the location of the aquifers, the estimated elevation of the water table, the location of impoundments, location of any water treatment facility, and the locations of discharges to any surface water on or adjacent to the affected land must also be included in the permit application. A reclamation plan is also needed. The regulations also deem some areas as unsuitable for mining operations, e.g., the alluvial floor limitation. There have been some federal/state conflicts concerning the new regulations. In one court it was ruled that the Secretary of the Interior cannot regulate the states' regulatory programs to demand information in mining permit applications beyond those specifically enumerated in the Surface Mining Control and Reclamation Act of 1977. This particular decision reveals the widespread feeling among federal courts that SMCRA and its federal regulators have gone too far in invading the traditional right of the states to exercise primary, if not exclusive, authority over essentially local land and water use issues. (Baker-FRC)
W82-00972

EXPERIENCE GAINED WITH THE U.S. POLLUTION CONTROL POLICIES,
Alvord, Burdick and Howson, Chicago, IL.
W. H. Richardson.
Aqua, No 2, p 245-255, 1981. 4 Fig, 25 Ref.

Descriptors: *Legal aspects, *Water pollution control, *Policy making, History, Administrative decisions, Federal jurisdiction, Political aspects, Government interrelations, *United States, Legislation.

Water pollution control efforts in the United States are viewed chronologically from 1800 to the present. Until the end of World War II, all of the pollution control activities were under the control of individual state Boards of Health or Sanitary Water Boards. The Federal Government's only concern was foreign matter in harbor waters. The

first Water Pollution Control Statute was established in 1956; this was the first time that funds were provided as Grants toward the construction of treatment facilities. The 1972 Clean Water Act established goals, deadlines and a management program. The next major change occurred in 1977. Special efforts were exerted toward toxic and hazardous substances. Other major laws bearing on pollution control included the 1974 Safe Drinking Water Act, and the 1976 Toxic Substances Control Act. The 1974 Safe Drinking Water Act recognized the effect of organic contamination in the nation's drinking water supplies. The Conservation and Recovery Act dealt with improvements of solid waste management and encouraged the recovery of materials and energy and their reuse. In the short time that pollution control policies have been in effect, benefits have fallen short of the expected targets. However, there have been benefits in the field of technology transfer. Federal incentives have speeded activity in the area of establishing water quality standards. With the government requirements, most local municipalities and systems no longer are masters of their own fate. Currently, concern about the possible contamination of groundwater sources is of utmost interest. (Baker-FRC)
W82-00996

ENFORCEMENT UNDER THE RESOURCE CONSERVATION AND RECOVERY ACT OF 1976,
R. A. Weiland.
Boston College Environmental Affairs Law Review, Vol 8, No 3, p 641-678, 1980. 344 Ref.

Descriptors: *Regulations, *Legal aspects, *Groundwater pollution, Federal jurisdiction, Conservation, Hazardous materials, *Industrial wastes, Hazards, Water pollution sources.

The enforcement mechanisms made available to the federal government by the Resource Conservation and Recovery Act (RCRA) of 1976 to control the disposal of hazardous wastes are reviewed. Since no cases have yet been brought in which the government has used Section 7003 or Section 3008 of this act, the analysis is based on the overall language of the RCRA, its sparse legislative history, and on analogies to administrative interpretation and judicial construction of other, principally environmental, statutes. The Imminent Hazard provision is explored with discussion on the meaning of the term imminent or substantial endangerment, the special requisites for obtaining an injunction in light of the fact that the power to bring suit for equitable relief is granted in the statute, and finally, with regard to Section 7003, the relief that may be granted. Federal enforcement section of Subtitle C is discussed. Administrative and judicial enforcement options available to the government are considered, including compliance orders, civil penalties, and other civil actions. Finally, the criminal penalties provision is examined, including a discussion of entities against whom criminal sanctions may be sought and of the requirements for finding criminal liability. Interpretation is expected to parallel similar passages in the Clean Water Act.
W82-01013

DISTRIBUTION SYSTEM LIABILITY,
Waukesha Water Utility, WI.
For primary bibliographic entry see Field 5F.
W82-01028

FREEDOM FROM THE NAVIGATION SERVITUDE THROUGH PRIVATE INVESTMENT,
C. E. Larsen.
Nebraska Law Review, Vol 59, No 4, p 1073-1092, 1980. 107 Ref.

Descriptors: *Judicial decisions, *Navigation, *Legal aspects, Navigation canals, Navigable waters, Public access, Remedies.

Federal regulatory control over the navigable waters of the United States derives from the commerce clause of the Constitution. As a corollary of the federal regulatory power over interstate commerce, previous decisions of the U.S. Supreme Court have held that private property interests obstructing the free flow of navigation over navigable waters are subject to destruction or confiscation by the government without compensation. This burden on property interests, known as the federal navigation servitude, has been applied often, but not consistently, by the Supreme Court, with inequitable results. In Kaiser Aetna v. United States, 100 S. Ct. 383 (1979), the Supreme Court ruled that special circumstances may limit the power of the U.S. Congress over navigable waters of the United States in a manner negating the no compensation rule of the navigation servitude. Factors contributing to the Court's refusal to apply the navigation servitude no compensation rule included the effect of private investment in the improvement of the navigability of the waterway, the waterway's status under state law, and the conduct of the Army Corps of Engineers in approving the development of the waterway. A second case, Vaughn v. Vermillion Corp., 100 S. Ct. 399 (1979), decided the same day as the Kaiser Aetna case, involved public access to canals dug on private land by private investors. This decision clearly stated that artificially constructed waterways are not subject to a public right of access. The Kaiser Aetna decision determined, in effect, that the navigation servitude is not coextensive with the navigable waters of the United States for commerce clause purposes, but did not resolve the question of the effective reach of the federal navigation servitude. (Carroll-FRC)
W82-01030

FEDERAL WATER RESOURCES RESEARCH: A REVIEW OF THE PROPOSED FIVE-YEAR PROGRAM PLAN.
National Research Council, Washington, DC. Water Resources Research Review Committee.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-135559, Price codes: A05 in paper copy, A01 in microfiche. National Academy Press, Washington, DC. 1981. 75 p, 19 Tab, 11 Ref, 2 Append. OWRT-C-0086-G(04260(1), 14-34-0001-0426.

Descriptors: *Federal water resources research, Reviews, *Management planning, *Research priorities, *Alternative planning, *Future planning, Education, Training, *Multiobjective planning, Water Resources Institutes, Administrative agencies, Water resources development, *Long-term planning, Institutions, Legal aspects, Social aspects, Political aspects, Economic aspects, Governmental interrelations, Federal jurisdiction, *Five-year plans.

The Water Resources Research Review Committee was created by the Commission on Natural Resources of the National Research Council to perform this study, which provides the Office of Wateer Research and Technology, U. S. Department of the Interior, with assistance in the preparation of the five-year water resources research plan called for in the Water Research and Development Act of 1978. The Committee studied the 1975 assessment of the nation's water resources by the U. S. Water Resources Council and other recent reports that highlight pressing water problems. The Committee then developed criteria by which to determine the research areas of highest priority. Using these criteria, the Committee identified thirty-one research areas where, in its judgement, emphasis should be placed in programming water resources research over the next five years in the continuing effort to see that the nation's water resources are used effectively to provide essential services. The thirty-one research aeas are described in relation to the professional disciplines. An alternative listing related to problem areas is contained in an appendix. The Committee concluded that: (1) the research grant programs of the Office of Water Research and Technology can serve an important role in training researchers for the future; (2) the institutional areas (social, behavioral, economic, legal, and political) should be the subject of significantly greater research effort in the future; (3) funding for actual research is only about two percent of the funding ($380 million) for all activities related to water resources by the federal government, a modest level considering the importance of water resources to the national well-being; (4) an improved management system is required for water resources research if the objectives of the Water Research and Development Act are to be achieved; and (5) three types of federal water arrangements might be considered: a managed multiagency research program; a policy committee based in the Office of Science and Te+chnology Policy in the Executive Office of the President; or a committee based in a reconstituted Water Resources Council.
W82-01051

ILLINOIS GROUNDWATER PROBLEMS AND NEEDS,
Illinois Environmental Protection Agency, Springfield. Div. of Land/Noise Pollution Control.
For primary bibliographic entry see Field 4B.
W82-01052

GROUNDWATER POLLUTION IN KENTUCKY: A STATUS REPORT,
Kentucky Dept. for Natural Resources, Frankfort.
For primary bibliographic entry see Field 4B.
W82-01053

GROUND WATER IN THE OHIO RIVER BASIN PORTION OF MARYLAND: PROBLEMS AND NEEDS,
Maryland Dept. of Natural Resources, Annapolis.
For primary bibliographic entry see Field 4B.
W82-01054

GROUNDWATER PROBLEMS AND NEEDS IN NEW YORK,
New York State Dept. of Environmental Conservation, Albany.
For primary bibliographic entry see Field 4B.
W82-01055

GROUNDWATER PROBLEMS IN NORTH CAROLINA,
North Carolina Dept. of Natural Resources and Community Development, Raleigh.
For primary bibliographic entry see Field 4B.
W82-01056

OHIO'S GROUND WATER RESOURCES AND PROBLEM AREAS,
Ohio Environmental Protection Agency, Columbus. Groundwater Div.
For primary bibliographic entry see Field 4B.
W82-01057

PENNSYLVANIA GROUND WATER PROBLEMS AND NEEDS,
Pennsylvania Dept. of Environmental Resources, Harrisburg.
For primary bibliographic entry see Field 4B.
W82-01058

GROUND WATER PROBLEMS VIRGINIA PORTION OHIO RIVER BASIN,
Virginia State Water Control Board, Richmond.
For primary bibliographic entry see Field 4B.
W82-01059

GROUND WATER PROBLEMS IN WEST VIRGINIA,
West Virginia Dept. of Natural Resources, Charleston. Div. of Water Resources.
For primary bibliographic entry see Field 4B.
W82-01060

STATE OF WASHINGTON WATER QUALITY ASSESSMENT REPORT 1980.
Washington State Dept. of Ecology, Olympia.
Document 81-6, December, 1980. 57 p, 8 Fig, 8 Tab.

Descriptors: *Water quality standards, *Water quality control, *Pollution effects, *Water quality management, *Long-term planning, Groundwater management, Ground water pollution, Surface

water, Pollution effects, Management planning, Industrial wastewater, Municipal wastewater, Comprehensive planning, *Washington.

This biennial Water Quality Assessment Report provides an overview of the status of the chemical, biological, and physical properties of the waters of the State of Washington. The current status is that the water quality goal of 'fishable/swimmable' waters is met in 45 percent of the segments in the state. Of the 31 percent not meeting the goal, the problems in 13 percent are due principally to nonpoint sources and those in 4 percent to point sources (municipal or industrial), and it is unknown whether the goal will be met in the near future. Until the mid-1970s, water quality management efforts were focused heavily on municipal and industrial discharges. Program emphasis is now shifting from categorical problems to priority geographic problem areas, which include Commencement Bay, Duwamish Waterway, Inner Grays Harbor, lower Yakima River and Spokane River. Water quality priority areas are Willipa Bay, Lake Chelan, Puget Sound, and Duwamish Waterway and River. The Puget Sound Study will be a multiyear program of plan development and implementation. Ground water quality monitoring and control is an increased state and federal priority, and a comprehensive management strategy is being developed by the state that will examine the need for ground water quality standards, a non-degradation policy, and control of sources through the state waste discharge permit program. This strategy will allow for coordinated development and operation of programs for underground injection control, onsite waste management, and storm water management. (Garrison-Omniplan)
W82-01067

A CASE STUDY ANALYSIS OF LEGAL AND INSTITUTIONAL OBSTACLES AND INCENTIVES TO THE POTENTIAL HYDROELECTRIC DEVELOPMENT AT HIGH FALLS STATE PARK, GEORGIA.
Franklin Pierce Law Center, Concord, NH. Energy Law Inst.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/RA/04934-34, Price codes: A04 in paper copy, A01 in microfiche. Department of Energy Report DOE/RA/04934-34, May, 1980. 61 p, 1 Fig, 15 Ref.

Descriptors: *Hydroelectric power, *Hydroelectric plants, *Institutional constraints, *Legal aspects, *Economic aspects, Economic efficiency, Environmental effects, Dams, Reservoirs, Licensing, Electrical transmission, *High Falls State Park, Georgia, Case studies.

There are four potential hydroelectric power sites at High Falls State Park, of which the old powerhouse site is the most favorable, economically and environmentally. The canal and penstock cradles already present would reduce construction costs. The legal requirement of keeping the water level in the reservoir constant mandates a run-of-the-river project, but this will reduce the environmental impact. A license will be required by the Federal Energy Regulatory Commission before the site can be used for hydroelectric power generation, and an environmental impact statement is part of the licensing process. The Georgia Department of Natural Resources has authority over hydroelectric projects, and, because of the age of the dam, is unlikely to license it without investigation and repairs. If the repairs are done, there seem to be few problems to use of the site, and electricity could be generated economically. There will be legal and functional problems if the Department of Natural Resources develops the site. These problems can be overcome if the Municipal Electric Authority of Georgia (MEAG) is the developer, and the MEAG has the advantage of existing power wheeling agreements, making it the most effective developer of the site. (Brambley-SRC)
W82-01078

6F. Nonstructural Alternatives

ARKANSAS WATER POLICY.
Water Policy Task Force, Little Rock, AR.
For primary bibliographic entry see Field 6D.
W82-00715

PROPOSED WATER QUALITY CONTROL PLAN FOR INDIO SUBAREA OF THE WHITEWATER HYDROLOGIC UNIT, WEST COLORADO RIVER BASIN.
California Regional Water Quality Control Board, Palm Desert. Colorado River Basin Region.
May, 1981. 62 p, 3 Fig, 12 Tab, Append.

Descriptors: *Water management, *Administrative decisions, *Long-term planning, *Water use, *Multi-objective planning, *Competing use, Water use efficiency, Aquifers, Aquifer management, Alternative planning, Water consumption, Groundwater management.

The proposed Water Quality Control Plan for the Indio subarea of the Whitewater Hydrologic Unit, West Colorado River Basin, was prepared as the first phase in updating the Plan for the Basin. For planning and reporting purposes, the Basin was divided into six major areas on the basis of economic and hydrologic characteristics: Lucerne Valley, Hayfield, Coachella Valley, Anza-Borrego, Imperial Valley, and Salton Sea. The Indio subarea is one of five within the Coachella Valley Planning Area, and its water quality issues are addressed in depth amid an overview of all six major planning areas. The groundwater in the Indio subarea lies principally in the alluvial deposits of the Coachella Valley. A deep aquifer is located along the entire length of the Valley from the San Gorgonio Pass to the Salton Sea. The area from Indio south also has a semi-perched zone resulting in a two-aquifer system; the deep aquifer is separated from the upper aquifer by an aquitard. A comparison of 1970-75 and 1938-39 groundwater quality data for shallow wells shows an increase in total dissolved solids concentrations near Indio and an increase in total hardness southeast of Indio. High nitrate concentrations (approximately 200 mg/l NO-3) were found in the Indian Wells area prior to 1937, and were attributed to the decomposition of mesquite forests. Significant variations in water quality exist within the subbasin. (Garrison-Omniplan)
W82-00716

FEDERAL PARTICIPATION IN LAND USE DECISION-MAKING AT THE WATER'S EDGE--FLOODPLAINS AND WETLANDS,
Economic Research Service, Washington, DC. Natural Resource Economics Div.
For primary bibliographic entry see Field 6E.
W82-00799

COSTS OF ALTERNATIVE POLICIES FOR CONTROLLING AGRICULTURAL SOIL LOSS AND ASSOCIATED STREAM SEDIMENTATION,
Idaho Univ., Moscow. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 4D.
W82-00869

6G. Ecologic Impact Of Water Development

LEAF LITTER PROCESSING IN A REGULATED ROCKY MOUNTAIN STREAM,
Colorado State Univ., Fort Collins. Dept. of Zoology and Entomology.
R. A. Short, and J. V. Ward.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 1, p 123-127, January, 1980. 1 Fig, 2 Tab, 15 Ref.

Descriptors: *Leaves, *Litter, *Environmental effects, *Dam effects, *Macroinvertebrates, *Colorado River, Ecological effects, Streams, River systems, Mayflies, Microbial degradation, Temperature effects, Aquatic populations, Granby Dam.

The ability of regulated (dammed) streams to process leaf litter of alder was examined by the leaf litter pack method at sites before the Granby Dam along the Colorado River. Similar studies conducted on sections of the undammed Fraser River were used for comparison. Leaf processing was studied during the autumn and winter with leaf packs attached to bricks and placed in riffles. Leaching controls were kept in the water two days, and five samples from each site were retrieved after 16, 38, 52, and 66 days. Macroinvertebrates collected from study sites were classified and counted and leaf processing was evaluated by comparing dry weights of remaining leaf packs after the end of the study period. Loss rate coefficients were much higher for leaves kept in regulated waters than in unregulated waters. These findings did not support the hypothesis that reductions in macroinvertebrate shredders would decrease leaf litter processing rates in regulated streams. It was suggested that the warmer winter temperatures below the dam compensated for the virtual absence of shredder species by increasing the microbial leaf degrading activities. (Geiger-FRC)
W82-00542

THEORY OF ECOLOGICAL PREDICTION OF LIMNETIC ECOSYSTEMS,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
I. I. Nikolaev.
Water Resources (English Translation), Vol 7, No 5, p 430-436, September/October, 1980. 48 Ref. Translated from Vodnye Resursy, No 5, p 100-109, September/October, 1980.

Descriptors: *Limnology, *Prediction, *Ecosystems, Ecological effects, *USSR, Reservoirs, Stream discharge, Europe, Species composition, Benthos, *Reservoir construction.

The first period of active prediction of limnetic ecosystems in the Soviet Union is associated with intensive hydraulic engineering construction conducted between 1930 and 1950. Regular hydrobiological and ichthyologuical investigations conducted on all of the large reservoirs have made it possible to evaluate the correctness of the predictions. The species composition of pelagic and benthic communities of reservoirs on the Volga generally corresponds to predictions, although the observed intense invasions of elements of southern fauna northward and of northern fauna southward were unexpected. The predictions with respect to the formation of main communities were considerably less accurate. While the predictions indicated that pelophilous benthos should have been predominant in the reservoirs, with oligochaetes and other homotropic fauna predominating in the benthos from the first years of existence, experience showed that heterotropic fauna dominated colonization of the bottom of the reservoirs, with larvae of midges being the predominant species in the first years. There were no substantial deviations from the predictions of the development of the communities of micro- and macrovegetation of the flatland reservoirs. Quite substantial errors were made in predicting the productivity of individual communities. Predictions of the phytoplankton productivity were underestimated and that of the zoobenthos and commercial fishes overestimated for many reservoirs. Although many of the predictions were not accurate, long-term comprehensive investigations facilitated analysis of the principal causes of deviations from the predictions and promoted the formation of more realistic concepts about the processes of formation of lakelike ecosystems and the feasibility of their prediction. (Carroll-FRC)
W82-00597

THE AZOV SEA PROBLEM,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
D. Ya. Ratkovich, V. E. Prival'skii, M. V. Matushanskii, S. S. Remizova, and Yu. Yu. Marti.
Water Resources (English Translation), Vol 7, No 4, p 304-320, July-August, 1980. 3 Fig, 6 Tab, 10 Ref. Translated from Vodnye Resursy, No 4, p 19-39, July-August, 1980.

Descriptors: *Salinity, *Water management, *Water allocation, *Azov Sea, Water consumption, Diversion, Volga River, Don River, Kuban

River, Saline water intrusion, Saline lakes, Lakes, Reservoirs, Irrigation effects, Water conservation, Fisheries, Fish management, Hydroelectric plants, Reservoir releases, Water use, Navigable waters, Model studies, Agriculture, Canals, Water pollution control, Water transfer, Russia.

As water consumption increases in the heavily populated and industrialized Azov Sea Basin, river inflow and biogenic runoff decreases. This causes an increase in salinity via an inflow of Black Sea waters and a deterioration of water quality and biological productivity. Projects to reduce nonreturnable losses include a sequence of low-head hydrostations to maintain a uniform transport depth in the Volga-Don waterway, fishery projects, and limiting new irrigation according to available water. Nonreturnable water consumption in the Lower Don Basin will be 20% of the total for the entire Don Basin until 1990, then 15%. Plans for water management in the Kuban River Basin involve transfer of water from other basins, reducing the navigation season from 285 days to 140-145 days, and spawning releases for fish. A model is used to predict the salinity of the Sea at intervals up to 2010 under different variations of water consumption. These calculations show that the salinity of the Sea can be reduced to a favorable regime (9.5-10.5 %) only by complete compensation of nonreturnable withdrawals. It is unlikely that fisheries and irrigated agriculture can continue to coexist until the end of the century. The effects of the proposed Kerch Strait hydroelectric project, between the Black and Azov Seas, have not been determined, but speculations are that salinity will increase, shoreline erosion will occur, anchovy migration will be disturbed, and salinity in the freshwater spawning areas will be unfavorably changed. (Cassar-FRC)
W82-00651

THE PONGOLO FLOODPLAIN: A UNIQUE ECOSYSTEM THREATENED,
Natal Univ., Pietermaritzburg (South Africa).
J. Heeg, C. M. Breen, and K. H. Rogers.
Civil Engineer in South Africa, Vol 22, No 5, p 125-128, May, 1980. 2 Fig, 1 Ref.

Descriptors: *Flood plains, *Dams, Levees, Weirs, Flood plain management, Flood plain zoning, Flood irrigation, Benefits, Ecosystems, Pongolapoort Dam, *South Africa.

The effects on the Pongolo Floodplain resulting from the construction of the Pongolapoort Dam are examined. The Dam was constructed for the purpose of impounding the waters of the river for irrigation. This will result in an absorption of the floods which now regularly inundate the floodplain during the summer months. In examining the energy pathways and nutrient cycles of the Floodplain, two main spheres of marked flood dependence were isolated: allochthonous and autochthonous energy inputs, which are directly affected; and the fishes, an exploitable resource, which are indirectly affected through reduced energy input as well as being directly dependent on the floods in their breeding biology. The principal requirement for preserving the Pongolo Floodplain is sufficient water to flood the system, applied at the correct time to stimulate fish spawning. The amount of water required to maintain the floodplain pans at the maximum retention level is estimated at 26,000,000 cubic meters per year, based on an annual evaporation of 2,000 mm and a rainfall of 600 mm/year. However, the productivity depends on inundation of the whole area between the levees and the adjoining high ground for a reasonable period of time, and this would require an additional 100,000,000 cubic meters per year, which is 14.6% of the mean assured yield of the dam. It is estimated that, given inflatable weirs with reasonably sensitive control, the requirements can be met at an annual water cost of 42,000,000 cubic meters per year, a 67% saving on the natural flow-through system. (Baker-FRC)
W82-00684

FINAL ENVIRONMENTAL IMPACT STATEMENT: NORTH FORK STANISLAUS RIVER PROJECT NO. 2409 - CALIFORNIA.
Federal Energy Regulatory Commission, Washington, D.C. Office of Electric Power Regulation. Report FERC/EIS-0011, June 1980. 297 p, 10 Fig, 28 Tab, 40 Ref, 8 Append.

Descriptors: *Environmental Impact Statement, *North Fork Stanislaus River, *California, *Hydroelectric power, *Environmental effects, *Electric power production, Dams, Tunnels, Transmission lines, Recreation, Flooding, Reservoirs, Wildlife habitats, Flow rates, Water quality, Social aspects, Cost-benefit analysis.

The Calaveras County Water District is proposing to construct a 205.2 MW hydroelectric project on the North Fork Stanislaus River, Stanislaus River, Highland Creek, Beaver Creek, Silver Creek, and Duck Creek in the vicinity of Arnold, California. It would require the construction of a dam, two powerhouses, three diversion dams, diversion tunnels, an afterbay dam, access roads, transmission lines, recreational facilities, and appurtenant facilities. About 2,848 acres of land would be occupied by the project, of which 2,723 acres are now Federal lands. Environmental impacts caused by construction and operation of the project would include: loss of 1865 acres of existing vegetation and wildlife habitat to the reservoirs; inundation of streams; altered flow and thermal regimes in the creeks and river; deterioration of water quality; loss of vegetation; temporary adverse impacts on air quality and ambient noise levels during construction; increased recreational use; effects on archeological sites; impacts of the increased labor force during construction; and changes in the visual resources. Alternative power sources using a combination of hydroelectric and fossil-fuel combustion were considered. The proposed project and the combination sources have the best benefit-cost ratios and would save various amounts of coal and oil. (Brambley-SRC)
W82-00737

FINAL ENVIRONMENTAL IMPACT STATEMENT: SWAN LAKE PROJECT NO. 2911 - ALASKA.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation. Report FERC/EIS-0012, April 1980. 189 p, 22 Fig, 16 Tab, 23 Ref, 3 Append.

Descriptors: *Hydroelectric plants, *Environmental impact statement, *Dam construction, Water quality, Turbidity, Environmental effects, Wildlife habitats, Construction, Fish, Swan Lake, *Alaska.

A 22 MW hydroelectric project on Falls Creek and Swan Lake near Ketchikan, Alaska, has been proposed. This would involve the construction of: a dam located 0.75 miles downstream from the outlet of the existing Swan Lake: a power tunnel leading to an indoor-type powerhouse at tidewater on Carroll Inlet; a switchyard; an access road; a transmission line; and appurtenant facilities. Environmental impacts caused by construction and operation of the project would include: inundation of about 460 acres of existing vegetation and wildlife habitat; inundation of about 3.5 miles of spawning habitat used by kokanee and Dolly Varden; diversion of all waters, except flood and spillage waters, at the dam, from the natural Falls Creek channel to the powerhouse; clearing of about 250 acres of land; loss of wildlife habitat, and temporary disruption of resident wildlife species in or near construction sites; disturbance of about 20 acres of land in the lower Carroll Creek watershed for extraction and processing of aggregate; turbidity and siltation in surface waters receiving drainage from construction sites and the aggregate site; temporary adverse impacts on air quality and ambient noise levels; and changes in the charactersitics of visual and recreational resources. Alternatives to the proposed action that were considered are: conservation and rate revision; alternative design arrangements; other sites; alternative forms of generating equivalent power; and denial of the application for license. (Moore-SRC)
W82-00738

MEASUREMENT OF PARTICULATES ENTRAINED IN SOME GREAT LAKES POWER PLANT COOLING WATER: AN EXERCISE IN FUTILITY,
Canada Centre for Inland Waters, Burlington (Ontario).
J. K. Leslie, and J. E. Moore.
Environmental Pollution (Series A), Vol 22, No 3, p 179-185, July, 1980. 1 Fig, 3 Tab, 18 Ref.

Descriptors: *Entrainment, *Phytoplankton, *Cooling water, Aquatic life, Measuring instruments, Great Lakes, *Powerplants, Lakes, Particulate matter, Intakes, Outlets.

Suspended particles were measured in intake and discharge cooling water at three Great Lakes electric power generating stations. Using the Coulter Counter, the total number and volume of particles in the discharge water was found to have increased by 11% and 5%, respectively, and mean size decreased 3%. Image analysis showed an 18% increase in number, 22% decrease in surface area, and 10% in linear dimension. The inverted microscope technique showed a 22% increase in number of discharge particles and a 10% reduction in total biomass. The Coulter Counter detected three times as many particles as did the other two methods. To detect a statistically significant + over - 5% change in particle number the Coulter Counter method would require 2839 samples; the image analyzer, 1541; and the inverted microscope technique, 7021. Sample numbers in this study were much smaller, on the order of 25-50. It was concluded that significant results may be obtained only with a massive sampling program. (Cassar-FRC)
W82-00782

GLEN CANYON DAM IS KILLING THE GRAND CANYON AND YOUR TAX DOLLARS ARE PAYING FOR IT.
J. Roberts.
National Parks, Vol 55, No 7/8, p 18-25, July/August, 1981. 1 Fig.

Descriptors: *Dams, *Environmental effects, Dam effects, Electric powerplants, Environmental protection, Grand Canyon, Fish, Birds, Plants, Hydroelectric power, Erosion, Beaches, Beach erosion, Water level fluctuations, *Reservoir releases, Surges.

Changes in the water level in the Colorado River as a result of manipulations at Glen Canyon Dam are discussed. These uneven releases of water through the Dam cause man-made tides to surge along the banks of the river, disrupting the naturally alternating erosion and redeposition of silt, enabling exotic species of plants to flourish on the banks while killing others that have been established there for years, eliminating some populations of birds, and allowing fish and eggs to be stranded far from the water when the surge has gone by. Beaches are washed away. The shallowness of the water at times prohibits groups of white water enthusiasts from completing their trips. Plans are in the works for making changes which will increase the destruction already being seen. These plans are being laid in supposed answer to increasing electricity needs, but opponents of the plans suggest that existing power plants could be used for far less money than will be required to make the changes, and without doing further environmental damage. (Baker-FRC)
W82-00813

TOXIC DINOFLAGELLATES AND TIDAL POWER GENERATION IN THE BAY OF FUNDY, CANADA,
Institute for Marine Environmental Research, Plymouth (England).
R. C. Reid.
Marine Pollution Bulletin, Vol 11, No 2, p 47-51, February, 1980. 2 Fig, 34 Ref.

Descriptors: *Shellfish, *Toxicity, *Dinoflagellates, *Tidal powerplants, Pyrrophyta, Red tide, *Bay of Fundy, Canada, Poisons, Public health, Plankton, Baseline studies, Planning, Prediction, Environmental effects, *Ecological effects.

Although the need for an environmental impact assessment of the proposed tidal power generation

plant to be constructed in the upper of reaches of the Bay of Fundy in Canada has been discussed by other researchers, issues relating to public health and the economic effect on mariculture were not raised. The Bay of Fundy is one of three core areas for paralytic shellfish poisoning along the eastern seaboard of North America. Core areas are defined as areas in which high levels of toxicity exceeding 80 micrograms of toxin per 100 grams of shellfish tissue occur almost every year and in which severe illness, and in some cases death, due to paralytic shellfish poisoning have been recorded. This poisoning is derived from neurotoxins contained in certain dinoflagellates which are concentrated and transferred via filter feeding mollusks to humans. Previous studies have shown that the occurrence of dinoflagellates is intimately linked to the physical structure of shelf waters, with these organisms occurring most abundantly in frontal regions and in shallow thermoclines and occurring only in small numbers in well-mixed environments. The water circulation and tidal regime of the Gulf of Maine and the Bay of Fundy will be considerably altered by construction of the proposed tidal power station. These alterations could result in changes in the occurrence of toxic dinoflagellates and associated patterns and intensity of paralytic shellfish poisoning. Changes in turbidity and sedimentation characteristics which would result from the proposed power plant would also be favorable to increases in the numbers of toxic resting cysts and toxicity in the bottom sediments. (Carroll-FRC)
W82-00908

GREAT LAKES ENVIRONMENTAL PROTECTION POLICIES FROM A FISHERIES PERSPECTIVE,
Canada Centre for Inland Waters, Burlington (Ontario).
M. G. Johnson.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 7, p 1196-1204, July, 1980. 33 Ref.

Descriptors: *Water resources development, *Great Lakes, *Environmental policy, Water quality management, Air pollution, Social aspects, Management planning, Long-term planning, Water supply development, Lake fisheries, *Fish management, *International waters.

International resource management plans and environmental protection policies of the Great Lakes may be categorized under the areas of water quantity and quality management, fisheries management, and air pollution abatement. Policy development often ignores the interaction of these departments and fails to deal with root causes of problems in a broad context. Ineffective use of socio-economic data hinders the implementation of remedial programs. Management policies are needed which reach across Great Lakes resource sectors to optimize a diversity of long-term benefits to society. Collaboration between the Great Lakes Fishery Commission and the International Joint Commission is recommended to identify issues, encourage strategic planning with resource sector and public participation, and adopt a broader outlook of societal goals and public policy in relation to the finite capacity of the Great Lakes ecosystem. (Geiger-FRC)
W82-00978

FORMULATING ALTERNATIVES FOR ENVIRONMENTAL STUDIES,
Wheeler and Gray, Los Angeles, CA.
D. R. Boone.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE3, p 527-538, June, 1980. 17 Ref.

Descriptors: *Alternative planning, *Environmental protection, Planning, Management decisions, Environmental engineering, Design criteria, Legal aspects.

An overview of the legal requirements for the identification of alternatives to proposed civil engineering projects is presented. A procedure is offered which enables alternatives to be formulated to provide the project engineer with a workable approach toward meeting the alternatives requirements of the National Environmental Policy Act (NEPA). In every recommendation or report on proposals for legislation and other major actions which affect the quality of the human environment the NEPA calls for the agencies of the Federal Government to include a detailed statement concerning environmental impact, possible adverse effects, alternatives to the proposed action, the relationship between local short-term uses and the maintenance and enhancement of long term productivity, and any irreversible and irretrievable commitments of resources which would be involved in the proposed action. Even so, the degree to which alternatives are seriously considered at the project management level varies, and inadequacies have been noted. Legal and institutional constraints tend to narrow the range of alternatives considered by project planners. A revised Council on Environmental Quality guideline is attempting further change in the way future projects will be planned. (Baker-FRC)
W82-00997

MORPHOLOGICAL CHANGES OF RIVER CHANNELS CONSEQUENT UPON HEADWATER IMPOUNDMENT,
Loughborough Univ. of Technology (England).
G. E. Petts.
Journal of the Institution of Water Engineers and Scientists, Vol 34, No 4, p 374-382, July, 1980. 1 Fig, 5 Tab, 10 Ref.

Descriptors: *Geomorphology, *Streams, *Channels, *Dams, *Reservoirs, Rivers, Impoundments, Environmental effects, Sediment, Deposition, Field tests, Headwaters, Erosion, *Channel morphology, Channel accretion, Channel erosion, Great Britain.

Geomorphological data from 14 impounded rivers located throughout Britain have been used to assess the long-term impact of reservoirs upon river channels downstream, and to identify the potential problems for river management. Changes of channel size and shape have halved the water conveyance capability of 11 of the 14 rivers studied. In the absence of adequate discharge data, two surrogate variables, reservoir surface area and time-to-peak of the reservoir inflow hydrograph, are used to explain the gross variation of channel morphology downstream from reservoirs. Four mechanisms, channel erosion, redistribution of the boundary sediment, channel side deposition, and channel bed aggrandizement, contributed to the morphological changes. Long-term changes downstream from reservoirs can affect land drainage, coastal stability, water quality, navigation, structural stability, fisheries, and aesthetics, as well as the aquatic flora and fauna. (Titus-FRC)
W82-01087

7. RESOURCES DATA

7A. Network Design

ESTIMATION OF MATERIAL FLUXES IN AN ESTUARINE CROSS SECTION: A CRITICAL ANALYSIS OF SPATIAL MEASUREMENT DENSITY AND ERRORS,
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
B. Kjerfve, L. H. Stevenson, J. A. Proehl, T. H. Chrzanowski, and W. M. Kichens.
Limnology and Oceanography, Vol 26, No 2, p 325-335, March, 1981. 5 Fig, 4 Tab, 12 Ref.

Descriptors: *Sampling, *Error analysis, *Estuaries, *North Inlet, *South Carolina, Water quality, Tidal effects.

The minimum number of stations in an estuarine cross section needed to calculate material fluxes within acceptable error limits was determined at North Inlet, South Carolina. Three stations, each representing a separate bathymetric regime, were selected as optimum, giving an error of 15%. To reach this conclusion 10 stations were sampled every hour for two tidal cycles in a 320 meter wide cross section. Discharge, ATP fluxes, and ammonium fluxes were computed. If the along-channel material flux is the value to be determined, distinct cross-sectional bathymetric regimes should be sampled. Calibration can be used in a well-mixed estuary to give good estimates of cross-sectional discharge or material flux from one or few samples. (Cassar-FRC)
W82-00816

A COMPARISON OF SENSITIVITY ANALYSIS AND ERROR ANALYSIS BASED ON A STREAM ECOSYSTEM MODEL,
Oak Ridge National Lab., TN.
R. H. Gardner, R. V. O'Neill, J. B. Mankin, and J. H. Carney.
Ecological Modelling, Vol 12, No 3, p 173-190, April, 1981. 5 Fig, 5 Tab, 20 Ref.

Descriptors: *Streams, *Sensitivity analysis, *Error analysis, Mathematical models, Mathematical studies, *Ecosystems, Prediction, Experimental design, Design criteria.

As ecological modeling techniques are increasingly applied to environmental problems, there is a need for increased understanding of prediction uncertainty and model limitations. Errors due to parameter estimation are particularly important to the modeler and the researcher in the field. One approach to parameter estimation, used when a complex ecosystem model is derived from population interaction theory and physiological ecology, involves determination of individual parameters through independent laboratory or field experiments. Either sensitivity analysis or Monte Carlo error analysis can be used to determine the required accuracy of these parameter values. Both of these analyses attempt to rank order the parameters according to their contributions to overall model error. While sensitivity analysis involves taking the partial derivatives of model equations with respect to individual parameters, error analysis treats each parameter as a random variable and determines the contribution of each parameter to model accuracy by statistical analysis of simulation results. Since both of these techniques can provide the information needed by field researchers, guidelines are needed for choosing the technique most suited to a specific problem. The simple correlation coefficient derived from analysis of Monte Carlo simulations appears to be a reasonable way to rank model parameters according to their contributions to prediction uncertainty.
W82-00991

7B. Data Acquisition

HYDROGEOLOGICAL AND GEOPHYSICAL LOGGING.
Wuidart Engineering Ltd., Shefford Beds (England).
Water Services, Vol 85, No 1022, p 187-188, 1981. 1 Fig.

Descriptors: *Hydrological data collection, *Measuring instruments, *Geophysics, Borehole geophysics, Boreholes, *Logging(Recording), Electrical well logging, Groundwater, Aquifer evaluation, *Geohydrology.

The logging of temperature and conductivity profiles in boreholes under changing conditions of groundwater flow was seen as a very successful method for investigating many problems of groundwater resources. The method of simultaneous logging of temperature and conductivity forms a basis for the interpretation of groundwater movement; appropriate supporting techniques can then be used in response to particular problems. Such considerations led to the production of the WEL-Micrologger. For investigations of natural gamma radiation both in boreholes and on the surface, a motorized three arm caliper is used with the Micrologger system. The signal is returned to the surface as pulses giving a continuous trace on the chart recorder. The range of the caliper can accommodate boreholes from 50 mm to 1 meter in diameter. The instrument can be used for depth

sampling and as a flowmeter. The equipment is ideally suited for producing a number of the accepted standard geophysical logs used in the determination and confirmation of formations. (Baker-FRC)
W82-00511

MEASUREMENT OF PH IN THE ESTUARINE ENVIRONMENT ON THE NBS SCALE. (LA MESURE DU PH EN MILIEU ESTUARIEN SUR L'ECHELLE NBS),
McGill Univ., Montreal (Quebec). Dept. of Chemistry.
E. Pelletier, and J. Lebel.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 4, p 703-706, April, 1980. 2 Fig, 1 Tab, 9 Ref.

Descriptors: *Hydrogen ion concentration, *Measuring instruments, *Estuaries, Ionic interference, Estuarine environment, Fluctuations, Monitoring, Reproducibility.

A modification to the classical method of measuring pH in estuaries and inshore environments is proposed. The technique employs a secondary standard of high ionic strength to monitor and adjust for the slow drift of electrodes which usually occurs over a long series of analyses on board a ship. The method is accurate to plus or minus 0.010 pH units, with a reproducibility of plus or minus 0.005 pH units for 95% of the analyzed samples. The procedure appears to be insensitive to abrupt changes in ionic strength of successive samples and provides a simple and practical way to study the pH fluctuations of estuarine environments. (Geiger-FRC)
W82-00521

SPRING FLOOD: MELTWATER OR GROUNDWATER,
Uppsala Univ. (Sweden). Div. of Hydrology.
A. Rodhe.
Nordic Hydrology, Vol 12, No 1, p 21-30, 1981. 2 Fig, 2 Tab, 14 Ref.

Descriptors: *Annual floods, *Snowmelt, *Streamflow, *Groundwater movement, *Surface-groundwater relations, Infiltration, Watersheds, Tracers, Water level, Oxygen-18, Isotopic tracers, Forest watersheds, *Sweden.

Stream discharge was separated into two flows: that originating from groundwater and the fresh melt. The environmental isotope oxygen-18 was used as a tracer in this study of two forested watersheds in southern Sweden. The separation is possible due to the seasonal variation of the isotope oxygen-18 in precipitation. The spring flood of 1979 mainly originated from groundwater. Discharged meltwater equaled the total melting over 10-15% of the basins. The results were in agreement with other studies, and the figures were assumed to represent the fraction of effluent area because no infiltration can take place in areas with the groundwater table at (or above) the ground surface. Groundwater was found to play a decisive role in the process streamflow generation; this supports the theory of influent and effluent areas for groundwater. Preliminary results from a similar study in an area situated above the postglacial shoreline indicated a smaller groundwater fraction (about 50%) of the 1980 total spring flood. Two watersheds in the original study were undertaken in basins with outwash morainic soils during a spring when the soil was almost unfrozen. (Small-FRC)
W82-00531

THE USE OF NA/CL RATIOS TO TRACE SOLUTE SOURCES IN A SEMIARID ZONE,
Weizmann Inst. of Science, Rehovot (Israel). Isotope Dept.
M. Margaritz, A. Nadler, H. Koyumdjisky, and J. Dan.
Water Resources Research, Vol 17, No 3, p 602-608, June, 1981. 4 Fig, 1 Tab, 32 Ref.

Descriptors: *Solute transport, *Tracers, *Groundwater recharge, *Groundwater movement, Sodium, Chlorides, Saline soils, Chemical reactions, Aquifers, Israel, Semiarid lands, Humid areas, Recharge, Rainfall, Dissolved solids, Path of pollutants.

The Na/Cl ratio may be a means of tracing the recharge mechanisms in semiarid regions. In the humid and arid zones, the Na/Cl ratio in groundwater is less than 1; in the transition zone, greater than 1. In this zone the combination of CaCO3 dissolution and base exchange reactions exists, whereas in humid areas minerals are already well leached and in dry areas the Ca(2+) minerals are not dissolved. An area on the south coastal plain of Israel was studied. Here the Na/Cl ratios change from 0.86-1.0 to 1.5-2.0 from north to south through addition of Na(+) to the groundwater as it interacts with soils of loessial origin. Evidently salt-accumulating profiles do not transfer water downward to the aquifer but add Na(+) salts to the groundwater from the efflorescent crust or from the upper horizon. These waters, now with a high Na/Cl ratio, may flow laterally and percolate through the soil in depressions where they can be found and traced. (Cassar-FRC)
W82-00601

DETERMINATION OF HYDROGEOLOGICAL PARAMETERS USING SINUSOIDAL PRESSURE TESTS: A THEORETICAL APPRAISAL,
Institute of Geological Sciences, Harwell (England). Environmental Protection Unit.
J. H. Black, and K. L. Kipp, Jr.
Water Resources Research, Vol 17, No 3, p 686-692, June, 1981. 3 Fig, 2 Tab, 20 Ref.

Descriptors: *Diffusivity, *Aquifer testing, *Pressure-measuring instruments, Groundwater movement, Hydraulic conductivity, Crystalline rocks, Porous media, *Borehole geophysics, Geohydrology, Measuring instruments, Permeability, Confined aquifers.

A method of measuring hydraulic diffusivity using sinusoidal pressure fluctuations in an excitation borehole is useful in fissured crystalline rocks but not in high storage/low hydraulic conductivity media such as peat and clay. Equations are derived which describe the dependence of pressures and phase lags outside the excitation borehole on distance, signal frequency, specific storage, hydraulic conductivity, and flow rates. These cover two distinct configurations: that of a point source deep within a water-saturated elastic formation and that of a line source totally penetrating a confined aquifer. For the three-dimensional examination of crystalline rock the signal frequency should be no greater than one cpd with measurement concentrating on the phase shift. Signals are measurable up to 100 meters from the source. For the two-dimensional examination of aquifer rocks in pollution studies, the line source has a more penetrating signal. Measurement would concentrate on the amplitude of the signal, and the excitation frequencies could be on the order of 100 cpd. This method is not seen as a substitute for classical aquifer testing but as a tool to be used in certain applications. (Cassar-FRC)
W82-00603

SEDIMENT SURVEYS IN THE DEPARTMENT OF WATER AFFAIRS,
Department of Water Affairs, Pretoria (South Africa).
T. P. C. Van Robbroeck.
Civil Engineer in South Africa, Vol 22, No 2, p 34-36, February, 1980. 4 Fig, 1 Tab.

Descriptors: *Dams, *Silting, *Sedimentation, Reservoir silting, Silt load, Silt, Sediments, Measuring instruments.

Use of a sophisticated, automated measuring and calculating method to measure the volume of sediment deposited in a dam over a number of years is described. The dam basin is divided into a number of compartments bounded by accurately measured cross sections taken between permanent silt beacons, the positions of which were determined beforehand. A capacity table is drawn separately for each compartment. End areas of every compartment for each contour interval are determined. Constant factors peculiar to a compartment are derived. To determine the volume of silt deposited, only the end areas of the compartments need to be resurveyed. This is done by electronic means. Echoes from an echo sounder, fitted in a survey boat, are continuously recorded on a chart. Simultaneously, the distance from a shore station is measured and recorded by the ralog, an electromagnetic range measuring device. The boat is kept on course between the silt beacons by radio signals from a surveyor observing the mast through a theodolite. The first dam to be surveyed in this manner was Welbedacht Dam on the Caledon River. It is hoped that with this new method surveys of 20 dams can be completed per year, compared to an average of two in the past. Some results of silting in dams already surveyed by this method are presented. (Baker-FRC)
W82-00680

AN IN SITU METHOD FOR MEASURING THE PRIMARY PRODUCTIVITY AND STANDING CROP OF THE EPILITHIC PERIPHYTON COMMUNITY IN LENTIC SYSTEMS,
California Univ., Davis. Div. of Environmental Studies.
S. L. Loeb.
Limnology and Oceanography, Vol 26, No 2, p 394-399, March, 1981. 4 Fig, 2 Tab, 17 Ref.

Descriptors: *Primary productivity, *Lentic environment, *Algae, Periphyton, Substrates, In situ tests, Productivity, Aquatic life, *Standing crops, Incubation, Sampling, *Lake Tahoe.

An incubation chamber and quantitative sampler were developed to measure the primary productivity and standing crop of an epilithic periphyton community. The incubation chamber is a hemispherical Plexiglas dome that encloses 200 ml of water over an area of 50 sq cm. The sampler, made of two 60-cc disposable syringes, contains a brushing device and collection device. The apparatus is serviced by SCUBA divers with minimal disturbance to the natural environment. The artificial substrate methods underestimated productivity by as much as 95%, and species composition was quite different from that in the in situ method. In this study, measurements were made up to 16 meters deep in Lake Tahoe. (Cassar-FRC)
W82-00756

QUANTITATIVE ASSESSMENT OF TIDAL WETLANDS USING REMOTE SENSING,
National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
D. S. Bartlett, and V. Klemas.
Environmental Management, Vol 4, No 4, p 337-345, July, 1980. 6 Fig, 1 Tab, 25 Ref.

Descriptors: *Wetlands, *Satellite technology, *Vegetation, *Remote sensing, Delaware, Spartina, Biomass, *Tidal marshes, Marshes, Landsat, Reflectance.

Effective wetlands management requires the collection of information on wetlands condition, which may be directly related to the production and distribution of emergent plant species. Remote sensing techniques were able to quantitatively determine the biomass of Spartina alterniflora (salt marsh cord grass) growing in wetlands in Delaware from April through September. Comparisons with the harvest method showed that canopy reflectance measurements in Landsat MSS Bands 4 and 5 (visible spectral region) were inversely related to the % by weight of green vegetation within the canopy. Infrared canopy reflectance was best correlated with green biomass rather than total biomass and canopy height. Spectral methods were not as highly correlated with canopy parameters for the other two species tested: Spartina patens and Distichlis spicata (salt bay). Seasonal changes in canopy characteristics and reflectance showed that in December, at visible wave lengths, the best potential existed for distinguishing between S. alterniflora and the salt hay species. Landsat/MSS digital data for July 31, 1977, was compared with harvest methods at three sites in determining mean green and mean total biomass of S. alterniflora.

Results were encouraging. For example, at Canary Creek Marsh the harvest method determined (all units in g dry weight per sq meter) mean green biomass, 451, and mean total biomass, 1081; Landsat, 407 and 1076, respectively. Woodland Beach results were: harvest, mean green, 820, and mean total, 1376; Landsat, 675, mean green, and 1206, mean total. (Cassar-FRC)
W82-00781

MEASUREMENT OF PARTICULATES EXTRAINED IN SOME GREAT LAKES POWER PLANT COOLING WATER: AN EXERCISE IN FUTILITY,
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 6G.
W82-00782

THE KYHOLM CORER--A DIVER-OPERATED SEDIMENT CORER,
Aarhus Univ. (Denmark), Lab. of Physical Geography.
P. Nornberg, and C. Christiansen.
Sedimentary Geology, Vol 25, No 1/2, p 1-4, January, 1980. 1 Fig, 8 Ref.

Descriptors: *Sediment sampler, *Bottom sampling, Sampling, Bottom sediments, Sand, Sediments, *Corer.

The Kyholm corer was developed to meet the needs of a study in which it was essential to know the exact location of the sample, necessary to collect compact sandy sediments, and essential to take orientated samples so the cores could be used for paleomagnetic dating. It was also necessary that the corer not be too heavy or too bulky to be handled by SCUBA-divers. The resultant Kyholm corer is easily operated by two SCUBA-divers who place the sampler and drive the corer into the bottom by hammer. The sampler is then hauled up by means of ropes over the divers' shoulders. A cover is placed on the tube as soon as the core has been extracted from the bottom. The sampling procedure involves no twisting, so orientation of the sample is preserved. The corer samples an area of about 28 square centimeters. The prototype has been used to collect 20 samples with a sample depth of 0.9 meters without regard to type of sediment, while a slightly modified version has collected three samples with a sampling depth of 1.95 meters. There have been no problems with retention of the samples nor with disturbance of the vertical stratification. (Carroll-FRC)
W82-00793

RELATION OF SATELLITE-BASED THUNDERSTORM INTENSITY TO RADAR-ESTIMATED RAINFALL,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 2B.
W82-00806

APPARATUS FOR THE SIMULATION OF RAIN IN THE LABORATORY,
State Univ. of New York at Albany.
For primary bibliographic entry see Field 2B.
W82-00807

SATELLITE RAIN ESTIMATION IN THE U.S. HIGH PLAINS,
National Oceanic and Atmospheric Administration, Boulder, CO.
For primary bibliographic entry see Field 2B.
W82-00808

A PORTABLE PUMP SAMPLER FOR LOTIC PERIPHYTON,
Northern Arizona Univ., Flagstaff. Dept. of Biological Sciences.
J. A. Hamala, S. W. Duncan, and D. W. Blinn.
Hydrobiologia, Vol 80, No 2, p 189-191, May, 1981. 1 Fig, 28 Ref.

Descriptors: *Water quality, *Monitoring, Measuring instruments, Sampling, Lotic environment. Bottom sampling, Sediments, Sediment sampler, *Substrates, *Lotic periphyton.

This note describes a simple, inexpensive sampling device and method for use in shallow flowing waters for collecting lotic periphyton on sedimentary substrates. The method offers several advantages: collection and comparison of quantitative samples of periphyton standing crop and colonization rate from intact, submerged substrata of sedimentary origin; establishment of permanent sampling sites on submerged substrata that may be monitored for seasonal or annual water quality programs; and an alternative to floating artificial samplers in areas with high recreational impact that eliminates human disturbance factors. A periphyton sampling program was initiated in May of 1979 at Slide Rock, Arizona, which is a recreational area. Members of the Bacillariophyta (diatoms) comprised the majority of the periphyton occurring on the colonization pads. Removal rates of periphyton from the substrate approached 90% based on sample counts taken from resampled colonization pads. In May of 1980 the periphyton sampling program at Slide Rock continued using the same colonization pads to withstand spring scouring events and associated high discharges indicates the applicability of these pads in ongoing water quality monitoring programs. (Baker-FRC)
W82-00826

THE RELATIONSHIP BETWEEN FRACTURE TRACES AND JOINTS IN A TERTIARY BASIN, SOUTHWEST MONTANA,
Indiana Univ. at Bloomington. Dept. of Geology.
N. C. Krothe, and M. P. Bergeron.
Ground Water, Vol 19, No 2, p 138-143, March/April, 1981. 5 Fig, 2 Tab, 13 Ref.

Descriptors: *Geologic fractures, *Aerial photography, *Groundwater mining, Aquifers, Limestone, Groundwater basins, *Montana, Groundwater potential.

A synclinal basin near Three Forks, Montana, was investigated, and the relationship between fracture traces mapped on aerial photographs and joints mapped in the field, was examined. Fracture traces were mapped in the southern half of Milligan Canyon by stereoscopic examination of 1:20,000 black and white aerial photographs. Fracture traces were transposed from the photographs to a base map using a Saltzmann projector. Also, joint and fracture orientations were measured in the field in outcrops of several pre-Tertiary formations. The Madison Group limestone which was measured in the field was a leaky artesian system. Regional flow direction was from west to east. A parallelism was found along a north-south and east-west direction which suggested that mapped fracture traces in the study area reflected areas of joint and fracture concentration in the subsurface. Field location of fracture intersections and subsequent drilling should produce high-yield water wells. (Small-FRC)
W82-00829

WASTE HEAT BALANCE IN AQUIFERS CALCULATED BY A COMPUTER PROGRAMME,
Geologisches Landesamt Nordrheim-Westfalen, Krefeld (Germany, F.R.).
W. Kley, and W. Heekmann.
Ground Water, Vol 19, No 2, p 144-148, March/April 1981. 6 Fig, 1 Ref.

Descriptors: *Groundwater reservoirs, *Heated water, *Waste heat, Computer programs, Heat, Heat transfer, *Energy, *Cologne, Federal Republic of Germany.

For many years, waste heat has been fed into the aquifers of the city of Cologne, Federal Republic of Germany, which has created a subsurface energy resource. A computer program was developed to analyze the temperature measurements in ground water and determine the isolines of the energy resource and of the recoverable amount of heat. This FORTRAN program determines the recoverable amount of heat per square unit and time in terms of heat flux density in W/sq m at a given exhaustion of the energy resource (within 10 and 20 years). A thickness of the ground water range amounting to 10 m is assumed. The results can be applied to plan and design the heat pump units. If heat pumps are not used, in the future a marked temperature rise in the ground water bearing layers will be observed. (Small-FRC)
W82-00830

A COMPARATIVE STUDY OF FOUR DREDGES USED FOR SAMPLING BENTHIC MACROINVERTEBRATES IN RIVERS,
Freshwater Biological Association, Windermere (England).
J. M. Elliott, and C. M. Drake.
Freshwater Biology, Vol 11, No 3, p 245-261, June, 1981. 6 Fig, 3 Tab, 27 Ref.

Descriptors: *Benthic environment, *Sampling, Bottom sampling, Rivers, Aquatic animals, Aquatic plants, Benthos, Aquatic life, *Dredging, Measuring instruments, Mathematical equations, *Macroinvertebrates.

Four light-weight dredges were chosen for manual operation from a small boat or the bank to secure samples of benthic macroinvertebrates in rivers. These four were: Irish triangular dredge, small Fast dredge, medium-sized and large Naturalist's dredges. The dredges usually took a similar range of stone sizes at each site, but the design of the Fast dredge was such that it excluded larger stones above 16 mm. The Irish dredge sometimes failed to operate correctly. Variations in the volume of substrate taken with each dredge were large, both between sampling units in the sample and between samples. Penetration depth was greatest for two Naturalist's dredges, smaller for the Fast dredge and smallest for the Irish dredge. The relative abundance of major taxa was similar for most dredges at each site. However, the high variability between sampling units in the same sample and thus a lack of precision in estimates of the mean number of invertebrates per sample makes the dredges unsuitable as quantitative samplers to estimate population density. There was a clear relationship between the number of taxa and the number of invertebrates taken at each site. The relationship was well described by a power law with an exponent within the range 0.18-0.53. The number of sampling units in the sample had no significant effect on the power-law equations for each site. These power-law relationships between number of taxa and number of individuals are probably applicable to samples taken with other equipment used for qualitative sampling such as pond nets and colonization samplers. (Baker-FRC)
W82-00833

EVIDENCE OF THE UNSUITABILITY OF GRAVITY CORING FOR COLLECTING SEDIMENT IN POLLUTION AND SEDIMENTATION RATE STUDIES,
Glasgow University (Scotland), Department of Chemistry.
M. S. Baxter, J. G. Farmer, I. G. McKinley, D. S. Swan, and W. Jack.
Environmental Science and Technology, Vol. 15, No 7, p 843-846, July, 1981.

Descriptors: *Sediments, *Sampling, Measuring instruments, Cores, Sedimentation, *Bottom sediments, Water pollution, Water quality.

Inherent dangers, specifically with respect to the not uncommon application of small-diameter gravity coring, in the collection of highly porous unconsolidated sediment as found in many coastal and lacustrine environments are cited. Specific evidence is presented based on the depth distributions of stable lead and manganese, 210-lead, 134-cesium, and 137-cesium in sediment cores collected at the same sites by two different devices: a small-diameter gravity corer and a soft-landing hydraulically damped Craib corer. The sediments studied were fine-grained silty clays from the deep basins of two fjoridc sea lochs, Loch Goil and Gareloch, of the Clyde Sea area. The material was relatively unconsolidated and highly porous. The gravity core profiles obtained seeemed plausible when considered individually. However, discrepancies were observed which point to a substantial (more than 15

cm) loss of surface sediment using the small-diameter gravity corer. The single most damaging piece of evidence to the credibility of small-diameter gravity coring is the complete absence of 134-cesium. It is concluded, therefore, that the vertical overlapping of craib and gravity core profiles is not valid, despite the apparently reasonable matching patterns which can emerge on occasion. (Baker-FRC)
W82-00840

A COMBINATION OF ELECTRICAL RESISTIVITY, SEISMIC REFRACTION, AND GRAVITY MEASUREMENTS FOR GROUNDWATER EXPLORATION IN SUDAN,
Groundwater Survey TNO, Delft (Netherlands).
For primary bibliographic entry see Field 2F.
W82-00852

POSSIBILITY OF USING TRITIUM FOR STUDYING GLOBAL CIRCULATION OF ATMOSPHERIC MOISTURE,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 2A.
W82-00863

EFFECTS OF JOULE HEATING ON THERMOCOUPLE PSYCHROMETER WATER POTENTIAL DETERMINATIONS,
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
D. C. Slack, and F. R. Riggle.
Transactions of the ASAE, Vol 23, No 4, p 877-883, July/August, 1980. 10 Fig, 22 Ref.

Descriptors: *Soil water potential, *Thermocouples, *Measuring instruments, *Soil water, Soil-water-plant relationships, Soil saturation, Psychrometry.

Thermocouple psychrometry has proved useful for the measurement of soil water potential in both laboratory and in situ environments. The magnitude and significance of Joule and resistance heating in two types of commercial soil thermocouple psychrometers on water potential determinations near saturation were investigated. The units tested were the Wescor PT51 single junction probe enclosed in a ceramic cup and the Emco PSY-350 double junction probe, which consists of two side-by-side junctions enclosed in a stainless steel cylinder covered on one end by a fine mesh screen. When water potentials were above -4 bars, a significant Joule and resistance heating was produced by a cooling current of 8 milliamperes (mA), resulting in unreliable measurements for both types of probes. The double junction probe was slightly less sensitive to heating than was the single junction probe. Significant reductions in the effects of heating at high water potentials were achieved by reducing the cooling current in the single junction probes to 3 mA. When the double junction probe was used, reduction of the cooling current to 4 mA eliminated heating problems. In each case, the reduced cooling current was applied for 15 seconds and the psychrometer was read 6 seconds after cessation of cooling. Using this procedure, reliable determinations were obtained for soil water potentials between -22 bars and -0.5 bars. Psychrometer response at water potentials below -22 bars was affected by the reduction in cooling current. The magnitude of the cooling current was found to have much more effect on heating than did the duration of the cooling current. (Carroll-FRC)
W82-00892

AERIAL PHOTOGRAPHY AS AN AID TO CROPLAND EROSION ANALYSIS,
Texas Christian Univ., Fort Worth. Dept. of Geology.
For primary bibliographic entry see Field 2J.
W82-00902

INTERPRETATION OF SURFACE-WATER CIRCULATION, ARANSAS PASS, TEXAS, USING LANDSAT IMAGERY,
Texas Univ. at Austin.
R. J. Finley, and R. W. Baumgardner.
Remote Sensing of Environment, Vol 10, No 1, p 3-22, August, 1980. 12 Fig, 3 Tab, 29 Ref.

Descriptors: Photography, *Aerial photography, *Remote sensing, *Satellite technology, Photogrammetry, Infrared imagery, Sensors, Telemetry, Sedimentation, Sediment concentration, *Sediment transport, Turbidity, Surface waters, *Coastal waters, Turbidity flow, Physical properties, Tidal effects, Wind-driven currents, *Aranasas Pass, *Texas, Gulf of Mexico.

The development of plumes of turbid surface water in the vivinity of Aransas Pass, Texas has been analyzed using Landsat imagery. The shape and extent of plumes present in the Gulf of Mexico are dependent on the wind regime and astronomical tide prior to and at the time of satellite overpass. The best developed plumes are evident when brisk northerly winds resuspend bay-bottom muds and flow through the Pass is increased by wind stress. Wind-influenced surface currents assume greater significance when astronomical tides are low within the coastal bays. Where intense hydrocarbon production and transportation activity may increase the risk of spillage, knowledge of surface current direction under given wind conditions is critical. (Titus-FRC)
W82-00904

ATMOSPHERIC WATER CONTENT OVER THE TROPICAL PACIFIC DERIVED FROM THE NIMBUS-6 SCANNING MICROWAVE SPECTROMETER,
National Environmental Satellite Service, Washington, DC.
N. C. Grody, A. Gruber, and W. C. Shen.
Journal of Applied Meteorology, Vol 19, No 8, p 986-996, August, 1980. 10 Fig, 17 Ref.

Descriptors: *Atmospheric water, *Tropical regions, *Meteorological data collection, Climatic data, Satellite technology, *Remote sensing, Clouds, Precipitation, Moisture content, Microwaves, Radiosondes, Spectrometers.

The scanning microwave spectrometer (SCAMS) aboard Nimbus-6 determined integrated water vapor (precipitable water) and cloud liquid water over the tropical Pacific Ocean between 130 degrees E to 100 degrees W and 35 degrees N to 35 degrees S for the period August 18 to September 4, 1975. The 2 channel measurements, at 22.23 GHz and 31.65 GHz, were used in a nonlinear relationship, which is more accurate than linear model for the large values of precipitable water found in the tropics. The SCAMS values of precipitable water and 163 radiosonde measurements from 19 island stations showed the same variability, with a 0.5 cm rms difference. The Intertropical Convergence Zone was delineated near 10 degrees N and contained $>$ 5 cm precipitable water and $>$ 0.4 mm liquid water. The Southern Convergence Zone was also well demonstrated. The equatorial Pacific dry zone in both hemispheres contained $<$ 3.5 cm of moisture and $<$ 0.2 mm liquid. (Cassar-FRC)
W82-01004

DESCRIPTION OF A NEW SUBMERSIBLE FILTER-PUMP APPARATUS FOR SAMPLING PLANKTON,
Illinois Natural History Survey, Urbana.
S. W. Waite, and S. M. O'Grady.
Hydrobiologia, Vol 74, No 2, p 187-191, September, 1980. 4 Fig, 1 Tab, 13 Ref.

Descriptors: *Submersible pumps, *Sampling, *Plankton, Zooplankton, Phytoplankton, Pumps, Filters, Aquatic life, Copepods, Rotifers, Cladocerans, Invertebrates, Rivers, Cooling ponds, Powerplants.

A low volume submersible filter-pump apparatus is useful in collecting zooplankters and other aquatic organisms, especially in rivers and powerplant cooling lakes. Both pump and filter are enclosed in a submersible plexiglass box, forming a unit that weighs only 7.7 kg. The intake diameter, filter mesh size, and rate capacity of the pump may be manipulated to produce the desired total sample volume. A 2 min pumping time with 80 micron mesh and 1200 gallons per hour pump gives 176 liters of water, equivalent to towing a 13 cm Wisconsin-style plankton net for 17 meters. Compared with conventional tow net samplers, the filter-pump collects greater numbers of rotifers and immature copepods per unit volume and fewer mature copepods. Cladocerans capture rate is similar for both types of apparatus. (Cassar-FRC)
W82-01012

A REVIEW ON SEDIMENT TRAPS IN AQUATIC ENVIRONMENTS,
Stockholm Univ. (Sweden). Dept. of Geology.
S. Blomqvist, and L. Hakanson.
Archiv fur Hydrobiologie, Vol 91, No 1, p 101-132, March, 1981. 15 Fig, 2 Tab, 240 Ref.

Descriptors: *Aquatic environment, *Sediments, *Trap efficiency, *Bottom sediments, *Suspended solids, Reviews, Measuring instruments, Experimental design, Design standards, Sediment traps, Sediment samples.

The use of trap devices for the collection of sedimentating material is becoming increasingly important in the study of aquatic systems. A broad literature review was conducted in an effort to identify various types of sediment traps suitable for use in aquatic environments and to evaluate the benefits and limitations of these devices. Bottom sediment traps may be located either at the sediment surface or above the sediment surface in the water phase. Buoy-carried sediment traps may be either moored or free-drifting. Selection of the type of sediment trap should be based on the purpose of the investigation. The results obtained will depend on the environment in which the trap is placed. Bottom sediment traps should be used only within zones of accumulation, while buoy-carried traps will yield best results if placed in a hydrodynamically calm environment. The sediment vessel must be kept in a horizontal position throughout the registration period. The geometry and size of the sediment collection vessel are important factors controlling the results. Negative edge effects often result from the use of unsymmetric and/or angular sediment vessels. Cylindrical vessels with narrow orifices may collect a disproportionate amount of organic material in non-stagnant waters. Marking and rigging devices for buoy-carried traps need to be improved. Free drifting sediment traps require further investigation. The relationships among deposition, Reynolds number, and height-diameter ratios for cylindrical vessels need to be studied, as does the relationship between orifice area and trapping efficiency in these vessels. The complex of selective trapping and qualitative representativity of deposited matter in sediment vessels needs to be evaluated. (Carroll-FRC)
W82-01020

SOIL PERCOLATION TESTS,
Indian Health Service, Seattle, WA. Office of Environmental Health.
For primary bibliographic entry see Field 2G.
W82-01044

7C. Evaluation, Processing and Publication

SUMMARY APPRAISAL OF WATER RESOURCES IN THE REDMOND QUADRANGLE, SANPETE AND SEVIER COUNTIES, UTAH,
Geological Survey, Salt Lake City, UT. Water Resources Div.
D. Price.
Br. of Distr. USGS Box 25286, Fed. Ctr. Denver, CO 80225. Price: $1.50. Geological Survey Miscellaneous Investigations Series Map I-1304-B, 1981. 1 Sheet, 11 Ref.

Descriptors: *Maps, *Surface water, *Groundwater, *Water quality, Water supply, Aquifer, Wells, Water yield, Dissolved solids, *Utah, Redmond quadrangle, Sevier River basin.

The Redmond Quadrangle is in the central Sevier River valley about 105 miles south of Salt Lake

City, Utah. The Sevier River, which flows northward through the quadrangle, is the principal source of surface water for the area. Average annual (1912-78) flow of the river were gaged, about 12 miles south of the quadrangle, is about 68,000 acre-feet (excluding upstream irrigation diversions). The principal source of ground water in the Redmond Quadrangle is the unconsolidated valley fill that underlies the Sevier River valley plain. The fill contains an estimated 120,000 acre-feet of recoverable water. It is tapped by many small-diameter domestic and stock wells, most of which produce less than 100 gallons per minute of water. However, available data indicate that the fill could yield several hundred gallons per minute to properly located and constructed large-diameter wells. Dissolved-solids concentrations of the surface water generally exceed 500 mg/L and periodically exceed 1,000 mg/L during low-flow periods. Dissolved-solids concentrations of the ground water also generally exceed 500 mg/L and can be expected to exceed 1,000 mg/L in many parts of the quadrangle. The principle source of the dissolved solids is the Arapien Formation of Jurassic (and Tertiary) age, which underlies much of the Redmond Quadrangle (including the valley fill) and adjacent areas. This formation contains large amounts of salt and other easily dissolved evaporite deposits. (USGS)
W82-00725

POTENTIOMETRIC-SURFACE MAP FOR THE CRETACEOUS AQUIFER, VIRGINIA COASTAL PLAIN, 1978,
Geological Survey, Richmond, VA. Water Resources Div.
H. T. Hopkins, R. F. Bower, J. M. Abe, and J. F. Harsh.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $2.50 in paper copy, $0.50 in microfiche. Geological Survey Open-File Report 80-965 (WRI), 1981. 1 Sheet, 11 Ref.

Descriptors: *Maps, *Groundwater, *Potentiometric level, *Aquifers, Geohydrology, Groundwater mining, Water use, Water supply, Wells, Water level, Subsidence, *Virgina, Coastal Plain.

The Atlantic Coastal Plain of Virginia includes 9,600 square miles--all or part of 40 counties east of the Fall Line. The undifferentiated Cretaceous sediments underlying this area are the most productive and extensive source of ground water, from which large withdrawals have been made over the past 40 years. In 1978, withdrawals exceeded 100 million gallons per day. To determine the effect of continued withdrawals, annual synoptic water levels for 1978 were used to prepare a map showing the approximate configuration of the potentiometric surface. (USGS)
W82-00727

POTENTIOMETRIC SURFACE OF THE WILCOX-CARRIZO AQUIFER; BIENVILLE, RED RIVER, NORTHERN NATCHITOCHES, AND SOUTHERN WEBSTER PARISHES, LOUISANA,
Geological Survey, Alexandria, LA. Water Resources Div.
G. N. Ryals.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $1.00 in paper copy, $0.50 in microfiche. Geological Survey Open-File Report 80-1179, 1980, 1 Sheet.

Descriptors: *Maps, *Potentiometric level, Aquifers, *Groundwater, Geohydrology, Contours, Water level fluctuations, Wells, Data collections, *Louisiana, *Wilcox-Carrizo aquifer.

The potentiometric surface of the Wilcox-Carrizo aquifer in central northwestern Louisiana is shown by contours using data collected from 1960 to 1980. The aquifer is not affected by regional water-level declines as no large pumping centers have been developed. Seasonal water-level fluctuations in wells are generally less than 10 feet annually. (USGS)
W82-00728

GENERALIZED THICKNESS OF THE FLORIDAN AQUIFER, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT,
Geological Survey, Tallahassee, FL. Water Resources Div.
R. M. Wolansky, and J. M. Garbade.
Geological Survey Open-File Report 80-1288 (WRI), 1981. 1 Sheet, 30 Ref.

Descriptors: *Maps, *Confined aquifers, *Aquifer characteristics, *Groundwater, Geohydrologic units, Geohydrology, Wells, *Florida, *Floridan aquifer, Southwest Florida Water Management District.

This map report presents the thickness of the Floridan aquifer in the Southwest Florida Water Management District. The Floridan aquifer ranges in thickness from 600 feet in the northern part of the District to 2,400 feet in the southern part. It is composed chiefly of limestone and dolomite beds that range in age from early Miocene to middle Eocene. For this investigation, the formations considered to be part of the Floridan aquifer are: Lake City and Avon Park Limestones of middle Eocene age; Ocala Limestone of late Eocene age; Suwannee Limestone of Oligocene age; and permeable parts of the Tampa Limestone and Hawthorn Formation of Miocene age that are in hydrologic contact with the rest of the aquifer. (USGS)
W82-00729

WATER RESOURCES DATA FOR ILLINOIS, WATER YEAR 1980--VOLUME 1. ILLINOIS EXCEPT ILLINOIS RIVER BASIN.
Geological Survey, Urbana, IL. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as 82-106311, Price codes: A99 in paper copy, A01 in microfiche. Geological Survey Water-Data Report IL-80-1, 1981. 708 p, 4 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Illinois.

Water resources data for the 1980 water year for Illinois consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels and water quality of ground-water wells. This volume contains records for water discharge at 98 gaging stations, stage only at 5 gaging stations, stage and contents at 3 lakes and reservoirs, stage only at 1 lake station, and water quality at 125 gaging stations and 43 wells. Also included are data for 38 crest-stage partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. These data together with the data in Volume 2 represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local, and Federal agencies in Illinois. (USGS)
W82-00731

WATER RESOURCES DATA FOR ILLINOIS, WATER YEAR 1980--VOLUME 2. ILLINOIS RIVER BASIN.
Geological Survey, Urbana, IL. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-106220, Price codes: A21 in paper copy, A01 in microfiche. Geological Survey Water-Data Report IL-80-2, 1981. 468 p, 4 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Illinois, *Illinois River basin.

Water resources data for the 1980 water year for Illinois consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels and water quality of ground-water wells. This volume contains records for water discharge at 85 gaging stations, stage only at 2 gaging stations, stage only at 3 lake stations, water quality at 97 gaging stations and 33 wells, and water levels at 3 observation wells. Also included are data for 44 crest-stage partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. These data together with the data in Volume 1 represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local, and Federal agencies in Illinois. (USGS)
W82-00732

WATER RESOURCES DATA FOR UTAH, WATER YEAR 1980.
Geological Survey, Salt Lake City, UT. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-108606, Price codes: A99 in paper copy, A01 in microfiche. Geological Survey Water-Data Report UT-80-1, 1981. 684 p, 12 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Utah.

Water resources data for the 1980 water year for Utah consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels and water quality of ground water. This report contains discharge records for 294 gaging stations; stage and contents for 22 lakes and reservoirs; water quality for 64 hydrologic stations, 194 partial-record stations, and 323 wells; and water levels for 36 observation wells. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in Utah. (USGS)
W82-00733

APPROXIMATE GROUND-WATER-LEVEL CONTOURS, APRIL 1981, FOR THE SOQUEL-APTOS AREA, SANTA CRUZ COUNTY, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
R. M. Bloyd.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $3.25 in paper copy, $4.00 in microfiche. Geological Survey, Open-File Report 81-680, June 1981. 3 p, 1 Fig, 2 Ref.

Descriptors: *Groundwater, *Water level, *Maps, *Contours, Aquifers, Groundwater movement, Wells, Pumping, *California, Santa Cruz County, Soquel-Aptos area, Water-level declines.

Ground-water levels in selected wells were measured in the Soquel-Aptos, Calif., area in April 1981. On the basis of these measurements approximate ground-water-level contours were constructed. The general direction of ground-water movement in the Soquell-Aptos area is from the ridges in the northern part of the area, toward the adjacent canyons, and then southward toward the ocean. Ground-water pumping has caused groundwater levels to decline below sea level in the Capitola area, in the area just to the west and northwest of aptos, and in isolated local areas southwest of Rio Del Mar. Ground-water levels in the northern part of the area away from the seacoast have not declined much over time. (USGS)
W82-00734

8. ENGINEERING WORKS

8A. Structures

SMALL HYDRO INSTALLATIONS SPUR UNIQUE ENGINEERING SOLUTIONS,
Tudor Engineering Co., Riverton, WY.
For primary bibliographic entry see Field 6B.
W82-00538

MODELING GRADUAL DAM BREACHES,
San Diego State Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8D.
W82-00554

RELIABILITY OF UNDERGROUND FLOOD CONTROL SYSTEM,
Arizona Univ., Tucson. Dept. of Systems and Industrial Engineering.
L. Duckstein, I. Bogardi, and F. Szidarovszky.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY7, p 817-827, July, 1981. 3 Fig, 1 Tab, 13 Ref.

Descriptors: *Mining engineering, *Flood protection, *Karst hydrology, Flood control, Drainage, Underground structures, Grouting, Protection, Pumping plants, Tunnel failure, Sediment control, Manyi, Hungary.

A reliability model of an underground hydraulic engineering system for protecting mines against inflows or inrushes of water is presented. This paper considers the probability that a flood control system will fulfill its function within a given time interval. The scope covers only equipment protection, not personnel escape routes. The recommended approach for studying these complex failure events is a failure tree analysis followed by Monte Carlo simulation. Possible failure events are flooding in faces, flooding in blocks, simultaneous disturbances in several blocks, and flooding of mines. A protection system may include face protection, water cut of faces, block water cut, mine water cut, sediment settler and removal equipment, and central pumping station. An example uses the Manyi mine, Hungary, which is 300 meters below the karstic water level. Two alternative protection methods are evaluated: INSTANTAN (which provokes inrushes before full-scale mining starts) combined with artificial sealing (moderate and high), and passive control (a drainage system). Results, depicted on bar graphs, can be used in design of the protection scheme. (Cassar-FRC)
W82-00556

WHY EPA'S I/I CONTROL PROGRAM FAILS,
Westech Engineering, Inc., Salem, OR.
C. H. Steketee.
Public Works, Vol 112, No 7, p 51-53, July, 1981. 3 Fig, 1 Tab.

Descriptors: *Sewer systems, *Infiltration, *Rehabilitation, Leakage, Water mains, Pipes, Maintenance, Economic aspects.

An evaluation of the EPA program to reduce infiltration/infow (I/I) in sewer systems showed that generally the program has not been effective, especially in older systems. In 18 communities the percent reduction achieved was 0 to 60% in 8 cases, an increase in 3 cases, and no information available for 5 cases. Some of the problems encountered are water-transmitting backfill materials, piping and erosion around the sewer pipes, storm-induced infiltration, difficulties in identifying the location of leaks in surcharging sewers, transference of leaks to other locations as holes are repaired, and the necessity to fix nearly all the leaks in a section to make a significant improvement. Some suggestions learned from experience are: (1) sometimes 3 years are required to significantly reduce I/I, (2) annual reevaluation should follow evaluation and repairs, (3) the cheapest techniques should be used first, (4) upstream problems should be dealt with before downstream problems, (5) a complete renovation is more effective than making scattered repairs, (6) all leaky joints must be grouted, and (7) all system components must be repaired, not just leaky mains and manholes. (Cassar-FRC)
W82-00790

FACTORS INFLUENCING THE OCCURRENCE OF BURSTS IN IRON WATER MAINS,
Severn-Trent Water Authority (England).
R. Newport.
Aqua, No 3, p 274-278, 1981. 10 Fig, 2 Ref.

Descriptors: *Water mains, *Pipes, *Iron, Water distribution, Metal pipes, Corrosion, Water loss, Leakage, Pipelines, Soil types, Frost, Frozen ground, Materials engineering, *Pipe failure, Seven-Trent Water Authority, *Great Britain.

A statistical study on burst water mains in the Severn-Trent Water Authority revealed two major causes of failure: ground loading (frost, drought, and soil type) and corrosion (soil type, water, and pipe material). A winter peak in bursts is caused by frosts, especially those earlier in the season. The relationship may be described as: Total bursts per year = 2.5 x Total degrees of frost + 500. The magnitude of this peak can identify areas where corrosion is severe. Summer peaks, less common, appear during severe drought and are caused by ground movement as the earth cracks. Age cannot be correlated well with pipe failure. However, the spun iron pipes laid since 1952 have the highest burst rate, 0.39 burst per km per year. These show fissure corrosion resulting in a circumferential break upon stress. Average burst rates for four areas with cast iron pipes dating back to 1890 are 0.08 to 0.12 burst per km per year. Other factors affecting failure rate are: soil type (pipes laid in clay soils have twice the burst rate of those in sand and gravel), water type (soft water is worst), traffic loading, and accidental damage (during construction or before installation). (Cassar-FRC)
W82-00960

A NEW LOOK AT DESIGN OF RAW WATER PIPING,
C. F. Bowman, and W. S. Bain.
Power Engineering, Vol 84, No 8, p 73-77, August, 1980. 8 Fig, 1 Tab.

Descriptors: *Pipelines, *Design criteria, *Corrosion, Steel, Materials, Raw water, Conveyance structures, Pressure distribution, Temperature effects, Aeration, Oxidation, Water pressure, Hydraulic roughness.

A study was undertaken to determine the extent of the problem of materials building up on the inside of pipelines in the Tennessee Valley Authority system. Some recommendations are made for procedures to help mitigate this problem in the design of future power plants. About 50 sections of carbon steel raw water piping were removed from nine different TVA steam plants. Normally stagnant and normally flowing piping systems were sampled as well as both vertical and horizontal runs of pipe. The primary mechanism of material build-up was corrosion of the steel piping by aerated river water and redeposition of the corrosion products. The result is random pitting in the pipe wall and the formation of a tubercle over each pit. Pressure drop tests were performed at several plants to evaluate the effects of corrosion product buildup on pressure drop. The results of this study should have a profound impact on the design of future raw water piping systems, as the pressure drops calculated by methods recommended herein are significantly greater than those which would be calculated by presently recognized standard methods. These findings apply only to friction losses and should not be applied to form losses. (Baker-FRC)
W82-01029

8B. Hydraulics

FRONTAL JUMP CONDITIONS FOR MODELS OF SHALLOW, BUOYANT SURFACE LAYER HYDRODYNAMICS,
Delaware Univ., Newark. Coll. of Marine Studies.
R. W. Garvine.
Tellus, Vol 33, No 3, p 301-312, June, 1981. 7 Fig, 22 Ref.

Descriptors: *Mathematical models, *Hydrodynamics, *Flow characteristics, Coastal waters, Interfaces, Thermocline, Thermal stratification, Hydraulic jump, Fluid mechanics, Lakes, Temperature effects, Saline-freshwater interfaces.

A shallow, buoyant upper layer is often found overlying heavier water of substantially greater depth in both coastal and inland waters. Examples of these moving frontal regions include surface plumes of buoyant water originating from a nearby source and the surface layer above the thermocline in lakes. This paper discusses an approach to modeling the hydrodynamics of these surface layers in which the flow field is partitioned into a frontal region where dissipative effects are important and an internal wave region in which they are not. The frontal region is treated as a horizontal discontinuity described by appropriate jump conditions. The wave region is described by nonlinear, long internal wave equations. Frontal jump conditions, which account for the transport of mass and momentum across the interface with the underlying fluid, are derived for use in applications of the model to small-scale flows where earth rotation has a negligible effect. These jump conditions are also applicable to flows where the depth of the buoyant layer vanishes on the upstream side of the front. The solution of a problem representing the sudden release of a shallow, buoyant upper layer into an unbounded domain is used to demonstrate the use of frontal jump conditions in conjunction with nonlinear internal wave equations. Although the results for zero interfacial transport are identical to the classical description of the analogous single layer problem posed by the sudden breaking of a dam, new features of the flow arise for non-zero transport. (Carroll-FRC)
W82-00804

HYDRAULIC DESIGN FOR THE TWO-STAGE STILLING BASIN,
Saskatchewan Univ. Saskatoon. Dept. of Civil Engineering.
C. D. Smith, and M. J. Klassen.
Canadian Journal of Civil Engineering, Vol 8, No 2, p 137-145, June, 1981. 12 Fig, 3 Tab, 5 Ref.

Descriptors: *Stilling basins, *Design criteria, *Hydraulic design, Hydraulic jump, Tailwater, Basins, Mathematical studies, Hydraulic models.

The two-stage stilling basin is a design sometimes used for high head energy dissipating structures. Such stilling basins are often located in deep excavations because otherwise the natural tailwater is insufficient to force a hydraulic jump. The existence of two hydraulic jumps occurring in series in the same structure is the distinguishing feature of the two-stage stilling basin design. The tailwater depth for the first jump is created by a fixed weir at the end of the first basin. The jump in the second basin is forced by the natural tailwater depth in the downstream channel. Dissipation of most of the energy of flow in the first jump results in a considerable decrease in the required tailwater depth necessary to produce a jump in the second basin. Although the two-stage basin is subatantially longer than the single-stage basin, the cost advantages of a higher floor elevation more than offset the costs of the extra length in some cases. Several hydraulic model tests for a two-stage stilling basin were conducted. The performance of the hydraulic jump in close proximity to a weir was first studied for two-dimensional flow using a parallel side flume. A design criterion was developed which was then verified on a three-dimensional model. Recommended values for the length of the first basin, length of the second basin, weir coefficient, weir shape, and weir height are included. (Carroll-FRC)
W82-00849

HYDRAULIC MODEL STUDY FOR THE DESIGN OF THE WRECK COVE CONTROL GATES,

McMaster Univ., Hamilton (Ontario). Dept. of Mechanical Engineering.
D. S. Weaver, and W. W. Martin.
Candian Journal of Civil Engineering, Vol 7, No 2, p 304-314, 1980. 14 Fig, 8 Ref.

Descriptors: *Hydraulic gates, *Reservoirs, *Flow characteristics, Model studies, Gates, Wreck Cove, *Nova Scotia, Powerplants, Outlets, Control systems, Oscillatory waves, Hydraulic models, Hydraulic design.

Scale model studies in a water tunnel were used to test the proposed configuration for the Wreck Cove, Nova Scotia, power plant vertical lift control gates. The gates are expected to operate under reasonable downpull loads and not suffer from sustained flow-induced oxicllations. Gates of similar geometry are planned upstream of the control gate and at two locations further upstream in the reservoir network. These locations differ in probable head, flow rate, and downpull. The data obtained from the model studies agree with previous results from sealed two-dimensional wind tunnel models. Maximum overall downpull coefficient is 0.4 and occurs at a gate opening of 45%. Gate slots do not significantly affect the maximum downpull coefficient or the relative opening at which it occurs. However, the downstream free surface increases the maximum downpull coefficient by about 5%. Removal of the curve fairing the bevelled gate bottom into the vertical face produces flow separation and significant buffeting of the gate. Changing the arrangement so that the bevel is downstream greatly increases downpull and could result in significant buffering if the bevelled face is submerged. (Cassar-FRC)
W82-00880

DEVELOPMENT OF MAKEUP-LINE SAFE-OPERATING CRITERIA,
Bechtel Inc., Norwalk, CA.
P. K. Su, and I. Joseph.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 106, No HY2, p 269-283, February, 1980. 10 Fig, 2 Tab, 1 Ref.

Descriptors: *Mathematical models, *Powerplants, *Pipelines, Head loss, Pumping plants, Water treatment facilities, Maintenance, Operating policies, *Navajo Generating Station, Arizona.

A field experiment and mathematical analysis of the hydraulic transients were performed on the makeup lines of the Navajo Generating Station, located in northcentral Arizona near the border of Utah. The station is a three-unit, coal-fired power plant. Its makeup system, including the lake pumping station and two parallel pipe lines, conveying water from Lake Powell to the water-treatment facility at the plant site. The water is used as a makeup supply for evaporation losses and blowdown from the cooling towers of the main condenser circulating water system. After adjusting the head-loss coefficients of the pipeline and the air-chamber nozzle in the mathematical model, the results show a satisfactory agreement between the measured and calculated transient response at the air chambers and several points along the pipeline. The mathematical model was next used to develop system operating criteria that include automatic control of the water levels in the air chamber for various flow rates. The system is protected from adverse transient effects due to power interruptions. (Baker-FRC)
W82-01095

8D. Soil Mechanics

MODELING GRADUAL DAM BREACHES,
San Diego State Univ., CA. Dept. of Civil Engineering.
V. M. Ponce, and A. J. Tsivoglou.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY7, p 829-838, July, 1981. 1 Tab, 25 Ref.

Descriptors: *Dam failure, *Erosion, Embankments, Earth dams, Model studies, Mathematical models, Channel morphology, Bank erosion, Flood peak, *Huaccoto Dam, Mantaro River, *Peru, Hydrographs, Reservoirs, Earthquakes, Landslides.

A simulation model of the gradual failure of an earth embankment dam was formulated, developed, and tested. Concepts of water and sediment routing and channel geometry were used to develop a self-contained mathematical model of the breach enlargement and the ensuing flood wave. Unsteady flow elements of the simulation are an implicit numerical solution of the complete Saint Venant equations coupled with a sequential sediment routing technique. The model was tested on the failure of a natural embankment formed by an earthquake landslide at Huaccot on the Mantaro River, Peru, in April, 1974. The failure of this 170 meter high, 3800 meter long embankment holding back 665 million cu meters of water occurred by overtopping. This developed a breach which grew under the erosive action of the waters for 48 hours, a period much longer than the usual few hours failure time documented for engineered dams. Comparisons between estimated actual and simulated flood characteristics were remarkable. Actual and simulated values were as follows, respectively: peak discharge, 13,700 and 13,200 cu meters per sec; maximum crest erosion, 35 and 37 meters; maximum flow depth, 15-20 and 12-22 meters; time from 0 to 100 cu meters per sec, both 16 hours; time from 100 cu meters per sec to peak discharge, both 10 hours; and hydrograph duration from 100 cu meters per sec to peak and recession, 32 and 34 hours. (Cassar-FRC)
W82-00554

SETTLEMENT OF A COMPACTED UNSATURATED EARTH EMBANKMENT,
University of the Witwatersrand, Johannesburg (South Africa).
G. E. Blight, G. H. H. Legge, and G. W. Annandale.
Civil Engineer in South Africa, Vol 22, No 2, p 25-29, February, 1980. 6 Fig, 16 Ref.

Descriptors: *Dams, *Soil compaction, Soil engineering, Soil mechanics, Sedimentation, *Mita Hills Dam, Mathematical studies, South Africa, Dam design, Settlement analysis.

A settlement analysis of the Mita Hills Dam, made during its design in 1956-57, has been reexamined in the light of current soil mechanics knowledge and computational procedures. The Mita Hills Dam embankment has a maximum height of 48.8 meters, a crest length of 366 meters, and consists of some one million cubic meters of rolled earth-fill. The entire downstream zone of the fill is protected from seepage by the inclined filter drain, while 12 pore pressure relief drains were provided in the heart of the downstream zone to relieve construction pore pressures. The time-settlement and void ratio-pressure characteristics of the Mita Hills soil had been measured by means of standard oedometer test techniques on specimens of soil taken from the proposed borrow pits. The difference between the original analysis and the analysis conducted in recent years indicated the results of post-construction consolidation. Use of more modern computational skills has enabled the prediction of post-construction settlement of a compacted earth embankment with increasing accuracy. The improved accuracy results more from computational improvements than from improvements in the area of soil mechanics understanding. (Baker-FRC)
W82-00678

LARGE RUBBLE-MOUND BREAKWATER FAILURES,
Harris (Frederic R.) Inc., Houston, TX.
E. H. Harlo.
Journal of the Waterway, Port, Coastal and Ocean Division, Proceedings of the American Society of Civil Engineers, Vol. 106, No. WW2, p 275-278, 1980. 1 Fig, 8 Ref.

Descriptors: *Coastal waters, *Breakwaters, *Jetties, *Sea walls, *Construction, Engineering, Dam construction, Construction materials, Construction methods, Stress, Stability analysis, Storms, Damage, Foundation failure.

The mechanism by which waves cause large internal water pressures and cause breakwater failures is outlined. Hydrodynamic pore pressures in the core material contribute significantly to the failure of rubble-mound structures. Steep slopes cause larger seepage pressures in the direction of incipient failure planes. The smaller the permeability of core materials next to the filter rock, the larger will be the seepage pressures along these planes. Model study of the phenomenon is recommended. This should include determination of the angle of internal friction of the core material, maximum instantaneous seepage pressures in the core, and dynamic analysis of slope stability for various breaking wave patterns at a series of stages during the maximum wave cycle. (Titus-FRC)
W82-00862

8G. Materials

SUCCEEDING WITH LINER INSTALLATION,
Water and Sewage Works, Vol 127, No 4, p 60-61, April, 1980. 1 Fig.

Descriptors: *Linings, *Reservoir linings, Ponds, Lagoons, Coating, Reservoirs.

The importance of installation technique in the application of a lining is discussed. Regardless of the type of lining membrane used, the success will depend to a very large extent on the experience and expertise of the installer. Information needed about the liner in order to make a selection includes a study of the compatibility of the liner material and scrims with the process fluids involved. A temperature test must be made of the fluid when it is injected into the pond as well as at its standing temperature. Injection and withdrawal methods must be examined, including the number and types of monitoring or inspection facilities that may be needed. The volume of liquid to be stored must be known, as well as length, width, depth, and side slope ratio of the pond. The type and condition of the soil, groundwater table and surrounding terrain as well as the location of the pond and the high and low temperatures experienced in the area must be known. Installation cost must be carefully computed before making final decisions. (Baker-FRC)
W82-00909

8I. Fisheries Engineering

FACTORS AFFECTING PUGET SOUND COHO SALMON (ONCORHYNCHUS KISUTCH) RUNS,
Washington Univ., Seattle. Coll. of Fisheries.
S. B. Matthews, and F. W. Olson.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 9, p 1373-1378, September, 1980. 2 Fig, 2 Tab, 16 Ref.

Descriptors: *Salmon, *Streamflow, *Fish populations, Fish management, Fisheries, Fish hatcheries, Temperature effects, Dissolved oxygen, Mathematical studies, Seasonal variation, Runoff, *Puget sound, Washington, Water quality.

During their freshwater stream residence, juvenile coho salmon (Oncorhynchus kisutch) may be subject to such stresses as high temperature, predation, low dissolved oxygen, disease, stranding and overcrowding. These factors have been associated with streamflow conditions and may affect salmon populations. Hatchery production of salmon has also had a significant effect on coho population growth. A relationship has been recognized between rearing flow conditions and coho run strength for more than 40 years. It was theorized that the survival of hatchery coho may be positively related to the same environmental conditions that affect the stream-reared salmon. A depensatory mortality relationship between abundances of stream-reared and hatchery coho similar to that observed in pink salmon was suggested. (Geiger-FRC)
W82-00883

GREAT LAKES ENVIRONMENTAL PROTECTION POLICIES FROM A FISHERIES PERSPECTIVE,
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 6G.
W82-00978

GONAD DEVELOPMENT, FECUNDITY, AND SPAWNING SEASON OF LARGEMOUTH BASS IN NEWLY IMPOUNDED WEST POINT RESERVOIR, ALABAMA-GEORGIA,
Alabama Cooperative Fishery Research Unit, Auburn.
For primary bibliographic entry see Field 2H.
W82-01080

9. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

FACTS FIX FUND FINDING,
Havens and Emerson Ltd., Cleveland, OH.
G. D. Simpson.
Water and Sewage Works, Vol 127, No 4, p 56, 84, April, 1980. 1 Tab, 5 Ref.

Descriptors: *Government finance, *Water treatment, *Wastewater treatment, Economic aspects, Training, Government supports, Grants, Legislation, Education.

Grants, loans, training and advisory services, and information services are among the programs available from the Federal and state governments to assist municipalities and sewer districts in discharging their responsibilities. Federal legislation in this area is contained primarily in the Water Pollution Control Act and the Clean Water Act, as well as the Safe Drinking Water Act and the Resource Conservation and Recovery Act amendments to the Solid Waste Disposal Act. Support includes grants for research and investigative studies, financing of pilot programs, grants to assist in costs for technical evaluation of operation and maintenance for demonstration projects, costs for technical evaluation of operation and costs of certain training, and scholarships to individuals for college training in the field of operation and maintenance of treatment works. Means of contacting various agencies are listed. (Baker-FRC)
W82-00885

10. SCIENTIFIC AND TECHNICAL INFORMATION

10D. Specialized Information Center Services

POINT-OF-USE WATER TREATMENT...AN ENLARGING REALITY,
L. Vinyard.
Water and Sewage Works, Vol 127, No 4, p 8, April, 1980.

Descriptors: *Organizations, *Water quality control, Water Quality management, Water quality standards, Professional societies, Professional personnel, *Water treatment, Information retrieval, *Water quality association.

The Water Quality Association (WQA) is the spokesman for the point-of-use water-treatment industry, which provides water treatment technology for systems ranging from a single home faucet to municipal treatment for small communities. The industry consists of more than 200 manufacturers and nearly 5000 retailers. The WQA is frequently contacted to provide information needed by legislators as they attempt to formulate needed legislation and governmental approches to solving current problems. Future research conducted by the WQA will include an analysis of economics and a possible demonstration project. (Baker-FRC)
W82-00784

SUBJECT INDEX

ABIENOL
Conversion of Abienol into Tetrahydroepimanool by Anaerobic Processes in Woodroom Debarking Effluent,
W82-00860 5C

ABSORPTION
Absorption of Fenitrothion by Plankton and Benthic Algae,
W82-00874 5B

ACCLIMATIZATION
Clonal Variations in the Water Relations of Red Osier Dogwood During Cold Acclimation,
W82-00839 2I

ACCUMULATION
The Effect of Temperature on Salt Uptake by Tomato Plants With Diurnal and Nocturnal Waterlogging of Salinized Rootzones,
W82-00608 2I

Uptake and Transfer of the Chlorinated Hydrocarbon Lindane (Gamma-BHC) in a Laboratory Freshwater Food Chain,
W82-01033 5C

ACID MINE WATER
Mechanism of Charged Membrane Ultrafiltration of Salt Solutions,
W82-00641 5D

ACID RAIN
Anthropogenic Trace Elements and Polycyclic Aromatic Hydrocarbon Levels in Sediment Cores From Two Lakes in the Adirondack Acid Lake Region,
W82-00501 5B

Relationships Between Sulfate and Nitrate Ion Concentrations and Rainfall PH for Use in Modeling Applications,
W82-00507 5B

Acid Rain: Facts and Fallacies,
W82-00518 5C

Acid Rain at Kennedy Space Center, Florida: Recent Observations,
W82-00533 5B

Influence of Gaseous Nitric Acid on Sulfate Production and Acidity in Rain,
W82-00642 5B

Acid Precipitation: The Importance of Nitric Acid,
W82-00643 2K

Sulfur and Associated Elements and Acidity in Continental and Marine Rain from North Florida,
W82-00965 2B

Analysis of Precipitation Chemistry at a Central Pennsylvania Site,
W82-00980 2K

ACIDIC SOILS
Acidity Fluctuations at a Broadland Site in Norfolk,
W82-00656 2K

ACIDIC WATER
Reviving Acidified Lakes,
W82-00933 2H

ACIDITY
Acidity Fluctuations at a Broadland Site in Norfolk,
W82-00656 2K

Biogeochemistry of Thoreau's Bog, Concord, Massachusetts,
W82-00887 2K

ACTIVATED CARBON
Pilot Plant Performances in Municipal Wastewater Treatment by Activated Carbon Adsorption,
W82-00851 5D

ACTIVATED SLUDGE
Feeding Animals Activated Sludge,
W82-00523 5D

Sludge Blanket in Activated Final Clarifiers,
W82-00951 5D

ACTIVATED SLUDGE PROCESS
The Cape Flats Sewage Treatment Works,
W82-00957 5D

Scott Brings Unique $25-Million Waste Treatment Facilities On-Line,
W82-01007 5D

Mutant Bacteria Control Filamentous Growth in Mill Wastewater Treatment,
W82-01008 5D

ACTIVATED SLUDGE PROCESSES
Occurrence of Cytophagas in Sewage Plants,
W82-00682 5A

ADENOSINE TRIPHOSPHATE
The Effect of Season and Location on Phosphoadenylate Concentrations and Adenylate Energy Charge in Two Species of Freshwater Clams,
W82-00810 2H

The Assay of Adenosine 5'Triphosphate Extracted from Salt-Marsh Microbiota,
W82-00838 2L

ADIRONDACKS
Anthropogenic Trace Elements and Polycyclic Aromatic Hydrocarbon Levels in Sediment Cores From Two Lakes in the Adirondack Acid Lake Region,
W82-00501 5B

ADMINISTRATIVE DECISIONS
Proposed Water Quality Control Plan for Indio Subarea of the Whitewater Hydrologic Unit, West Colorado River Basin.
W82-00716 6F

ADMINISTRATIVE REGULATIONS
Arkansas Water Policy.
W82-00715 6D

Ground Water in the Ohio River Basin Portion of Maryland: Problems and Needs,
W82-01054 4B

Groundwater Problems and Needs in New York,
W82-01055 4B

Ground Water Problems in West Virginia,
W82-01060 4B

ADSORPTION
Groundwater Contaminant Transport with Adsorption and Ion Exchange Chemistry: Method of Characteristics for the Case Without Dispersion,
W82-00551 5B

Adsorption as a Control of Metal Concentrations in Sediment Extracts,
W82-00614 5A

Adsorption on Carbon: Solvent Effects on Adsorption,
W82-00619 5F

Manganese Dioxide as an Adsorbant for Heavy Metals,
W82-00775 5F

Electrical Aspects of Adsorbing Colloid Flotation. XI. Surfactant Adsorption Isotherms, Particle Displacement, and Differential Capacitance,
W82-00788 1B

Pilot Plant Performances in Municipal Wastewater Treatment by Activated Carbon Adsorption,
W82-00851 5D

AERATION
Water Chemistry Changes During Artificial Aeration of Spruce Knob Lake, West Virginia,
W82-01049 5G

AERIAL PHOTOGRAPHY
The Relationship Between Fracture Traces and Joints in a Tertiary Basin, Southwest Montana,
W82-00829 7B

Aerial Photography as an Aid to Cropland Erosion Analysis,
W82-00902 2J

Interpretation of Surface-Water Circulation, Aransas Pass, Texas, Using Landsat Imagery,
W82-00904 7B

AEROMONAS
Growth of Aeromonas Hydrophila at Low Concentrations of Substrates Added to Tap Water,
W82-00578 5A

AEROSOLS
Trace Element Concentrations Over Midlake Michigan as a Function of Meteorology and Source Region,
W82-00550 5B

Trace Constituents in Cloud Water, Rainwater and Aerosol Samples Collected near the West Coast of India During the Southwest Monsoon,
W82-00676 2B

AESCHYNOMENE
Growth and Nitrogen Fixation of Aeschynomene Under Water Stressed Conditions,
W82-00758 2I

AGRICULTURAL CHEMICALS
A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
W82-00532 5A

Distribution of Silvex, 2,4-D, and TCDD Applied to Turf in Chambers and Field Plots,
W82-00568 5B

Search for Linuron Residues in Tributaries of the Chesapeake Bay,
W82-00569 5A

Enrichment of the Agricultural Herbicide Atrazine in the Microsurface Water of an Estuary,
W82-00877 5B

AGRICULTURAL HYDROLOGY
Water - Its Use and the Implications for Arkansas Agriculture.
W82-00714 6D

AGRICULTURAL RUNOFF
Enrichment of the Agricultural Herbicide Atrazine in the Microsurface Water of an Estuary,
W82-00877 5B

Wilson Creek Drainage - Surface and Ground Water Quality, July 1978 to July 1979.
W82-01069 5B

AGRICULTURAL WATERSHEDS
Role of Solute-Transport Models in the Analysis of Groundwater Salinity Problems in Agricultural Areas,
W82-00993 5B

AGRICULTURE
A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
W82-00532 5A

Water Dynamics in the Soil-Plant-Atmosphere System,
W82-00759 2I

AIR POLLUTION
Acid Rain: Facts and Fallacies,
W82-00518 5C

Trace Element Concentrations Over Midlake Michigan as a Function of Meteorology and Source Region,
W82-00550 5B

Sources and Control of Organic Air Pollutants,
W82-00711 5B

AIR POLLUTION EFFECTS
Assessment of Airborne Organic Contaminants in the Great Lakes Ecosystem,
W82-00709 5B

Assessment of Airborne Inorganic Contaminants in the Great Lakes,
W82-00710 5B

Sources and Control of Organic Air Pollutants,
W82-00711 5B

AIR-WATER INTERFACES
Water-To-Air Fractionation of Bacteria,
W82-00575 5B

Electrical Aspects of Adsorbing Colloid Flotation. XI. Surfactant Adsorption Isotherms, Particle Displacement, and Differential Capacitance,
W82-00788 1B

ALASKA
Final Environmental Impact Statement: Swan Lake Project No. 2911 - Alaska.
W82-00738 6G

Some Aspects of Plant Water Relations in Alaskan Arctic Tundra Species,
W82-00846 2I

ALBERTA
Response of Fababean Yield, Protein Production and Water Use to Irrigation,
W82-01089 2I

ALGAE
An In Situ Method for Measuring the Primary Productivity and Standing Crop of the Epilithic Periphyton Community in Lentic Systems,
W82-00756 7B

Effects of Thermal Effluents on Communities of Benthic Marine Macroalgae,
W82-00870 5C

Massive Cultivation of Microalgae: Results and Prospects,
W82-00913 5D

The Use of Algal Assays and Chlorophyll Concentrations to Determine Fertility of Water in Small Impoundments in West Virginia,
W82-00919 2H

ALGAL CONTROL
Experimental Manipulation of Algal Bloom Composition by Nitrogen Addition,
W82-00998 5C

ALGAL GROWTH
Monitoring River Periphyton With Artificial Benthic Substrates,
W82-00581 5A

Metal Speciation. Effects on Aquatic Toxicity,
W82-00610 5A

Sediments as a Source of Phosphate: A Study of 38 Impoundments,
W82-00653 2H

Distribution and Biological Availability of Reactive High Molecular Weight Phosphorus in Natural Waters in New Zealand,
W82-00659 2H

1980 Report on Great Lakes Water Quality - Appendix,
W82-00708 5C

ALKALINE WATER
Acute Toxicity of Zinc to Some Fishes in High Alkalinity Water,
W82-00713 5C

ALLOCATION OF RESOURCES
Arkansas Water Policy.
W82-00715 6D

ALTERNATIVE PLANNING
Formulating Alternatives for Environmental Studies,
W82-00997 6G

Federal Water Resources Research: A Review of the Proposed Five-Year Program Plan.
W82-01051 6E

ALUM
Acute and Chronic Effects of Alum to Midge Larva (Diptera: Chironomidae),
W82-00650 5F

ALUMINUM
Interaction of Orthophosphate with Iron (III) and Aluminum Hydroxides,
W82-00783 2H

AMAZON LAKES
Classification of Central Amazon Lakes on the Basis of their Microbiological and Physico-Chemical Characteristics,
W82-00666 2H

AMINO ACIDS
Chemical Composition of Labile Fractions in DOM,
W82-00917 2H

AMMONIA
Ammonia and Nitrate Uptake in the Lower Great Lakes,
W82-00882 2H

Ammonia Electrode with Immobilized Nitrifying Bacteria,
W82-01099 5A

AMMONIUM
Transformations of Nitrogen in a Polluted Estuary: Nonlinearities in the Demand for Oxygen at Low Flow,
W82-00777 5B

Effects of Temperature, pH, Salinity, and Inorganic Nitrogen on the Rate of Ammonium Oxidation by Nitrifiers Isolated from Wetland Environments,
W82-00910 2L

ANAEROBIC CONDITIONS
A Note on the Fate of El Tor Cholera and Other Vibrios in Percolating Filters,
W82-00566 5D

Conversion of Abienol into Tetrahydroepimanool by Anaerobic Processes in Woodroom Debarking Effluent,
W82-00860 5C

ANIMAL DISEASES
Persistence and Distribution of Erysipelothrix Rhusiopathiae and Bacterial Indicator Organisms on Land Used for Disposal of Piggery Effluent,
W82-00686 5B

ANIMAL WASTES
Persistence and Distribution of Erysipelothrix Rhusiopathiae and Bacterial Indicator Organisms on Land Used for Disposal of Piggery Effluent,
W82-00686 5B

ANN ARBOR
Cold Weather Waste Treatment,
W82-00636 5D

ANNE ARUNDEL COUNTY
Coordinated Effort Stems Sediment and Erosion,
W82-00766 4D

ANNUAL FLOODS
Spring Flood: Meltwater or Groundwater,
W82-00531 7B

APPLICATION EQUIPMENT
Traveling Sprinkler System and Method,
W82-00561 3F

AQUACULTURE
Growth of the Bay Scallop, Argopecten Irradians, in a Waste Recycling Aquaculture System,
W82-00842 3C

Kinetics of Nitrate and Ammonium Uptake by the Tropical Freshwater Macrophyte Pistia Stratiotes L.,
W82-00937 5D

AQUATIC ANIMALS
Toxicities of Paraquat and Diquat Herbicides to Freshwater Copepods (Diaptomus Sp. and Eucyclops Sp.),
W82-00589 5C

Dynamics of Selenium in Mercury-Contaminated Experimental Freshwater Ecosystems,
W82-00595 5B

Growth of the Bay Scallop, Argopecten Irradians, in a Waste Recycling Aquaculture System,
W82-00842 3C

AQUATIC ENVIRONMENT
Occurrence of Tetraalkylead Compounds in the Aquatic Environment,
W82-00878 5A

A Review on Sediment Traps in Aquatic Environments,
W82-01020 7B

AQUATIC INSECTS
Acute and Chronic Effects of Alum to Midge Larva (Diptera: Chironomidae),
W82-00650 5F

AQUATIC LIFE
Metal Speciation. Effects on Aquatic Toxicity,
W82-00610 5A

Organochlorine Residues in Kenya's Rift Valley Lakes,
W82-00690 5A

AQUATIC PLANTS
Search for Linuron Residues in Tributaries of the Chesapeake Bay,
W82-00569 5A

Control of Water Weeds by Grass Carp in Two Small Lakes,
W82-00609 3B

Seasonal Influx and Decomposition of Autochthonous Macrophyte Litter in a North Temperate Estuary,
W82-00918 2L

The Impact of a Natural Drawdown on the Growth of Four Emergent Species in a Prairie Glacial Marsh,
W82-01096 2H

AQUATIC POPULATIONS
Report of the Aquatic Ecosystem Objectives Committee,
W82-00705 5G

AQUATIC WEED CONTROL
Aquatic Weed Cutting Apparatus,
W82-00624 4A

AQUIFER CHARACTERISTICS
Generalized Thickness of the Floridan Aquifer, Southwest Florida Water Management District,
W82-00729 7C

The Development of Methods for Determining Aquifer Characteristics,
W82-00827 2F

AQUIFER MANAGEMENT
Plan of Study for the Regional Aquifer-System Analysis of the Snake River Plain, Idaho and Eastern Oregon,
W82-00730 6A

Interstate Conflict Over Ground Water: Wisconsin-Illinois,
W82-00818 6E

Ground Water in the Ohio River Basin Portion of Maryland: Problems and Needs,
W82-01054 4B

AQUIFER TESTING
Determination of Hydrogeological Parameters Using Sinusoidal Pressure Tests: A Theoretical Appraisal,
W82-00603 7B

AQUIFERS
Potentiometric-Surface Map for the Cretaceous Aquifer, Virginia Coastal Plain, 1978,
W82-00727 7C

Well-Field Drawdowns Using Coupled Aquifer Model,
W82-00990 2F

ARANASAS PASS
Interpretation of Surface-Water Circulation, Aransas Pass, Texas, Using Landsat Imagery,
W82-00904 7B

ARCTIC
Physical Mechanics of Aufeis Growth,
W82-00836 2C

Some Aspects of Plant Water Relations in Alaskan Arctic Tundra Species,
W82-00846 2I

ARCTIC ZONE
Occurrence of Ice Layers at the Base of High Arctic Snowpacks,
W82-00844 2C

The Distribution of Sea Ice Meltwater in the Eastern Canadian Arctic,
W82-00966 2C

AREAL PRECIPITATION
Evaluation of Areal Versus Point Rainfall with Sparse Data,
W82-00835 2B

ARID LANDS
Annual Plant Production-Precipitation Relations in Arid and Semi-Arid Regions,
W82-00693 2I

ARIZONA
Factors Influencing Fish Distribution in Two Desert Reservoirs, Central Arizona,
W82-00814 2H

ARKANSAS
Water - Its Use and the Implications for Arkansas Agriculture.
W82-00714 6D

Arkansas Water Policy.
W82-00715 6D

ARTIFICIAL PRECIPITATION
Seeding-Opportunity Recognition in Winter Orographic Clouds,
W82-01005 3B

ASBESTOS
Chrysotile Asbestos Fiber Removal During Potable Water Treatment. Pilot Plant Studies,
W82-00613 5F

Interim Method for Determining Asbestos in Water,
W82-00741 5A

The Activity of Environmental Samples in a Cell Culture Test for Asbestos Toxicity,
W82-01031 5C

ASBESTOS CEMENT
Asbestos Cement Pipe and Cancer in Connecticut 1955-1974,
W82-01094 5C

ATMOSPHERIC MOISTURE
Possibility of Using Tritium for Studying Global Circulation of Atmospheric Moisture,
W82-00863 2A

ATMOSPHERIC WATER
Atmospheric Water Content Over the Tropical Pacific Derived from the Nimbus-6 Scanning Microwave Spectrometer,
W82-01004 7B

ATRAZINE
Enrichment of the Agricultural Herbicide Atrazine in the Microsurface Water of an Estuary,
W82-00877 5B

AUFEIS
Physical Mechanics of Aufeis Growth,
W82-00836 2C

AUSTRALIA
Effects of Recent Increases in Rainfall on Floods and Runoff in the Upper Hunter Valley,
W82-00668 2E

Research and Development to Service a Sustainable Agriculture,
W82-00669 3F

Effect of Otter Prawn Trawling on the Macrobenthos of a Sandy Substratum in a New South Wales Estuary,
W82-00677 5C

Persistence and Distribution of Erysipelothrix Rhusiopathiae and Bacterial Indicator Organisms on Land Used for Disposal of Piggery Effluent,
W82-00686 5B

Holocene Sequences on an Embayed High-Energy Coast: An Evolutionary Model,
W82-00695 2J

The Influence of Plant Communities Upon the Hydrology of Catchments,
W82-00931 2D

AUTOMATION
Automation of Norwich Sewage-Treatment Works: Early Cost Considerations,
W82-00955 5D

AZOV SEA
The Azov Sea Problem,
W82-00651 6G

BACKFILL
Backfill Alteration Effects on Pipe Drainage of a Clay Soil,
W82-00763 4A

BACTERIA
Effect of Crude Oil and Petroleum-Degrading Microorganisms on the Growth of Freshwater and Soil Protozoa,
W82-00517 5C

Microbial Mobilization of Calcium and Magnesium in Waterlogged Soils,
W82-00560 2G

Simultaneous Concentration of Salmonella and Enterovirus From Surface Water by Using Micro-Fiber Glass Filters,
W82-00573 5A

Water-To-Air Fractionation of Bacteria,
W82-00575 5B

Utilization of Dichloromethane by Suspended and Fixed-Film Bacteria,
W82-00577 5B

Growth of Aeromonas Hydrophila at Low Concentrations of Substrates Added to Tap Water,
W82-00578 5A

Destruction by Anaerobic Mesophilic and Thermophilic Digestion of Viruses and Indicator Bacteria Indigenous to Domestic Sludges,
W82-00580 5A

Effect of Temperature on Mineralization by Heterotrophic Bacteria,
W82-00583 5C

Enumeration of Bacteriophages and Host Bacteria in Sewage and the Activated-Sludge Treatment Process,
W82-00584 5A

Movement of Endotoxin Through Soil Columns,
W82-00586 5B

Influence of Seasonal Temperature on the Temperature Optima of Bacteria in Sediments of Lake George, New York,
W82-00606 2H

Cold Weather Waste Treatment,
W82-00636 5D

Antibiotic-Resistant Bacteria in Drinking Water,
W82-00645 5F

Occurrence of Cytophagas in Sewage Plants,
W82-00682 5A

Bacterial DNA Repair Assay of Selected Compounds in Pulp and Paper Mill Effluents,
W82-00687 5C

Purification of Wastewater by Electrolysis,
W82-00847 5D

Effect of Turbidity on Chlorination Efficiency and Bacterial Persistence in Drinking Water,
W82-00865 5A

Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay, Canada. I: Bacteriological Aspects,
W82-00921 2L

Mutant Bacteria Control Filamentous Growth in Mill Wastewater Treatment,
W82-01008 5D

Assessment of Water Quality Conditions in Skamokawa Creek, Washington,
W82-01066 5C

BACTERIAL ANALYSIS
New Waterborne Bacteriophages Active on Yersinia Enterocolitica,
W82-00662 5A

Dispersal of Salmonella from a Polluted Stream to Neighboring Terrestrial Habitats,
W82-01043 5A

BACTERIOPHAGE
New Waterborne Bacteriophages Active on Yersinia Enterocolitica,
W82-00662 5A

BAFFIN BAY
The Distribution of Sea Ice Meltwater in the Eastern Canadian Arctic,
W82-00966 2C

BASELINE STUDIES
Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay, Canada. I: Bacteriological Aspects,
W82-00921 2L

Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay II. Mycological Aspects,
W82-00922 2L

BASIN IRRIGATION
Depths of Flow in Level Basins,
W82-00900 3F

BASINS
Depths of Flow in Level Basins,
W82-00900 3F

BASS
Gonad Development, Fecundity, and Spawning Season of Largemouth Bass in Newly Impounded West Point Reservoir, Alabama-Georgia,
W82-01080 2H

BAY OF FUNDY
Toxic Dinoflagellates and Tidal Power Generation in the Bay of Fundy, Canada,
W82-00908 6G

BEHAVIOR
Preference-Avoidance Reactions of Crayfish to Sublethal Concentrations of Cadmium,
W82-00916 5A

BELLINGHAM BAY AREA
Water Quality Conditions in the Bellingham Bay Area 1979-1980,
W82-01068 5B

BENTHIC ENVIRONMENT
Monitoring River Periphyton With Artificial Benthic Substrates,
W82-00581 5A

Effect of Otter Prawn Trawling on the Macrobenthos of a Sandy Substratum in a New South Wales Estuary,
W82-00677 5C

A Comparative Study of Four Dredges Used for Sampling Benthic Macroinvertebrates in Rivers,
W82-00833 7B

BENTHIC FAUNA
Effects of a Cattleskin Tannery of Stream Quality and Benthic Macroinvertebrates in Central Maine,
W82-00872 5C

Macrobenthos of Pine Island Bayou in the Big Thicket National Preserve, Texas,
W82-00924 5C

BENTHOS
Accurate and Efficient Estimation of Benthic Populations: A Comparison Between Removal Estimation and Conventional Sampling Techniques,
W82-00633 5A

Absorption of Fenitrothion by Plankton and Benthic Algae,
W82-00874 5B

BENTONITE
Bentonite Liners for Power Plant Lagoons,
W82-00617 5E

BIG RUN BOG
Vegetational Analysis of Big Run Bog, A Nonglaciated Sphagnum Bog in West Virginia,
W82-00992 2I

BIOACCUMULATION
Bioconcentration of Pesticides by Egg Masses of the Caddisfly, Triaenodes Tardus Milne,
W82-00982 5B

Relation Between Trophic Position and Mercury Accumulation Among Fishes from the Tongue River Reservoir, Montana,
W82-01041 5A

BIOASSAY
Sea Urchin Sperm Bioassay for Sewage and Chlorinated Seawater and Its Relation to Fish Bioassays,
W82-00988 5A

BIOASSAYS
A Rapid Simple Long-Term Toxicity Assay for Aquatic Contaminants Using the Nematode Panagrellus Redivivus,
W82-01017 5A

BIOCHEMISTRY
Biogeochemistry of Thoreau's Bog, Concord, Massachusetts,
W82-00887 2K

BIOCONTROL
Detoxification of Residual Quaternaries,
W82-00562 5G

BIODEGRADATION
Biodegradability of Halogen-Substituted Diphenylmethanes,
W82-00599 5B

BIOFILTRATION
Vegetative Filter Treatment of Livestock Feedlot Runoff,
W82-00794 5D

BIOINDICATORS
Industrial Effluent Monitoring Incorporating a Recent Automated Fish Biomonitoring System,
W82-00530 5A

Destruction by Anaerobic Mesophilic and Thermophilic Digestion of Viruses and Indicator Bacteria Indigenous to Domestic Sludges,
W82-00580 5A

Accurate and Efficient Estimation of Benthic Populations: A Comparison Between Removal Estimation and Conventional Sampling Techniques,
W82-00633 5A

Aquatic Mosses as Monitors of Heavy Metal Contamination in the River Etherow, Great Britain,
W82-00787 5A

Behavior and Transport of Microbial Pathogens and Indicator Organisms in Soils Treated with Organic Wastes,
W82-00797 5B

The Effect of Season and Location on Phosphoadenylate Concentrations and Adenylate Energy Charge in Two Species of Freshwater Clams,
W82-00810 2H

Retention of Radionuclides by Some Aquatic Fresh Water Plants,
W82-00853 5B

Evaluation of an Automatic System for Detection of Toxic Substances in Surface Water Using Trout,
W82-00855 5A

Serum Enzymes in Rainbow Trout as Tools in the Diagnosis of Water Quality,
W82-00857 5A

Preference-Avoidance Reactions of Crayfish to Sublethal Concentrations of Cadmium,
W82-00916 5A

BIOLOGICAL WASTEWATER TREATMENT
Massive Cultivation of Microalgae: Results and Prospects,
W82-00913 5D

Fluidized Bed for Biological Wastewater Treatment,
W82-00968 5D

Biological Treatment of Synthetic Fuel Wastewater,
W82-00971 5D

BLOOD
Serum Enzymes in Rainbow Trout as Tools in the Diagnosis of Water Quality,
W82-00857 5A

BOGS
Biogeochemistry of Thoreau's Bog, Concord, Massachusetts,
W82-00887 2K

Vegetational Analysis of Big Run Bog, A Nonglaciated Sphagnum Bog in West Virginia,
W82-00992 2I

BOREHOLE GEOPHYSICS
Determination of Hydrogeological Parameters Using Sinusoidal Pressure Tests: A Theoretical Appraisal,
W82-00603 7B

BOTTOM SAMPLING
The Kyholm Corer--A Diver-Operated Sediment Corer,
W82-00793 7B

BOTTOM SEDIMENTS
Modeling of Processes of Decomposition of Organic Matter in Bottom Sediments,
W82-00553 5B

On Lake Bottom Dynamics--The Energy-Topography Factor,
W82-00837 2H

Evidence of the Unsuitability of Gravity Coring for Collecting Sediment in Pollution and Sedimentation Rate Studies,
W82-00840 7B

A Method for the Evaluation of Conditions in a Fish Pond Sediment,
W82-01019 2H

A Review on Sediment Traps in Aquatic Environments,
W82-01020 7B

Trace Metal Fluxes to Nearshore Long Island Sound Sediments,
W82-01040 5B

BRACKISH WATER
Inorganic Transformation of Applied Phosphorus in Brackish Water Fish Pond Soil Under Different Water Salinity Levels,
W82-00920 2H

BREAKWATERS
Large Rubble-Mound Breakwater Failures,
W82-00862 8D

BROMACIL
Dye-Sensitized Photooxidation of Bromacil in Water,
W82-00514 5B

BROMINE CHLORIDE
An Alternative Wastewater Disinfectant,
W82-00950 5D

BUBBLES
Electrical Aspects of Adsorbing Colloid Flotation. XI. Surfactant Adsorption Isotherms, Particle Displacement, and Differential Capacitance,
W82-00788 1B

BUFFALO RIVER
Aromatic Amines in and Near the Buffalo River,
W82-00622 5B

BUOYANCY
Buoyancy Force Reversals in Vertical Natural Convection Flows in Cold Water,
W82-00981 1A

BURLINGTON
Low Turbidity Water from Fast Processes,
W82-00946 5F

BUTYL BENZYL PHTHALATE
An Environmental Safety Assessment of Butyl Benzyl Phthalate,
W82-00615 5A

BYRAM LAKE
Factors Controlling Phytoplankton Primary Productivity in Byram Lake, Mt. Kisco, N.Y., Summer, 1977,
W82-00915 2H

CADDISFLIES
Bioconcentration of Pesticides by Egg Masses of the Caddisfly, Triaenodes Tardus Milne,
W82-00982 5B

CADMIUM
Monitoring Trace Amounts of Cadmium in Natural Waters,
W82-00516 5A

The Impact of an Industrially Contaminated Lake on Heavy Metal Levels in it's Effluent Stream,
W82-00886 5B

Preference-Avoidance Reactions of Crayfish to Sublethal Concentrations of Cadmium,
W82-00916 5A

Organic Matrix Modifiers for Direct Graphite Furnace Atomic Absorption Determination of Cadmium in Seawater,
W82-01085 5A

CALCIUM
Microbial Mobilization of Calcium and Magnesium in Waterlogged Soils,
W82-00560 2G

CALIBRATIONS
Apparatus for the Simulation of Rain in the Laboratory,
W82-00807 2B

CALIFORNIA
Approximate Ground-Water-Level Contours, April 1981, for the Soquel-Aptos Area, Santa Cruz County, California,
W82-00734 7C

Final Environmental Impact Statement: North Fork Stanislaus River Project No. 2409 - California.
W82-00737 6G

Effects of Thermal Effluents on Communities of Benthic Marine Macroalgae,
W82-00870 5C

Impact of Water Resource Development on Salinization of Semi-Arid Lands,
W82-01024 5B

Soil Moisture Relations in the Southern California Chaparral,
W82-01035 2D

CANADA
Occurrence of Ice Layers at the Base of High Arctic Snowpacks,
W82-00844 2C

Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay, Canada. I: Bacteriological Aspects,
W82-00921 2L

Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay II. Mycological Aspects,
W82-00922 2L

The Distribution of Sea Ice Meltwater in the Eastern Canadian Arctic,
W82-00966 2C

CANOPY
Seasonal Changes in Leaf Area, Stomatal and Canopy Conductances and Transpiration From Bracken Below a Forest Canopy,
W82-00655 2D

CAPE FEAR ESTUARY
Dieback of Salt-Water Cordgrass (Spartina Alterniflora Loisel.) in the Lower Cape Fear Estuary of North Carolina: An Experimental Approach to Re-Establishment,
W82-00889 2L

CAPITAL COSTS
Small Hydro Installations Spur Unique Engineering Solutions,
W82-00538 6B

CARBOHYDRATES
Vertical Distribution of Monosaccharides in Lake Water,
W82-00665 2H

Chemical Composition of Labile Fractions in DOM,
W82-00917 2H

CARBON
Adsorption on Carbon: Solvent Effects on Adsorption,
W82-00619 5F

A Simulation Model for Sludge Decomposition in Soil,
W82-01001 5E

CARBONATE ROCKS
Chemical Mass-Wasting of the Northern Yucatan Peninsula by Groundwater Dissolution,
W82-01015 2K

CARBONATES
Health Implications of Non-NTA Detergent Builders,
W82-00703 5G

CARCINOGENS
Asbestos Cement Pipe and Cancer in Connecticut 1955-1974,
W82-01094 5C

CARP
Control of Water Weeds by Grass Carp in Two Small Lakes,
W82-00609 3B

CASPIAN SEA
The Caspian Sea Problem,
W82-00657 4A

CASTLE ROCK
Submersible Pumps Help Quell Damage From Mount St. Helens Mudflow.
W82-00509 4D

CATALYSTS
Trace Metal Catalysis in Aquatic Environments,
W82-00629 5B

Application of Immobilized Hydrogenase for the Detritiation of Water,
W82-00768 5D

CATCHMENT AREAS
The Influence of Plant Communities Upon the Hydrology of Catchments,
W82-00931 2D

CATFISH
Water Movement for Water Quality in Catfish Production,
W82-00866 5G

CATION EXCHANGE
Cation Chromatography With a Conductivity Detector,
W82-00582 5A

Cation Transport in Packed Bed Reactor of Soil,
W82-00970 5D

CATIONS
Cation Chromatography With a Conductivity Detector,
W82-00582 5A

CHANNEL FLOW
Tractive Force Design of Vegetated Channels,
W82-00901 4D

CHANNEL IMPROVEMENT
Aquatic Weed Cutting Apparatus,
W82-00624 4A

CHANNEL MORPHOLOGY
Morphological Changes of River Channels Consequent Upon Headwater Impoundment,
W82-01087 6G

CHANNELING
Graphed Equilibrium Parameters of Channels Formed in Sediment,
W82-00881 2J

CHANNELS
Graphed Equilibrium Parameters of Channels Formed in Sediment,
W82-00881 2J

Morphological Changes of River Channels Consequent Upon Headwater Impoundment,
W82-01087 6G

CHAPARRAL
Comparative Field Water Relations of Four Co-Occuring Chaparral Shrub Species,
W82-00762 2I

Soil Moisture Relations in the Southern California Chaparral,
W82-01035 2D

CHAR
Leach Characteristics of Coal-Gasification Char,
W82-01025 5B

CHELATING AGENTS
Metal Speciation. Effects on Aquatic Toxicity,
W82-00610 5A

CHEMICAL ANALYSIS
Determination of Terbutryn and its Degradation Products in Water, Sediments, Aquatic Plants, and Fish,
W82-00567 5A

Identification of Organic Compounds,
W82-00635 5A

CHEMICAL ANALYSIS

The Nature of Selected Prairie Lake and Stream Sediments,
W82-00815 2J

Comparison of Methods for the Determination of Trace Elements in Seawater,
W82-01086 5A

CHEMICAL COMPOSITION
Chemistry of Lake Water and Groundwater in Areas of Contrasting Glacial Drifts in Eastern Minnesota,
W82-00821 2K

Chemical Composition of Labile Fractions in DOM,
W82-00917 2H

Sulfur and Associated Elements and Acidity in Continental and Marine Rain from North Florida,
W82-00965 2B

CHEMICAL DEGRADATION
Sources and Control of Organic Air Pollutants,
W82-00711 5B

Chemical Mass-Wasting of the Northern Yucatan Peninsula by Groundwater Dissolution,
W82-01015 2K

CHEMICAL INDUSTRY
An Environmental Safety Assessment of Butyl Benzyl Phthalate,
W82-00615 5A

CHEMICAL PRECIPITATION
Assessment of Airborne Inorganic Contaminants in the Great Lakes,
W82-00710 5B

Sources and Control of Organic Air Pollutants,
W82-00711 5B

CHEMICAL PROPERTIES
Chemical Composition of Interstitial Waters in Bottom Sediments of Some Polish Lakes of the Wigry Group (Northern Poland),
W82-00675 2H

Relationships Between Water Chemistry and Respiration Rate in Several Populations of Lymnaea Peregra Muller (Gastropoda:Mollusca),
W82-00854 2K

Phosphorus, Nirogen, and Organic Carbon Flux in a Headwater Stream,
W82-01021 2K

CHEMICAL REACTIONS
Trace Metal Catalysis in Aquatic Environments,
W82-00629 5B

Measurement of in situ Rates of Nitrification in Sediment,
W82-00798 5A

CHEMICAL TREATMENT
Water-Treatment Chemicals,
W82-00618 5F

CHEMICAL WASTES
Human Health Hazards Associated With Chemical Contamination of Aquatic Environment,
W82-00632 5C

Removal of Priority Pollutants,
W82-00639 5D

Phosphorus Management for the Great Lakes: Final Report of the Phosphorus Management Strategies Task Force,
W82-00702 6E

1980 Annual Report - A Perspective on the Problem of Hazardous Substances in the Great Lakes Basin Ecosystem,
W82-00707 5C

Detection of Volatile Nitrosamines in Waste Water from Chemical Plants by Combined Capillary Gas Chromatography-Mass Spectrometry,
W82-00856 5A

CHEMISTRY OF PRECIPITATION
Associations and Mesoscale Spatial Relationships Among Rainwater Constituents,
W82-00964 2B

Analysis of Precipitation Chemistry at a Central Pennsylvania Site,
W82-00980 2K

CHESAPEAKE BAY
Search for Linuron Residues in Tributaries of the Chesapeake Bay,
W82-00569 5A

Kepone in the James River,
W82-00631 5B

CHIRONOMIDS
Insect Community Structure as an Index of Heavy-Metal Pollution in Lotic Ecosystems,
W82-00596 5C

CHLORDANE
Residues in Cutthroat Trout (Salmo Clarki) and California Newts (Tarichia Torosa) From a Lake Treated With Technical Chlordane,
W82-00558 5C

CHLORIDES
Hydrogeology of the Sierra Nevada Foothill Lineament Near Oakhurst, California,
W82-00831 2F

CHLORINATED HYDROCARBONS
Residues in Cutthroat Trout (Salmo Clarki) and California Newts (Tarichia Torosa) From a Lake Treated With Technical Chlordane,
W82-00558 5C

CHLORINATION
Effect of Ozonation and Chlorination on the Mutagenic Potential of Drinking Water,
W82-00649 5A

Effect of Turbidity on Chlorination Efficiency and Bacterial Persistence in Drinking Water,
W82-00865 5A

Health Effects of Monochloramines in Drinking Water,
W82-01091 5C

CHLORINE
Assessment of Some Aqueous Residual Chlorine Measurements,
W82-00867 5F

CHROMATOGRAPHY
Cation Chromatography With a Conductivity Detector,
W82-00582 5A

Determination of Alkaline Earth and Divalent Transition Metal Cations by Ion Chromatography with Sulfate-Suppressed Barium and Lead Eluents,
W82-01082 5A

CHROMIUM
Determination of Chromium Speciation in Natural Waters by Electrodeposition on Graphite Tubes for Electrothermal Atomization,
W82-01084 5A

CITRUS FRUITS
Water Stress and Cold Hardiness in Field-Grown Citrus,
W82-00864 2I

CLAMS
The Effect of Season and Location on Phosphoadenylate Concentrations and Adenylate Energy Charge in Two Species of Freshwater Clams,
W82-00810 2H

CLARIFICATION
Low Turbidity Water from Fast Processes,
W82-00946 5F

CLARIFIERS
Sludge Blanket in Activated Final Clarifiers,
W82-00951 5D

Simulation Modeling of Primary Clarifiers,
W82-01027 6A

CLASSIFICATION
Classification of Central Amazon Lakes on the Basis of their Microbiological and Physico-Chemical Characteristics,
W82-00666 2H

CLAYS
Flocculation of Clay Particles with a Synthetic Anionic Polymer,
W82-00773 5F

Mechanics of Mudflow Mobilization in Low-Angled Clay Slopes,
W82-00989 2J

CLEAR-CUTTING
Seston Dynamics in Southern Appalachian Streams: Effects of Clear-Cutting,
W82-00543 4C

CLOSED LAKES
Probability-Theoretical Analysis of Fluctuations in the Level of a Closed Water Body,
W82-00571 2H

CLOUD SEEDING
Seeding-Opportunity Recognition in Winter Orographic Clouds,
W82-01005 3B

Variations in Precipitation Parameters Between Drought and Non-Drought Periods in Texas and Some Implications for Cloud Seeding,
W82-01006 2B

CLOUDS
Trace Constituents in Cloud Water, Rainwater and Aerosol Samples Collected near the West Coast of India During the Southwest Monsoon,
W82-00676 2B

COAGULATION
Interaction of Orthophosphate with Iron (III) and Aluminum Hydroxides,
W82-00783 2H

Ferric Chloride Takes Over,
W82-00954 5F

COAL GASIFICATION
Biological Treatment of Synthetic Fuel Wastewater,
W82-00971 5D

Leach Characteristics of Coal-Gasification Char,
W82-01025 5B

COAL MINING
Western Coal Mining in the 1980s: A Study in Federal/State Conflicts,
W82-00972 6E

Illinois Groundwater Problems and Needs,
W82-01052 4B

COAL TAR COATINGS
Coal Tar Coatings of Storage Tanks. A Source of Contamination of the Potable Water Supply,
W82-00616 5B

COASTAL AQUIFERS
Resistivity Study of a Coastal Karst Terrain, Florida,
W82-00817 2F

COASTAL MARSHES
Managing Oil and Gas Activities in Coastal Environments: Refuge Manual,
W82-01081 5G

COASTAL WATERS
Large Rubble-Mound Breakwater Failures,
W82-00862 8D

Interpretation of Surface-Water Circulation, Aransas Pass, Texas, Using Landsat Imagery,
W82-00904 7B

Mean Summer Circulation in Lake Ontario Within the Coastal Zone,
W82-00967 2H

COATINGS
Coal Tar Coatings of Storage Tanks. A Source of Contamination of the Potable Water Supply,
W82-00616 5B

COLD REGIONS
Clonal Variations in the Water Relations of Red Osier Dogwood During Cold Acclimation,
W82-00839 2I

COLIFORMS
R Factors in Coliform-Fecal Coliform Sewage Flora of the Prairies and Northwest Territories of Canada,
W82-00508 5A

Evaluation of Standard and Modified M-FC, Macconkey, and Teepol Media for Membrane Filtration Counting of Fecal Coliforms in Water,
W82-00644 5A

Modification of the Standard Most-Probable-Number Procedure for Fecal Coliform Bacteria in Seawater and Shellfish,
W82-00646 5A

Assessment of Water Quality Conditions in Skamokawa Creek, Washington,
W82-01066 5C

COLOGNE
Waste Heat Balance in Aquifers Calculated by a Computer Programme,
W82-00830 7B

COLOR REMOVAL
Fungal Decolorization of Kraft Bleach Plant Effluents,
W82-00689 5D

COLORADO
Hydrogeochemistry and Simulated Solute Transport, Piceance Basin, Northwestern Colorado,
W82-00723 5B

COLORADO RIVER
Leaf Litter Processing in a Regulated Rocky Mountain Stream,
W82-00542 6G

COLORADO RIVER BASINS
Saline Water Use and Disposal Opportunities; Colorado River Water Quality Improvement Program,
W82-00717 3C

COMMERCIAL FISHING
Towards a Predictive Model for the Economic Regulation of Commercial Fisheries,
W82-00549 6A

COMPARISON ANALYSIS
Grab Versus Composite Sampling: A Primer for the Manager and Engineer,
W82-00891 5A

COMPARISON STUDIES
A Numerical Comparison Between Lagrangian and Eulerian Rainfall Statistics,
W82-00803 2B

A Comparison of Rainfall-Runoff Models,
W82-00911 2A

COMPETING USE
Water - Its Use and the Implications for Arkansas Agriculture.
W82-00714 6D

Proposed Water Quality Control Plan for Indio Subarea of the Whitewater Hydrologic Unit, West Colorado River Basin.
W82-00716 6F

COMPOSTING
Composting Is Working in Camden,
W82-00948 5E

COMPREHENSIVE PLANNING
Great Lakes International Surveillance Plan,
W82-00701 6E

COMPUTER MODELS
Temperature and Solute-Transport Simulation in Streamflow Using a Lagrangian Reference Frame,
W82-00726 2E

Satellite Rain Estimation in the U.S. High Plains,
W82-00808 2B

Interstate Conflict Over Ground Water: Wisconsin-Illinois,
W82-00818 6E

Numerical Simulation of Potentiometric Surface Changes Caused by a Proposed Open-Pit Anthracite Mine,
W82-00819 6A

COMPUTER PROGRAMS
Answers: A Model for Watershed Planning,
W82-00898 6A

Lateral Sizes for Efficient Level-Basin Irrigation,
W82-00942 3F

COMPUTERS
Empire Controlled by Computer,
W82-00529 5D

CONCRETE CONSTRUCTION
Good Looks, Low Maintenance Guide Water Tank Choice,
W82-00868 5A

CONDENSATES
The Removal of Organic Matter from Demineralised Water,
W82-00888 5F

CONDUCTIVITY
Cation Chromatography With a Conductivity Detector,
W82-00582 5A

CONFINED AQUIFERS
Generalized Thickness of the Floridan Aquifer, Southwest Florida Water Management District,
W82-00729 7C

CONSERVATION
Health Aspects of Urban Water Conservation,
W82-01047 3C

CONSTRUCTION
The Waterway That Cannot be Stopped,
W82-00510 6E

Richards Bay: An Ecological Dilemma,
W82-00679 6A

Large Rubble-Mound Breakwater Failures,
W82-00862 8D

CONSTRUCTION COSTS
Low-Cost Wastewater Treatment,
W82-00841 5D

CONSTRUCTION MATERIALS
Design and Construction of the Danvers, Massachusetts Water Processing Plant,
W82-01088 5F

CONSUMPTIVE USE
Consumptive Use and Daily Evapotranspiration of Corn Under Different Levels of Nitrogen and Moisture Regimes,
W82-00660 2D

CONTAMINANTS
1980 Annual Report - A Perspective on the Problem of Hazardous Substances in the Great Lakes Basin Ecosystem,
W82-00707 5C

CONTAMINATION
Waterborne Methylene Bis(2-Chloroaniline) and 2-Chloroaniline Contamination Around Adrian, Michigan,
W82-00873 5B

Giardia Prevalence in Commercially Trapped Mammals,
W82-01046 5A

CONTOURS
Approximate Ground-Water-Level Contours, April 1981, for the Soquel-Aptos Area, Santa Cruz County, California,
W82-00734 7C

CONTROL SYSTEMS
Control Systems for Return and Waste Sludge,
W82-00949 5D

CONVEYANCE STRUCTURES
Operational Evaluation of Village Level Irrigation Conveyance Systems,
W82-00696 3F

COOLING PONDS
Annual Succession of Phytoplankton in One Heated Pond in Central Finland,
W82-00673 5C

COOLING TOWERS
Numerical Simulation of the Effects of Cooling Tower Complexes on Clouds and Severe Storms,
W82-00995 2B

COOLING WATER
Saline Water Use and Disposal Opportunities; Colorado River Water Quality Improvement Program,
W82-00717 3C

Measurement of Particulates Extrained in Some Great Lakes Power Plant Cooling Water: An Exercise in Futility,
W82-00782 6G

Effects of Water Quality on Forage Production,
W82-01002 3C

Ground-Water Use for Cooling: Associated Aquifer Temperature Changes,
W82-01014 3E

COOPERATIVES
The U.S. Geological Survey Federal-State Cooperative Water Resources Program,
W82-00735 6B

COPEPODS
Toxicities of Paraquat and Diquat Herbicides to Freshwater Copepods (Diaptomus Sp. and Eucyclops Sp.),
W82-00589 5C

Effect of Metals on the Biomass Production Kinetics of Freshwater Copepods,
W82-00593 5C

CORER
The Kyholm Corer--A Diver-Operated Sediment Corer,
W82-00793 7B

CORN
Effects of Municipal Waste Water Effluent on Performance and Feed Quality of Maize Vs. Reed Canarygrass,
W82-00564 3C

Consumptive Use and Daily Evapotranspiration of Corn Under Different Levels of Nitrogen and Moisture Regimes,
W82-00660 2D

CORN BELT
Risk and the Demand for Supplemental Irrigation: A Case Study in the Corn Belt,
W82-00522 6A

CORROSION
A New Look at Design of Raw Water Piping,
W82-01029 8A

COST ALLOCATION
The Distribution of the Costs of Federal Water Pollution Control Policy,
W82-00537 6B

COST ANALYSIS
Fundamental Economic Issues in the Development of Small Scale Hydro.
W82-00722 6C

Automation of Norwich Sewage-Treatment Works: Early Cost Considerations,
W82-00955 5D

COST-BENEFIT ANALYSIS
Evaluating Irrigation Systems,
W82-00772 6B

An Intangible Benefit of Water Pollution Control Programs,
W82-01092 6B

COSTS
The Waterway That Cannot be Stopped,
W82-00510 6E

Treatability Manual; Volume IV. Cost Estimating.
W82-01076 5D

CRAYFISH
Preference-Avoidance Reactions of Crayfish to Sublethal Concentrations of Cadmium,
W82-00916 5A

CROP PRODUCTION
Risk and the Demand for Supplemental Irrigation: A Case Study in the Corn Belt,
W82-00522 6A

Annual Plant Production-Precipitation Relations in Arid and Semi-Arid Regions,
W82-00693 2I

Water Dynamics in the Soil-Plant-Atmosphere System,
W82-00759 2I

Water Requirement for Sugarcane Production,
W82-00899 3F

CROP YIELD
Effects of Municipal Waste Water Effluent on Performance and Feed Quality of Maize Vs. Reed Canarygrass,
W82-00564 3C

Land Forming Effects on Dryland Sorghum Production in the Southern Great Plains,
W82-00764 3F

Effect of Soil Water Content and a Growing Season Straw Mulch on Grain Sorghum,
W82-00765 3F

Quality of Irrigation Water and Effects of Sulfuric Acid and Gypsum on Soil Properties and Sundangrass Yields,
W82-00767 3C

Response of Fababean Yield, Protein Production and Water Use to Irrigation,
W82-01089 2I

CROP YIELDS
Water Relations of Three Cowpea Cultivars (Vigna Unguiculata L.),
W82-00607 2I

CROPLAND
Aerial Photography as an Aid to Cropland Erosion Analysis,
W82-00902 2J

Sediment Sizes Eroded from Crop Row Sideslopes,
W82-00903 2J

Dryland Management for Salinity Control,
W82-01018 2G

Dryland Cropping Strategies for Efficient Water-Use to Control Saline Seeps in the Northern Great Plains, U.S.A.,
W82-01023 3F

CRUDE OIL
Effect of Crude Oil and Petroleum-Degrading Microorganisms on the Growth of Freshwater and Soil Protozoa,
W82-00517 5C

CULTIVATION
Land Forming Effects on Dryland Sorghum Production in the Southern Great Plains,
W82-00764 3F

CULTURE MEDIA
Evaluation of Standard and Modified M-FC, Macconkey, and Teepol Media for Membrane Filtration Counting of Fecal Coliforms in Water,
W82-00644 5A

CYCLING NUTRIENTS
Nitrogen and Phosphorus Recycling in Lake Sammamish, A Temperate Mesotrophic Lake,
W82-00824 2H

CYTOPHAGAS
Occurrence of Cytophagas in Sewage Plants,
W82-00682 5A

DAIRY INDUSTRY
Dairy Liquid Waste Distribution in an Overland Flow Vegetative-Soil Filter System,
W82-00897 5D

DAM CONSTRUCTION
Final Environmental Impact Statement: Swan Lake Project No. 2911 - Alaska.
W82-00738 6G

DAM EFFECTS
Leaf Litter Processing in a Regulated Rocky Mountain Stream,
W82-00542 6G

DAM FAILURE
Modeling Gradual Dam Breaches,
W82-00554 8D

DAMAGE
Submersible Pumps Help Quell Damage From Mount St. Helens Mudflow.
W82-00509 4D

DAMS
Settlement of a Compacted Unsaturated Earth Embankment,
W82-00678 8D

Sediment Surveys in the Department of Water Affairs,
W82-00680 7B

The Pongolo Floodplain: A Unique Ecosystem Threatened,
W82-00684 6G

Executive Summary; Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in the Seven Mid-Western States.
W82-00718 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in Illinois.
W82-00719 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Rhode Island.
W82-00720 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New Hampshire.
W82-00721 6E

A Case Study Analysis of the Legal and Institutional Obstacles and Incentives to the Development of the Hydrolelectric Power of the Boardman River at Traverse City, Michigan.
W82-00747 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Indiana.
W82-00748 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Ohio.
W82-00749 6E

A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Development of the Hydroelectric Potential at Goose River, Maine.
W82-00751 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Pennsylvania.
W82-00752 6E

Glen Canyon Dam Is Killing the Grand Canyon and Your Tax Dollars Are Paying for It.
W82-00813 6G

Morphological Changes of River Channels Consequent Upon Headwater Impoundment,
W82-01087 6G

DANVERS
Design and Construction of the Danvers, Massachusetts Water Processing Plant,
W82-01088 5F

DATA COLLECTION
Great Lakes International Surveillance Plan,
W82-00701 6E

DATA COLLECTIONS
Mathematical Modeling Techniques for Groundwater Management,
W82-01062 4B

DDE
Chlorinated Hydrocarbons as a Factor in the Reproduction and Survival of Lake Trout (Salvelinus Namaycush) in Lake Michigan.
W82-01079 5C

DEBRIS BASINS
Debris Flow Deposits of Early Miocene Age, Deadman Stream, Marlborough, New Zealand,
W82-00694 2J

DECISION MAKING
Using Ecological Knowledge for Development Planning,
W82-00671 6A

DECOMPOSING ORGANIC MATTER
Modeling of Processes of Decomposition of Organic Matter in Bottom Sediments,
W82-00553 5B

DECOMPOSITION
Seasonal Influx and Decomposition of Autochthonous Macrophyte Litter in a North Temperate Estuary,
W82-00918 2L

A Simulation Model for Sludge Decomposition in Soil,
W82-01001 5E

The Role of Substratum in Benthic Macroinvertebrate Microdistribution and Litter Decomposition in a Woodland Stream,
W82-01037 2E

DEEP WELLS
Groundwater Problems in North Carolina,
W82-01056 4B

DEGRADATION
Dye-Sensitized Photooxidation of Bromacil in Water,
W82-00514 5B

Degradation of Hydrocarbons in Oxidized and Reduced Sediments,
W82-00907 5B

DELAWARE
Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Delaware.
W82-00755 6E

DELTAS
Sediment Yield from a Flatland Watershed,
W82-00941 2J

DENITRIFICATION
Removal of Nitrate from Public Water Supply Abstractions,
W82-00774 5F

DEPOSITION
Associations and Mesoscale Spatial Relationships Among Rainwater Constituents,
W82-00964 2B

DES ALLEMANDS
Modeling Hydrology and Eutrophication in a Louisiana Swamp Forest Ecosystem,
W82-00890 4A

DESALINATION APPARATUS
Superseparation: Soret Effect Reversed,
W82-00791 3A

DESERT PLANTS
Leaf and Environmental Parameters Influencing Transpiration: Theory and Field Measurements,
W82-00979 2D

Photosynthetic Recovery of Resurrection Spikemosses from Different Hydration Regimes,
W82-01010 2I

Water Vapor Conductance and CO2 Uptake for Leaves of a C4 Desert Grass, Hilaria Rigida,
W82-01039 2I

DESIGN CRITERIA
Hydraulic Design for the Two-Stage Stilling Basin,
W82-00849 8B

Good Looks, Low Maintenance Guide Water Tank Choice,
W82-00868 5A

Sizing Rice Irrigation Canals,
W82-00895 3F

A New Look at Design of Raw Water Piping,
W82-01029 8A

Design and Construction of the Danvers, Massachusetts Water Processing Plant,
W82-01088 5F

DETERGENTS
Effects of Wastewater Sludge and Its Detergents on the Stability of Rotavirus,
W82-00576 5A

Health Implications of Non-NTA Detergent Builders,
W82-00703 5G

Ecological Effects of Non-Phosphate Detergent Builders: Final Report on Organic Builders other than NTA,
W82-00704 5G

DETOXIFICATION
Detoxification of Residual Quaternaries,
W82-00562 5G

DETRITUS
Movement of Loose, Sandy Detritus by Shallow Water Flows: An Experimental Study,
W82-00776 2J

Seasonal Influx and Decomposition of Autochthonous Macrophyte Litter in a North Temperate Estuary,
W82-00918 2L

DEVELOPING COUNTRIES
Using Ecological Knowledge for Development Planning,
W82-00671 6A

DIATOMS
Aluminum Shadowing-Direct Projection Photomicroscopy of Diatom Frustules,
W82-00884 5A

DICHLOROMETHANE
Utilization of Dichloromethane by Suspended and Fixed-Film Bacteria,
W82-00577 5B

DIFFUSIVITY
Determination of Hydrogeological Parameters Using Sinusoidal Pressure Tests: A Theoretical Appraisal,
W82-00603 7B

DINOFLAGELLATES
Toxic Dinoflagellates and Tidal Power Generation in the Bay of Fundy, Canada,
W82-00908 6G

DIPHENYLMETHANES
Biodegradability of Halogen-Substituted Diphenylmethanes,
W82-00599 5B

DIQUAT
Toxicities of Paraquat and Diquat Herbicides to Freshwater Copepods (Diaptomus Sp. and Eucyclops Sp.),
W82-00589 5C

DIRECT FILTRATION
Direct Filtration Studies at Traverse City Water Treatment Plant,
W82-00945 5F

DISINFECTANTS
An Alternative Wastewater Disinfectant,
W82-00950 5D

Removing Trihalomethanes from Drinking Water,
W82-00953 5F

DISINFECTION
Purification of Wastewater by Electrolysis,
W82-00847 5D

Chemicals Disinfect Sludge,
W82-01003 5D

DISSOLUTION
Chemical Mass-Wasting of the Northern Yucatan Peninsula by Groundwater Dissolution,
W82-01015 2K

DISSOLVED ORGANIC MATTER
Chemical Composition of Labile Fractions in DOM,
W82-00917 2H

DISSOLVED OXYGEN
The Impact of Effluent from the Renton Wastewater Treatment Plant on the Dissolved Oxygen Regimen of the Lower Green/Duwamish River,
W82-01064 5D

DISTRIBUTION PATTERNS
The Changing Status of Reedswamp in the Norfolk Broads,
W82-00691 5C

DOGWOOD
Clonal Variations in the Water Relations of Red Osier Dogwood During Cold Acclimation,
W82-00839 2I

DOMESTIC ANIMALS
Feeding Animals Activated Sludge,
W82-00523 5D

DRAINAGE
Backfill Alteration Effects on Pipe Drainage of a Clay Soil,
W82-00763 4A

DRAINAGE WATERS
Irrigation and Drainage Waters of a New Irrigation Zone in the Hungry Steppe and Possibilities of their Use,
W82-00658 3C

DRAWDOWN
Well-Field Drawdowns Using Coupled Aquifer Model,
W82-00990 2F

The Impact of a Natural Drawdown on the Growth of Four Emergent Species in a Prairie Glacial Marsh,
W82-01096 2H

DREDGING
A Comparative Study of Four Dredges Used for Sampling Benthic Macroinvertebrates in Rivers,
W82-00833 7B

Dredging and Disposal of Toxic Material Using Japanese Technology Suggested for United States,
W82-01026 5E

DRINKING WATER
What Caused the Bad Odor in the Drinking Water,
W82-00527 5F

Growth of Aeromonas Hydrophila at Low Concentrations of Substrates Added to Tap Water,
W82-00578 5A

Chrysotile Asbestos Fiber Removal During Potable Water Treatment. Pilot Plant Studies,
W82-00613 5F

Environmental Health Hazards,
W82-00625 5F

Antibiotic-Resistant Bacteria in Drinking Water,
W82-00645 5F

Effect of Turbidity on Chlorination Efficiency and Bacterial Persistence in Drinking Water,
W82-00865 5A

Determination of Low NG/L Levels of Polychlorinated Biphenyls in Drinking Water by Ex-

traction with Macroreticular Resin and Analysis Using a Capillary Column,
W82-00875 5A

Determination of Polyhalogenated Phenolic Compounds in Drinking Water, Human Blood Serum and Adipose Tissue,
W82-00879 5A

The Fate of Heavy Metals in the Ruhr System and Their Influence on Drinking Water Quality,
W82-00962 5B

The Activity of Environmental Samples in a Cell Culture Test for Asbestos Toxicity,
W82-01031 5C

Giardia Prevalence in Commercially Trapped Mammals,
W82-01046 5A

Groundwater Problems and Needs in New York,
W82-01055 4B

Health Effects of Monochloramines in Drinking Water,
W82-01091 5C

DROUGHT

The Manifestation of Dehydration Avoidance in Wheat Breeding Germplasm,
W82-00958 2I

Variations in Precipitation Parameters Between Drought and Non-Drought Periods in Texas and Some Implications for Cloud Seeding,
W82-01006 2B

Seasonal Patterns of Leaf Water Relations in Four Co-Occurring Forest Tree Species: Parameters from Pressure-Volume Curves,
W82-01011 2I

DROUGHT RESISTANCE

Photosynthetic Recovery of Resurrection Spikemosses from Different Hydration Regimes,
W82-01010 2I

DRUGS

R Factors in Coliform-Fecal Coliform Sewage Flora of the Prairies and Northwest Territories of Canada,
W82-00508 5A

Antibiotic-Resistant Bacteria in Drinking Water,
W82-00645 5F

DRY FARMING

Research and Development to Service a Sustainable Agriculture,
W82-00669 3F

DUSTS

The Effects of Surface Dust on Snowmelt Rates,
W82-00845 2C

DYE INDUSTRY WASTES

Aromatic Amines in and Near the Buffalo River,
W82-00622 5B

DYES

Dye-Sensitized Photooxidation of Bromacil in Water,
W82-00514 5B

EAGLE LAKE

The Impact of a Natural Drawdown on the Growth of Four Emergent Species in a Prairie Glacial Marsh,
W82-01096 2H

EASTERN UNITED STATES

The Magnitude of the Hydrological Frequency Factor in Maximum Rainfall Estimation,
W82-00983 2B

ECHINODERMS

Sea Urchin Sperm Bioassay for Sewage and Chlorinated Seawater and Its Relation to Fish Bioassays,
W82-00988 5A

ECOLOGICAL EFFECTS

Interpreting Dynamics of Aquatic Resources: A Perspective for Resource Managers,
W82-00539 6A

Effect of Otter Prawn Trawling on the Macrobenthos of a Sandy Substratum in a New South Wales Estuary,
W82-00677 5C

Richards Bay: An Ecological Dilemma,
W82-00679 6A

Does Improved Waste Treatment Have Demonstrable Biological Benefits,
W82-00779 5C

Toxic Dinoflagellates and Tidal Power Generation in the Bay of Fundy, Canada,
W82-00908 6G

The Impact of a Natural Drawdown on the Growth of Four Emergent Species in a Prairie Glacial Marsh,
W82-01096 2H

ECOLOGY

Using Ecological Knowledge for Development Planning,
W82-00671 6A

Aluminum Shadowing-Direct Projection Photomicroscopy of Diatom Frustules,
W82-00884 5A

ECONOMIC ASPECTS

Risk and the Demand for Supplemental Irrigation: A Case Study in the Corn Belt,
W82-00522 6A

State Water Use and Socioeconomic Data Related to the Second National Water Assessment,
W82-00739 6D

Summary of the Mid-Atlantic Conference on Small-Scale Hydro-Power in the Mid-Atlantic States: Resolution of the Barriers Impeding Its Development.
W82-00743 6E

A Case Study Analysis of the Legal and Institutional Obstacles and Incentives to the Development of the Hydrolelectric Power of the Boardman River at Traverse City, Michigan.
W82-00747 6E

A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Development of the Hydroelectric Potential at Goose River, Maine.
W82-00751 6E

A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Potential Hydroelectric Development at High Falls State Park, Georgia.
W82-01078 6E

ECONOMIC EFFICIENCY

Cold Weather Waste Treatment,
W82-00636 5D

ECONOMIC FEASIBILITY

Fundamental Economic Issues in the Development of Small Scale Hydro.
W82-00722 6C

ECONOMIC JUSTIFICATION

Economic Analysis of Granular-Bed Filtration,
W82-00975 5F

ECOSYSTEMS

Model of the Seasonal Dynamics of an Ecosystem of a Shallow Lake,
W82-00552 2H

Dynamics of Selenium in Mercury-Contaminated Experimental Freshwater Ecosystems,
W82-00595 5B

Theory of Ecological Prediction of Limnetic Ecosystems,
W82-00597 6G

Report of the Aquatic Ecosystem Objectives Committee,
W82-00705 5G

A Comparison of Sensitivity Analysis and Error Analysis Based on a Stream Ecosystem Model,
W82-00991 7A

A Method for the Evaluation of Conditions in a Fish Pond Sediment,
W82-01019 2H

Phosphorus, Nirogen, and Organic Carbon Flux in a Headwater Stream,
W82-01021 2K

Water Relations, Soil Fertility, and Plant Nutrient Composition of a Pygmy Oak Ecosystem,
W82-01034 2I

Nutrient Budget Studies for Forests Along an Elevational Gradient in New Mexico,
W82-01036 2K

The Role of Substratum in Benthic Macroinvertebrate Microdistribution and Litter Decomposition in a Woodland Stream,
W82-01037 2E

Flow Analysis of Models of the Hubbard Brook Ecosystem,
W82-01038 1A

Managing Oil and Gas Activities in Coastal Environments: Refuge Manual,
W82-01081 5G

EFFLUENTS

Industrial Effluent Monitoring Incorporating a Recent Automated Fish Biomonitoring System,
W82-00530 5A

Utilization of Dichloromethane by Suspended and Fixed-Film Bacteria,
W82-00577 5B

Does Improved Waste Treatment Have Demonstrable Biological Benefits,
W82-00779 5C

Mutlichamber Septic Tanks,
W82-00969 5D

Treatability Manual; Volume III. Technologies for Control/Removal of Pollutants.
W82-01075 5D

Treatability Manual; Volume V. Summary.
W82-01077 5D

EGGS

Bioconcentration of Pesticides by Egg Masses of the Caddisfly, Triaenodes Tardus Milne,
W82-00982 5B

ELECTRIC POWER PRODUCTION

Final Environmental Impact Statement: North Fork Stanislaus River Project No. 2409 - California.
W82-00737 6G

ELECTRIC POWERPLANTS

Ground-Water Use for Cooling: Associated Aquifer Temperature Changes,
W82-01014 3E

ELECTROLYSIS
Purification of Wastewater by Electrolysis,
W82-00847 5D

ELECTRON MICROSCOPY
Interim Method for Determining Asbestos in Water,
W82-00741 5A

ELECTROPLATING
The Impact of an Industrially Contaminated Lake on Heavy Metal Levels in it's Effluent Stream,
W82-00886 5B

ENDOTOXIN
Movement of Endotoxin Through Soil Columns,
W82-00586 5B

ENERGY
Waste Heat Balance in Aquifers Calculated by a Computer Programme,
W82-00830 7B

ENERGY CONSERVATION
Mixing Technology Reduces Energy Use,
W82-00634 5D

ENGLAND
The Changing Status of Reedswamp in the Norfolk Broads,
W82-00691 5C

ENTEROVIRUSES
Simultaneous Concentration of Salmonella and Enterovirus From Surface Water by Using Micro-Fiber Glass Filters,
W82-00573 5A

Survival of Human Enteroviruses in the Hawaiian Ocean Environment: Evidence for Virus-Inactivating Microorganisms,
W82-00587 5C

ENTRAINMENT
Measurement of Particulates Extrained in Some Great Lakes Power Plant Cooling Water: An Exercise in Futility,
W82-00782 6G

ENVIRONMENTAL EFFECTS
Leaf Litter Processing in a Regulated Rocky Mountain Stream,
W82-00542 6G

Acidity Fluctuations at a Broadland Site in Norfolk,
W82-00656 2K

Factor Analysis of the Impact of the Environment on Microbial Communities in the Tvarminne Area, Southern Coast of Finland,
W82-00672 5C

Effects of Environmental Factors on Microbial Populations in Brackish Waters off the Southern Coast of Finland,
W82-00683 2L

Final Environmental Impact Statement: North Fork Stanislaus River Project No. 2409 - California.
W82-00737 6G

Glen Canyon Dam Is Killing the Grand Canyon and Your Tax Dollars Are Paying for It.
W82-00813 6G

Waterborne Methylene Bis(2-Chloroaniline) and 2-Chloroaniline Contamination Around Adrian, Michigan,
W82-00873 5B

Modeling Hydrology and Eutrophication in a Louisiana Swamp Forest Ecosystem,
W82-00890 4A

Environmental Effects of Water Reuse Scheme,
W82-00973 3C

ENVIRONMENTAL GRADIENT
Aluminum Shadowing-Direct Projection Photomicroscopy of Diatom Frustules,
W82-00884 5A

ENVIRONMENTAL IMPACT STATEMENT
Final Environmental Impact Statement: North Fork Stanislaus River Project No. 2409 - California.
W82-00737 6G

Final Environmental Impact Statement: Swan Lake Project No. 2911 - Alaska.
W82-00738 6G

ENVIRONMENTAL POLICY
Great Lakes Environmental Protection Policies from a Fisheries Perspective,
W82-00978 6G

ENVIRONMENTAL PROTECTION
An Environmental Safety Assessment of Butyl Benzyl Phthalate,
W82-00615 5A

Formulating Alternatives for Environmental Studies,
W82-00997 6G

EPHEMERAL STREAMS
A Leaky Reservoir Model for Ephemeral Flow Recession,
W82-00600 2E

EPIDEMIOLOGY
The Relationship of Environmental Epidemiology to Water and Wastewater Plant Operators,
W82-00789 5C

EQUIPMENT
Aquatic Weed Cutting Apparatus,
W82-00624 4A

EROSION
Modeling Gradual Dam Breaches,
W82-00554 8D

Holocene Sequences on an Embayed High-Energy Coast: An Evolutionary Model,
W82-00695 2J

Graphed Equilibrium Parameters of Channels Formed in Sediment,
W82-00881 2J

EROSION CONTROL
Coordinated Effort Stems Sediment and Erosion,
W82-00766 4D

Costs of Alternative Policies for Controlling Agricultural Soil Loss and Associated Stream Sedimentation,
W82-00869 4D

Tractive Force Design of Vegetated Channels,
W82-00901 4D

Aerial Photography as an Aid to Cropland Erosion Analysis,
W82-00902 2J

EROSION RATES
Effect of Slope Length on Erosion from Low Slopes,
W82-00896 2J

Chemical Mass-Wasting of the Northern Yucatan Peninsula by Groundwater Dissolution,
W82-01015 2K

ERROR ANALYSIS
Estimation of Material Fluxes in an Estuarine Cross Section: A Critical Analysis of Spatial Measurement Density and Errors,
W82-00816 7A

A Comparison of Sensitivity Analysis and Error Analysis Based on a Stream Ecosystem Model,
W82-00991 7A

ESTIMATING EQUATIONS
Estimation of Soil-Moisture Characteristics from Mechanical Properties of Soils,
W82-00785 2G

Transport of Salts in Soils and Subsoils,
W82-00930 5B

Residence Times of Water and Solutes Within and Below the Root Zone,
W82-00932 2G

ESTUARIES
Measurement of PH in the Estuarine Environment on the NBS Scale. (LA Mesure Du PH En Milieu Estuarien Sur L'Echelle NBS),
W82-00521 7B

Holocene Sequences on an Embayed High-Energy Coast: An Evolutionary Model,
W82-00695 2J

Spatial Distributions of Pollen in Surface Sediments of the Potomac Estuary,
W82-00757 2L

Transformations of Nitrogen in a Polluted Estuary: Nonlinearities in the Demand for Oxygen at Low Flow,
W82-00777 5B

Estimation of Material Fluxes in an Estuarine Cross Section: A Critical Analysis of Spatial Measurement Density and Errors,
W82-00816 7A

The Assay of Adenosine 5'Triphosphate Extracted from Salt-Marsh Microbiota,
W82-00838 2L

Enrichment of the Agricultural Herbicide Atrazine in the Microsurface Water of an Estuary,
W82-00877 5B

Dieback of Salt-Water Cordgrass (Spartina Alterniflora Loisel.) in the Lower Cape Fear Estuary of North Carolina: An Experimental Approach to Re-Establishment,
W82-00889 2L

ESTUARIES *HYDROGEN ION CONCENTRATION
Effect of pH and Redox Potential on Concentration of Dissolved Nutrients in an Estuarine Sediment,
W82-00795 2L

ESTUARINE ENVIRONMENT
Partitioning of No. 2 Fuel Oil in Controlled Estuarine Ecosystems. Sediments and Suspended Particulate Matter,
W82-00541 2L

Relationships Between Environmental Factors, Bacterial Indicators, and the Occurrence of Enteric Viruses in Estuarine Sediments,
W82-00574 5A

Effect of Otter Prawn Trawling on the Macrobenthos of a Sandy Substratum in a New South Wales Estuary,
W82-00677 5C

The Design and Interpretation of Marine Pollution Surveys,
W82-00700 6E

Methylation of Trimethyltin Compounds by Estuarine Sediments,
W82-00801 5B

Effects of Temperature, pH, Salinity, and Inorganic Nitrogen on the Rate of Ammonium Oxi-

dation by Nitrifiers Isolated from Wetland Environments,
W82-00910 2L

ESTUARINE ENVIRONMENTS
Effects of Environmental Factors on Microbial Populations in Brackish Waters off the Southern Coast of Finland,
W82-00683 2L

EUTROPHIC LAKES
Acute and Chronic Effects of Alum to Midge Larva (Diptera: Chironomidae),
W82-00650 5F

Distribution and Biological Availability of Reactive High Molecular Weight Phosphorus in Natural Waters in New Zealand,
W82-00659 2H

1980 Report on Great Lakes Water Quality - Appendix,
W82-00708 5C

Factors Controlling Phytoplankton Primary Productivity in Byram Lake, Mt. Kisco, N.Y., Summer, 1977,
W82-00915 2H

The Effects of Heavy Metals on Microbial Biomass in Sediments of Palestine Lake,
W82-00925 5C

Prediction of Phosphorus and Nitrogen Concentrations in Lakes from Both Internal and External Loading Rates,
W82-00928 2H

The Effect of Changes in the Nutrient Income on the Condition of Lake Washington,
W82-00987 2H

EUTROPHICATION
Potential Eutrophication of the Rideau River by an Urban Drainage Waterway,
W82-00834 5C

Modeling Hydrology and Eutrophication in a Louisiana Swamp Forest Ecosystem,
W82-00890 4A

Experimental Manipulation of Algal Bloom Composition by Nitrogen Addition,
W82-00998 5C

EVALUATION
The U.S. Geological Survey Federal-State Cooperative Water Resources Program,
W82-00735 6B

Evaluating Irrigation Systems,
W82-00772 6B

EVAPOTRANSPIRATION
Consumptive Use and Daily Evapotranspiration of Corn Under Different Levels of Nitrogen and Moisture Regimes,
W82-00660 2D

The Influence of Plant Communities Upon the Hydrology of Catchments,
W82-00931 2D

Ratio Between Evapotranspiration of Irrigated Crops from Floating Lysimeters and Class A Pan Evaporation,
W82-01050 2D

EXCESS RAINFALL
Effects of Tropical Cyclone Wally in Southeast Viti Levu, Fiji, Easter 1980,
W82-00670 2A

EXPLORATION
Managing Oil and Gas Activities in Coastal Environments: Refuge Manual,
W82-01081 5G

FABABEANS
Response of Fababean Yield, Protein Production and Water Use to Irrigation,
W82-01089 2I

FACTOR ANALYSIS
Associations and Mesoscale Spatial Relationships Among Rainwater Constituents,
W82-00964 2B

FARM MANAGEMENT
Costs of Alternative Policies for Controlling Agricultural Soil Loss and Associated Stream Sedimentation,
W82-00869 4D

FATE OF POLLUTANTS
Dye-Sensitized Photooxidation of Bromacil in Water,
W82-00514 5B

Uptake of Polychlorinated Biphenyls by Natural Phytoplankton Assemblages: Field and Laboratory Determination of C14-PCB Particle-Water Index of Sorption,
W82-01032 5B

FECAL COLIFORM
Evaluation of Standard and Modified M-FC, Macconkey, and Teepol Media for Membrane Filtration Counting of Fecal Coliforms in Water,
W82-00644 5A

FECES
Assessment of Water Quality Conditions in Skamokawa Creek, Washington,
W82-01066 5C

FEDERAL JURISDICTION
The Distribution of the Costs of Federal Water Pollution Control Policy,
W82-00537 6B

FEDERAL-STATE COOPERATION
The U.S. Geological Survey Federal-State Cooperative Water Resources Program,
W82-00735 6B

FEDERAL WATER RESOURCES RESEARCH
Federal Water Resources Research: A Review of the Proposed Five-Year Program Plan.
W82-01051 6E

FEEDLOT RUNOFF
Vegetative Filter Treatment of Livestock Feedlot Runoff,
W82-00794 5D

FEEDLOT WASTES
Dairy Liquid Waste Distribution in an Overland Flow Vegetative-Soil Filter System,
W82-00897 5D

FEEDS
Feeding Animals Activated Sludge,
W82-00523 5D

FERRIC CHLORIDE
Ferric Chloride Takes Over,
W82-00954 5F

FERTILITY
The Use of Algal Assays and Chlorophyll Concentrations to Determine Fertility of Water in Small Impoundments in West Virginia,
W82-00919 2H

FIJI ISLANDS
Effects of Tropical Cyclone Wally in Southeast Viti Levu, Fiji, Easter 1980,
W82-00670 2A

FILTER MEDIA
Direct Filtration Studies at Traverse City Water Treatment Plant,
W82-00945 5F

FILTRATION
Mechanism of Charged Membrane Ultrafiltration of Salt Solutions,
W82-00641 5D

Direct Filtration Studies at Traverse City Water Treatment Plant,
W82-00945 5F

Low Turbidity Water from Fast Processes,
W82-00946 5F

Economic Analysis of Granular-Bed Filtration,
W82-00975 5F

FINLAND
Factor Analysis of the Impact of the Environment on Microbial Communities in the Tvarminne Area, Southern Coast of Finland,
W82-00672 5C

Annual Succession of Phytoplankton in One Heated Pond in Central Finland,
W82-00673 5C

Effects of Environmental Factors on Microbial Populations in Brackish Waters off the Southern Coast of Finland,
W82-00683 2L

FISH
Residues of Isobornyl Thiocyanoacetate (Thanite) and a Metabolite in Fish and Treated Ponds,
W82-00570 5B

Toxicity of Five Forest Insecticides to Cutthroat Trout and Two Species of Aquatic Invertebrates,
W82-00590 5C

Control of Water Weeds by Grass Carp in Two Small Lakes,
W82-00609 3B

Effects of Hypolimnetic Discharge on Fish Health Below a Reservoir,
W82-00805 5C

Factors Influencing Fish Distribution in Two Desert Reservoirs, Central Arizona,
W82-00814 2H

Heavy Metal Concentrations in the Holston River Basin (Tennessee),
W82-00959 5A

Uptake and Transfer of the Chlorinated Hydrocarbon Lindane (Gamma-BHC) in a Laboratory Freshwater Food Chain,
W82-01033 5C

Relation Between Trophic Position and Mercury Accumulation Among Fishes from the Tongue River Reservoir, Montana,
W82-01041 5A

FISH EGGS
Gonad Development, Fecundity, and Spawning Season of Largemouth Bass in Newly Impounded West Point Reservoir, Alabama-Georgia,
W82-01080 2H

FISH FARMING
Thames Rears Carp in Sewage.
W82-00681 3C

Water Movement for Water Quality in Catfish Production,
W82-00866 5G

FISH MANAGEMENT
Management Provoked Conflict in Fisheries,
W82-00780 6A

Great Lakes Environmental Protection Policies from a Fisheries Perspective,
W82-00978 6G

FISH PHYSIOLOGY
Serum Enzymes in Rainbow Trout as Tools in the Diagnosis of Water Quality,
W82-00857 5A

Occurrence of Tetraalkylead Compounds in the Aquatic Environment,
W82-00878 5A

FISH PONDS
Inorganic Transformation of Applied Phosphorus in Brackish Water Fish Pond Soil Under Different Water Salinity Levels,
W82-00920 2H

A Method for the Evaluation of Conditions in a Fish Pond Sediment,
W82-01019 2H

FISH POPULATIONS
Acute Toxicity of Zinc to Some Fishes in High Alkalinity Water,
W82-00713 5C

Factors Influencing Fish Distribution in Two Desert Reservoirs, Central Arizona,
W82-00814 2H

Water Movement for Water Quality in Catfish Production,
W82-00866 5G

Mercury and Selenium Concentrations in Fish, Sediments, and Water of Two Northwestern Quebec Lakes,
W82-00876 5B

Factors Affecting Puget Sound Coho Salmon (Oncorhynchus Kisutch) Runs,
W82-00883 8I

FISH TOXINS
Acute Toxicity of Zinc to Some Fishes in High Alkalinity Water,
W82-00713 5C

Conversion of Abienol into Tetrahydroepimanool by Anaerobic Processes in Woodroom Debarking Effluent,
W82-00860 5C

Mercury and Selenium Concentrations in Fish, Sediments, and Water of Two Northwestern Quebec Lakes,
W82-00876 5B

Biological Testing Methods - Compliance with Hazardous Waste Regulation Chapter 173-302 WAC.
W82-01071 5A

FISHERIES
Towards a Predictive Model for the Economic Regulation of Commercial Fisheries,
W82-00549 6A

Receiving Stream Fisheries Studies Relative to Secondary Treated Pulp and Paper Mill Effluents,
W82-00688 5C

Management Provoked Conflict in Fisheries,
W82-00780 6A

FISHKILL
Relationship Between Thermal Stability and Summer Oxygen Depletion in a Prairie Pothole Lake,
W82-00545 2H

Experimental Manipulation of Algal Bloom Composition by Nitrogen Addition,
W82-00998 5C

Biological Testing Methods - Compliance with Hazardous Waste Regulation Chapter 173-302 WAC.
W82-01071 5A

FIVE-YEAR PLANS
Federal Water Resources Research: A Review of the Proposed Five-Year Program Plan.
W82-01051 6E

FJORDS
Circulation and Energetics of a Deep, Strongly Stratified Inlet,
W82-00547 2L

FLOCCULATION
Flocculation of Clay Particles with a Synthetic Anionic Polymer,
W82-00773 5F

Floc/Float System Cleans Desalter Effluent,
W82-00906 5D

FLOOD DAMAGE
Floods in Kansas City, Missouri and Kansas, September 12-13,
W82-00724 2E

FLOOD DATA
Floods in Kansas City, Missouri and Kansas, September 12-13,
W82-00724 2E

FLOOD FREQUENCY
Effects of Recent Increases in Rainfall on Floods and Runoff in the Upper Hunter Valley,
W82-00668 2E

FLOOD PEAK
Floods in Kansas City, Missouri and Kansas, September 12-13,
W82-00724 2E

FLOOD PLAINS
The Pongolo Floodplain: A Unique Ecosystem Threatened,
W82-00684 6G

Federal Participation in Land Use Decision-Making at the Water's Edge--Floodplains and Wetlands,
W82-00799 6E

FLOOD PROFILES
Floods in Kansas City, Missouri and Kansas, September 12-13,
W82-00724 2E

FLOOD PROTECTION
Reliability of Underground Flood Control System,
W82-00556 8A

FLOODING
Submersible Pumps Help Quell Damage From Mount St. Helens Mudflow.
W82-00509 4D

FLOODS
Floods in Kansas City, Missouri and Kansas, September 12-13,
W82-00724 2E

FLORENCE
Effect of Ozonation and Chlorination on the Mutagenic Potential of Drinking Water,
W82-00649 5A

FLORIDA
Acid Rain at Kennedy Space Center, Florida: Recent Observations,
W82-00533 5B

Generalized Thickness of the Floridan Aquifer, Southwest Florida Water Management District,
W82-00729 7C

Resistivity Study of a Coastal Karst Terrain, Florida,
W82-00817 2F

Water Stress and Cold Hardiness in Field-Grown Citrus,
W82-00864 2I

Limnological Characteristics of Several Lakes on the Lake Wales Ridge, South-Central Florida,
W82-00914 2H

Tampa Bay Water Guarded by Computer,
W82-00934 4B

Sulfur and Associated Elements and Acidity in Continental and Marine Rain from North Florida,
W82-00965 2B

Well-Field Drawdowns Using Coupled Aquifer Model,
W82-00990 2F

FLORIDAN AQUIFER
Generalized Thickness of the Floridan Aquifer, Southwest Florida Water Management District,
W82-00729 7C

FLOW CHARACTERISTICS
Circulation and Energetics of a Deep, Strongly Stratified Inlet,
W82-00547 2L

Frontal Jump Conditions for Models of Shallow, Buoyant Surface Layer Hydrodynamics,
W82-00804 8B

Hydraulic Model Study for the Design of the Wreck Cove Control Gates,
W82-00880 8B

Flow Analysis of Models of the Hubbard Brook Ecosystem,
W82-01038 1A

FLOW FRICTION
Circulation and Energetics of a Deep, Strongly Stratified Inlet,
W82-00547 2L

FLOW MEASUREMENT
Modeling Water Flux on Strip-Mined Land,
W82-00944 2G

FLOW RATES
Effect of Leachate Flow Rate on Metal Migration Through Soil,
W82-00565 5E

Depths of Flow in Level Basins,
W82-00900 3F

FLUIDIZED BEDS
Fluidized Bed for Biological Wastewater Treatment,
W82-00968 5D

FOAM SEPARATION
Foam Control in Aeration Tanks,
W82-00525 5D

FOAMING
Foam Control in Aeration Tanks,
W82-00525 5D

FOOD CHAIN
Uptake and Transfer of the Chlorinated Hydrocarbon Lindane (Gamma-BHC) in a Laboratory Freshwater Food Chain,
W82-01033 5C

FOOD PROCESSING INDUSTRY
Anaerobic Biological Treatment of Food Industry Wastewaters,
W82-00698 5D

FOOD-PROCESSING WASTES
Low-Cost Wastewater Treatment,
W82-00841 5D

FORAGES
Effects of Water Quality on Forage Production,
W82-01002 3C

FOREST WATERSHEDS
Seston Dynamics in Southern Appalachian Streams: Effects of Clear-Cutting,
W82-00543 4C

The Influence of Plant Communities Upon the Hydrology of Catchments,
W82-00931 2D

FORESTS
Seasonal Changes in Leaf Area, Stomatal and Canopy Conductances and Transpiration From Bracken Below a Forest Canopy,
W82-00655 2D

Seasonal Patterns of Leaf Water Relations in Four Co-Occurring Forest Tree Species: Parameters from Pressure-Volume Curves,
W82-01011 2I

Water Relations, Soil Fertility, and Plant Nutrient Composition of a Pygmy Oak Ecosystem,
W82-01034 2I

FOULING
Methylation of Trimethyltin Compounds by Estuarine Sediments,
W82-00801 5B

FREEZING
Physical Mechanics of Aufeis Growth,
W82-00836 2C

FREQUENCY ANALYSIS
The Magnitude of the Hydrological Frequency Factor in Maximum Rainfall Estimation,
W82-00983 2B

FROST PROTECTION
Water Stress and Cold Hardiness in Field-Grown Citrus,
W82-00864 2I

FUEL
Managing Oil and Gas Activities in Coastal Environments: Refuge Manual,
W82-01081 5G

FUNGI
Fungal Decolorization of Kraft Bleach Plant Effluents,
W82-00689 5D

Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay II. Mycological Aspects,
W82-00922 2L

FURROWS
Sediment Sizes Eroded from Crop Row Sideslopes,
W82-00903 2J

FUTURE PLANNING
Federal Water Resources Research: A Review of the Proposed Five-Year Program Plan.
W82-01051 6E

GAS CHROMATOGRAPHY
Detection of Volatile Nitrosamines in Waste Water from Chemical Plants by Combined Capillary Gas Chromatography-Mass Spectrometry,
W82-00856 5A

GEOCHEMISTRY
Hydrogeochemistry and Simulated Solute Transport, Piceance Basin, Northwestern Colorado,
W82-00723 5B

GEOHYDROLOGY
Hydrogeological and Geophysical Logging.
W82-00511 7B

Hydrogeology of the Sierra Nevada Foothill Lineament Near Oakhurst, California,
W82-00831 2F

A Combination of Electrical Resistivity, Seismic Refraction, and Gravity Measurements for Groundwater Exploration in Sudan,
W82-00852 2F

GEOLOGIC FRACTURES
The Relationship Between Fracture Traces and Joints in a Tertiary Basin, Southwest Montana,
W82-00829 7B

GEOLOGIC HISTORY
Debris Flow Deposits of Early Miocene Age, Deadman Stream, Marlborough, New Zealand,
W82-00694 2J

Hydrogeology of the Sierra Nevada Foothill Lineament Near Oakhurst, California,
W82-00831 2F

GEOMORPHOLOGY
A Geomorphologic Synthesis of Nonlinearity in Surface Runoff,
W82-00604 2A

Morphological Changes of River Channels Consequent Upon Headwater Impoundment,
W82-01087 6G

GEOPHYSICS
Hydrogeological and Geophysical Logging.
W82-00511 7B

A Combination of Electrical Resistivity, Seismic Refraction, and Gravity Measurements for Groundwater Exploration in Sudan,
W82-00852 2F

GEOTHERMAL STUDIES
A Mathematical Model for Consolidation in a Thermoelastic Aquifer Due to Hot Water Injection or Pumping,
W82-00602 2F

Gravitational Stability of Water Over Steam in Vapor-Dominated Geothermal Systems,
W82-00963 1A

GERMINATION
Investigations of Control Mechanisms of Germination Under Water Stress,
W82-00912 2I

GLACIAL AQUIFERS
Predictive Depositional Model for Glacial Aquifers,
W82-00828 2F

GOOSE RIVER
A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Development of the Hydroelectric Potential at Goose River, Maine.
W82-00751 6E

GOVERNMENT FINANCE
Facts Fix Fund Finding,
W82-00885 9A

GRANADA
New Waterborne Bacteriophages Active on Yersinia Enterocolitica,
W82-00662 5A

GRAND VALLEY
Lateral Sizes for Efficient Level-Basin Irrigation,
W82-00942 3F

GRASSES
Water Vapor Conductance and CO2 Uptake for Leaves of a C4 Desert Grass, Hilaria Rigida,
W82-01039 2I

GREAT BRITAIN
Environmental Virology and its Problems,
W82-00505 5A

Removal of Nitrate from Public Water Supply Abstractions,
W82-00774 5F

Aquatic Mosses as Monitors of Heavy Metal Contamination in the River Etherow, Great Britain,
W82-00787 5A

Factors Influencing the Occurrence of Bursts in Iron Water Mains,
W82-00960 8A

GREAT LAKES
Great Lakes International Surveillance Plan,
W82-00701 6E

Health Implications of Non-NTA Detergent Builders,
W82-00703 5G

Report of the Aquatic Ecosystem Objectives Committee,
W82-00705 5G

1980 Annual Report, Committee on the Assessment of Human Health Effects of Great Lakes Water Quality,
W82-00706 5C

Assessment of Airborne Inorganic Contaminants in the Great Lakes,
W82-00710 5B

Ammonia and Nitrate Uptake in the Lower Great Lakes,
W82-00882 2H

Great Lakes Environmental Protection Policies from a Fisheries Perspective,
W82-00978 6G

GREAT LAKES BASIN
Phosphorus Management for the Great Lakes: Final Report of the Phosphorus Management Strategies Task Force,
W82-00702 6E

1980 Annual Report - A Perspective on the Problem of Hazardous Substances in the Great Lakes Basin Ecosystem,
W82-00707 5C

Assessment of Airborne Organic Contaminants in the Great Lakes Ecosystem,
W82-00709 5B

GREAT LAKES ECOSYSTEM
1980 Report on Great Lakes Water Quality - Appendix,
W82-00708 5C

GREAT PLAINS
Dryland Management for Salinity Control,
W82-01018 2G

Saline Seep Development and Control in the North American Great Plains - Hydrogeological Aspects,
W82-01022 5B

GROUNDWATER
Groundwater Strategies,
W82-00620 5G

Groundwater Leaching of Organic Pollutants From in Situ Retorted Oil Shale. A Mass Transfer Analysis,
W82-00626 5B

Hydrogeochemistry and Simulated Solute Transport, Piceance Basin, Northwestern Colorado,
W82-00723 5B

Summary Appraisal of Water Resources in the Redmond Quadrangle, Sanpete and Sevier Counties, Utah,
W82-00725 7C

Potentiometric-Surface Map for the Cretaceous Aquifer, Virginia Coastal Plain, 1978,
W82-00727 7C

Potentiometric Surface of the Wilcox-Carrizo Aquifer; Bienville, Red River, Northern Natchitoches, and Southern Webster Parishes, Louisana,
W82-00728 7C

Generalized Thickness of the Floridan Aquifer, Southwest Florida Water Management District,
W82-00729 7C

Water Resources Data for Illinois, Water Year 1980--Volume 1. Illinois Except Illinois River Basin.
W82-00731 7C

Water Resources Data for Illinois, Water Year 1980--Volume 2. Illinois River Basin.
W82-00732 7C

Water Resources Data for Utah, Water Year 1980.
W82-00733 7C

Approximate Ground-Water-Level Contours, April 1981, for the Soquel-Aptos Area, Santa Cruz County, California,
W82-00734 7C

Chemistry of Lake Water and Groundwater in Areas of Contrasting Glacial Drifts in Eastern Minnesota,
W82-00821 2K

Hydrogeology of the Sierra Nevada Foothill Lineament Near Oakhurst, California,
W82-00831 2F

Role of Solute-Transport Models in the Analysis of Groundwater Salinity Problems in Agricultural Areas,
W82-00993 5B

Saline Seep Development and Control in the North American Great Plains - Hydrogeological Aspects,
W82-01022 5B

GROUNDWATER AVAILABILITY

Groundwater Problems and Needs in New York,
W82-01055 4B

Groundwater Problems in North Carolina,
W82-01056 4B

Ohio's Ground Water Resources and Problem Areas,
W82-01057 4B

Pennsylvania Ground Water Problems and Needs,
W82-01058 4B

GROUNDWATER BASINS

Uranium Concentration in the Ground Waters of the Pullman-Moscow Basin, Whitman County, Washington, and Latah County, Idaho,
W82-00809 5B

Overland Flow on a Diverging Surface,
W82-00986 2A

GROUNDWATER BUDGET

The Declining Ground-Water Resources of Alluvial Valleys: A Case Study,
W82-00832 4B

GROUNDWATER DEPLETION

Interstate Conflict Over Ground Water: Wisconsin-Illinois,
W82-00818 6E

The Declining Ground-Water Resources of Alluvial Valleys: A Case Study,
W82-00832 4B

GROUNDWATER MANAGEMENT

Tampa Bay Water Guarded by Computer,
W82-00934 4B

Illinois Groundwater Problems and Needs,
W82-01052 4B

Groundwater Pollution in Kentucky: A Status Report,
W82-01053 4B

Ground Water in the Ohio River Basin Portion of Maryland: Problems and Needs,
W82-01054 4B

Groundwater Problems and Needs in New York,
W82-01055 4B

Groundwater Problems in North Carolina,
W82-01056 4B

Ohio's Ground Water Resources and Problem Areas,
W82-01057 4B

Pennsylvania Ground Water Problems and Needs,
W82-01058 4B

Ground Water Problems Virginia Portion Ohio River Basin,
W82-01059 4B

Ground Water Problems in West Virginia,
W82-01060 4B

Mathematical Modeling Techniques for Groundwater Management,
W82-01062 4B

GROUNDWATER MINING

Predictive Depositional Model for Glacial Aquifers,
W82-00828 2F

The Relationship Between Fracture Traces and Joints in a Tertiary Basin, Southwest Montana,
W82-00829 7B

GROUNDWATER MOVEMENT

Spring Flood: Meltwater or Groundwater,
W82-00531 7B

The Use of Na/Cl Ratios to Trace Solute Sources in a Semiarid Zone,
W82-00601 7B

A Non-Equilibrium Thermodynamics Approach to Transport Phenomena in Capillary Porous Media,
W82-00697 2F

Numerical Simulation of Potentiometric Surface Changes Caused by a Proposed Open-Pit Anthracite Mine,
W82-00819 6A

GROUNDWATER POLLUTION

Movement of Endotoxin Through Soil Columns,
W82-00586 5B

Uranium Concentration in the Ground Waters of the Pullman-Moscow Basin, Whitman County, Washington, and Latah County, Idaho,
W82-00809 5B

Sampling Ground Water for Organic Contaminants,
W82-00820 5A

Enforcement Under the Resource Conservation and Recovery Act of 1976,
W82-01013 6E

Illinois Groundwater Problems and Needs,
W82-01052 4B

Groundwater Pollution in Kentucky: A Status Report,
W82-01053 4B

Groundwater Problems and Needs in New York,
W82-01055 4B

Ohio's Ground Water Resources and Problem Areas,
W82-01057 4B

Pennsylvania Ground Water Problems and Needs,
W82-01058 4B

Ground Water Problems Virginia Portion Ohio River Basin,
W82-01059 4B

Ground Water Problems in West Virginia,
W82-01060 4B

Groundwater Quality Models - State of the Art,
W82-01061 5G

GROUNDWATER POTENTIAL

A Combination of Electrical Resistivity, Seismic Refraction, and Gravity Measurements for Groundwater Exploration in Sudan,
W82-00852 2F

GROUNDWATER RECHARGE

The Use of Na/Cl Ratios to Trace Solute Sources in a Semiarid Zone,
W82-00601 7B

A Method for Estimating Recharge and Boundary Flux from Groundwater Level Observations,
W82-00985 2F

GROUNDWATER RESERVOIRS

Waste Heat Balance in Aquifers Calculated by a Computer Programme,
W82-00830 7B

GROWTH RATES

Effect of Crude Oil and Petroleum-Degrading Microorganisms on the Growth of Freshwater and Soil Protozoa,
W82-00517 5C

Water Relations of Three Cowpea Cultivars (Vigna Unguiculata L.),
W82-00607 2I

GYPSUM

Quality of Irrigation Water and Effects of Sulfuric Acid and Gypsum on Soil Properties and Sundangrass Yields,
W82-00767 3C

HABITATS

Photosynthesis and Growth in Populations of Populus Deltoides from Constrating Habitats,
W82-00935 2I

HALOGENS

Determination of Polyhalogenated Phenolic Compounds in Drinking Water, Human Blood Serum and Adipose Tissue,
W82-00879 5A

HARBORS

Richards Bay: An Ecological Dilemma,
W82-00679 6A

HARDNESS

Water Hardness Determination by the Catalytic Polarographic Wave of Magnesium Ion,
W82-01083 5A

HAWAII

Survival of Human Enteroviruses in the Hawaiian Ocean Environment: Evidence for Virus-Inactivating Microorganisms,
W82-00587 5C

HAZARDOUS MATERIALS
The Toxic Waste Dump Problem and a Suggested Insurance Program,
W82-00591 5E

Environmental Health Hazards,
W82-00625 5F

Report of the Aquatic Ecosystem Objectives Committee,
W82-00705 5G

1980 Annual Report, Committee on the Assessment of Human Health Effects of Great Lakes Water Quality,
W82-00706 5C

Toxics in Municipal and Industrial Wastewaters,
W82-00712 5A

Dredging and Disposal of Toxic Material Using Japanese Technology Suggested for United States,
W82-01026 5E

An Industrial and Hazardous Waste Inventory of Washington's Manufacturing Industries (1980),
W82-01065 5B

Biological Testing Methods - Compliance with Hazardous Waste Regulation Chapter 173-302 WAC.
W82-01071 5A

HAZARDOUS WASTE INVENTORY
An Industrial and Hazardous Waste Inventory of Washington's Manufacturing Industries (1980),
W82-01065 5B

HEATED WATER
Waste Heat Balance in Aquifers Calculated by a Computer Programme,
W82-00830 7B

HEAVY METALS
Effect of Metals on the Biomass Production Kinetics of Freshwater Copepods,
W82-00593 5C

Insect Community Structure as an Index of Heavy-Metal Pollution in Lotic Ecosystems,
W82-00596 5C

Assessment of Airborne Inorganic Contaminants in the Great Lakes,
W82-00710 5B

Manganese Dioxide as an Adsorbant for Heavy Metals,
W82-00775 5F

The Effects of Heavy Metals on Microbial Biomass in Sediments of Palestine Lake,
W82-00925 5C

Extracting Heavy Metals and Toxic Organics from Sludge,
W82-00947 5D

Heavy Metal Concentrations in the Holston River Basin (Tennessee),
W82-00959 5A

The Fate of Heavy Metals in the Ruhr System and Their Influence on Drinking Water Quality,
W82-00962 5B

Heavy Metal Contents in Some Macrophytes from Saginaw Bay (Lake Huron, U.S.A.),
W82-01000 5B

A Rapid Simple Long-Term Toxicity Assay for Aquatic Contaminants Using the Nematode Panagrellus Redivivus,
W82-01017 5A

Multielement Preconcentration of Trace Heavy Metals in Water by Coprecipitation and Flotation with Indium Hydroxide for Inductively Coupled Plasma-Atomic Emission Spectrometry,
W82-01097 5A

HERBICIDES
Dye-Sensitized Photooxidation of Bromacil in Water,
W82-00514 5B

Determination of Terbutryn and its Degradation Products in Water, Sediments, Aquatic Plants, and Fish,
W82-00567 5A

Search for Linuron Residues in Tributaries of the Chesapeake Bay,
W82-00569 5A

Toxicities of Paraquat and Diquat Herbicides to Freshwater Copepods (Diaptomus Sp. and Eucyclops Sp.),
W82-00589 5C

Enrichment of the Agricultural Herbicide Atrazine in the Microsurface Water of an Estuary,
W82-00877 5B

HIGH FALLS STATE PARK
A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Potential Hydroelectric Development at High Falls State Park, Georgia.
W82-01078 6E

HIGHWAY EFFECTS
Are Metals from Highway Dustfall Hazardous in Swimming Pools,
W82-01093 5B

HOLSTON RIVER
Heavy Metal Concentrations in the Holston River Basin (Tennessee),
W82-00959 5A

HOME WATER HEATERS
What Caused the Bad Odor in the Drinking Water,
W82-00527 5F

HOME WATER SOFTENERS
Home Water Softeners, Water Softness and Possible Health Implications,
W82-01045 5F

HUACCOTO DAM
Modeling Gradual Dam Breaches,
W82-00554 8D

HUMAN DISEASE
A Note on the Fate of El Tor Cholera and Other Vibrios in Percolating Filters,
W82-00566 5D

HUMAN DISEASES
Preliminary Pollutant Limit Values for Human Health Effects,
W82-00628 5G

Human Health Hazards Associated With Chemical Contamination of Aquatic Environment,
W82-00632 5C

Dispersal of Salmonella from a Polluted Stream to Neighboring Terrestrial Habitats,
W82-01043 5A

Home Water Softeners, Water Softness and Possible Health Implications,
W82-01045 5F

HUNTER VALLEY
Effects of Recent Increases in Rainfall on Floods and Runoff in the Upper Hunter Valley,
W82-00668 2E

HYDRAULIC DESIGN
Hydraulic Design for the Two-Stage Stilling Basin,
W82-00849 8B

HYDRAULIC GATES
Hydraulic Model Study for the Design of the Wreck Cove Control Gates,
W82-00880 8B

HYDROCARBONS
New Liquid Chromatographic Detection System for Environmental Pollutants,
W82-00740 5A

Degradation of Hydrocarbons in Oxidized and Reduced Sediments,
W82-00907 5B

HYDRODYNAMICS
Frontal Jump Conditions for Models of Shallow, Buoyant Surface Layer Hydrodynamics,
W82-00804 8B

HYDROELECTRIC PLANTS
Small Hydro Installations Spur Unique Engineering Solutions,
W82-00538 6B

Executive Summary; Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in the Seven Mid-Western States.
W82-00718 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in Illinois.
W82-00719 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Rhode Island.
W82-00720 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New Hampshire.
W82-00721 6E

Fundamental Economic Issues in the Development of Small Scale Hydro.
W82-00722 6C

Water Resources Appraisal for Hydroelectric Licensing: Jordan River Basin, Utah.
W82-00736 6D

Final Environmental Impact Statement: Swan Lake Project No. 2911 - Alaska.
W82-00738 6G

A Case Study Analysis of the Legal and Institutional Obstacles and Incentives to the Development of the Hydrolelectric Power of the Boardman River at Traverse City, Michigan.
W82-00747 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Indiana.
W82-00748 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Ohio.
W82-00749 6E

Analysis of Legal Obstacles and Incentives to the Development of Low-Head Hydroelectric Power in Maine.
W82-00750 6E

A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Development of the Hydroelectric Potential at Goose River, Maine.
W82-00751 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Pennsylvania.
W82-00752 6E

A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Potential Hydroelectric Development at High Falls State Park, Georgia.
W82-01078 6E

HYDROELECTRIC POWER
Final Environmental Impact Statement: North Fork Stanislaus River Project No. 2409 - California.
W82-00737 6G

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New Jersey.
W82-00742 6E

Summary of the Mid-Atlantic Conference on Small-Scale Hydro-Power in the Mid-Atlantic States: Resolution of the Barriers Impeding Its Development.
W82-00743 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Virginia,
W82-00744 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Maryland.
W82-00745 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in Wisconsin.
W82-00746 6E

Analysis of Legal Obstacles and Incentives to the Development of Low-Head Hydroelectric Power in Maine.
W82-00750 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in West Virginia.
W82-00753 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New York.
W82-00754 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Delaware.
W82-00755 6E

A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Potential Hydroelectric Development at High Falls State Park, Georgia.
W82-01078 6E

HYDROGEN ION CONCENTRATION
Measurement of PH in the Estuarine Environment on the NBS Scale. (LA Mesure Du PH En Milieu Estuarien Sur L'Echelle NBS),
W82-00521 7B

Biogeochemistry of Thoreau's Bog, Concord, Massachusetts,
W82-00887 2K

HYDROLOGIC BUDGET
Probability-Theoretical Analysis of Fluctuations in the Level of a Closed Water Body,
W82-00571 2H

HYDROLOGIC DATA
Water Resources Data for Illinois, Water Year 1980--Volume 1. Illinois Except Illinois River Basin.
W82-00731 7C

Water Resources Data for Illinois, Water Year 1980--Volume 2. Illinois River Basin.
W82-00732 7C

Water Resources Data for Utah, Water Year 1980.
W82-00733 7C

The U.S. Geological Survey Federal-State Cooperative Water Resources Program,
W82-00735 6B

HYDROLOGICAL DATA COLLECTION
Hydrogeological and Geophysical Logging.
W82-00511 7B

HYPOLIMNION
Effects of Hypolimnetic Discharge on Fish Health Below a Reservoir,
W82-00805 5C

ICE FORMATION
Physical Mechanics of Aufeis Growth,
W82-00836 2C

Occurrence of Ice Layers at the Base of High Arctic Snowpacks,
W82-00844 2C

IDAHO
Plan of Study for the Regional Aquifer-System Analysis of the Snake River Plain, Idaho and Eastern Oregon,
W82-00730 6A

ILLINOIS
Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in Illinois.
W82-00719 6E

Water Resources Data for Illinois, Water Year 1980--Volume 1. Illinois Except Illinois River Basin.
W82-00731 7C

Water Resources Data for Illinois, Water Year 1980--Volume 2. Illinois River Basin.
W82-00732 7C

Interstate Conflict Over Ground Water: Wisconsin-Illinois,
W82-00818 6E

Dispersal of Salmonella from a Polluted Stream to Neighboring Terrestrial Habitats,
W82-01043 5A

Illinois Groundwater Problems and Needs,
W82-01052 4B

ILLINOIS RIVER BASIN
Water Resources Data for Illinois, Water Year 1980--Volume 2. Illinois River Basin.
W82-00732 7C

IMPAIRED WATER USE
Saline Water Use and Disposal Opportunities; Colorado River Water Quality Improvement Program,
W82-00717 3C

INDIA
Consumptive Use and Daily Evapotranspiration of Corn Under Different Levels of Nitrogen and Moisture Regimes,
W82-00660 2D

Trace Constituents in Cloud Water, Rainwater and Aerosol Samples Collected near the West Coast of India During the Southwest Monsoon,
W82-00676 2B

INDIANA
Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Indiana.
W82-00748 6E

INDUSRIAL WASTE
Waterborne Methylene Bis(2-Chloroaniline) and 2-Chloroaniline Contamination Around Adrian, Michigan,
W82-00873 5B

INDUSTRIAL EFFLUENTS
Floc/Float System Cleans Desalter Effluent,
W82-00906 5D

INDUSTRIAL WASTES
Industrial Effluent Monitoring Incorporating a Recent Automated Fish Biomonitoring System,
W82-00530 5A

Mixing Technology Reduces Energy Use,
W82-00634 5D

Foam Control and Degradation of Nonionic Detergents,
W82-00637 5D

Removal of Priority Pollutants,
W82-00639 5D

Chloramine-T as A Potential Scrubbing Agent: Removal of Odorous Sulfur-Containing Environmental Pollutants,
W82-00871 5D

Effects of a Cattleskin Tannery of Stream Quality and Benthic Macroinvertebrates in Central Maine,
W82-00872 5C

The Impact of an Industrially Contaminated Lake on Heavy Metal Levels in it's Effluent Stream,
W82-00886 5B

Separation of Selenium from Sulfide Leach Liquors,
W82-00905 5D

Potential for Land Disposal of Two Nonbiodegradable Wastes,
W82-00939 5D

Guideline Tables to Industrial Wastes Problems.
W82-00956 5D

Enforcement Under the Resource Conservation and Recovery Act of 1976,
W82-01013 6E

An Industrial and Hazardous Waste Inventory of Washington's Manufacturing Industries (1980),
W82-01065 5B

INDUSTRIAL WASTEWATER
Toxics in Municipal and Industrial Wastewaters,
W82-00712 5A

Dairy Liquid Waste Distribution in an Overland Flow Vegetative-Soil Filter System,
W82-00897 5D

Guideline Tables to Industrial Wastes Problems.
W82-00956 5D

The Fate of Heavy Metals in the Ruhr System and Their Influence on Drinking Water Quality,
W82-00962 5B

Wilson Creek Drainage - Surface and Ground Water Quality, July 1978 to July 1979.
W82-01069 5B

Treatability Manual; Volume I. Treatability Data.
W82-01073 5D

Treatability Manual: Volume II. Industrial Descriptions.
W82-01074 5D

Treatability Manual; Volume III. Technologies for Control/Removal of Pollutants.
W82-01075 5D

Treatability Manual; Volume IV. Cost Estimating.
W82-01076 5D

Treatability Manual; Volume V. Summary.
W82-01077 5D

INDUSTRIAL WATER
Detoxification of Residual Quaternaries,
W82-00562 5G

INFILTRATION
Why EPA's I/I Control Program Fails,
W82-00790 8A

INJECTION WELLS
A Mathematical Model for Consolidation in a Thermoelastic Aquifer Due to Hot Water Injection or Pumping,
W82-00602 2F

Ground-Water Use for Cooling: Associated Aquifer Temperature Changes,
W82-01014 3E

INLAND WATERWAYS
The Waterway That Cannot be Stopped,
W82-00510 6E

INLETS
General Morphology and Sediment Patterns in Tidal Inlets,
W82-00792 2L

INSECTICIDES
Residues of Isobornyl Thiocyanoacetate (Thanite) and a Metabolite in Fish and Treated Ponds,
W82-00570 5B

Toxicity of Five Forest Insecticides to Cutthroat Trout and Two Species of Aquatic Invertebrates,
W82-00590 5C

INSTITUTIONAL CONSTRAINTS
Fundamental Economic Issues in the Development of Small Scale Hydro.
W82-00722 6C

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New Jersey.
W82-00742 6E

Summary of the Mid-Atlantic Conference on Small-Scale Hydro-Power in the Mid-Atlantic States: Resolution of the Barriers Impeding Its Development.
W82-00743 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Virginia,
W82-00744 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Maryland.
W82-00745 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in Wisconsin.
W82-00746 6E

A Case Study Analysis of the Legal and Institutional Obstacles and Incentives to the Development of the Hydrolelectric Power of the Boardman River at Traverse City, Michigan.
W82-00747 6E

A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Development of the Hydroelectric Potential at Goose River, Maine.
W82-00751 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in West Virginia.
W82-00753 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New York.
W82-00754 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Delaware.
W82-00755 6E

A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Potential Hydroelectric Development at High Falls State Park, Georgia.
W82-01078 6E

INSURANCE
The Toxic Waste Dump Problem and a Suggested Insurance Program,
W82-00591 5E

INTERNATIONAL AGREEMENTS
Great Lakes International Surveillance Plan,
W82-00701 6E

INTERNATIONAL WATERS
Great Lakes Environmental Protection Policies from a Fisheries Perspective,
W82-00978 6G

INTERSTITIAL WATER
Chemical Composition of Interstitial Waters in Bottom Sediments of Some Polish Lakes of the Wigry Group (Northern Poland),
W82-00675 2H

INVERTEBRATES
Toxicity of Five Forest Insecticides to Cutthroat Trout and Two Species of Aquatic Invertebrates,
W82-00590 5C

ION EXCHANGE
Gas Chromatographic Determination of Trialkyl/Aryl Phosphates in Drinking Water, Following Isolation Using Macroreticular Resin,
W82-00502 5A

Groundwater Contaminant Transport with Adsorption and Ion Exchange Chemistry: Method of Characteristics for the Case Without Dispersion,
W82-00551 5B

Removal of Nitrate from Public Water Supply Abstractions,
W82-00774 5F

The Removal of Organic Matter from Demineralised Water,
W82-00888 5F

ION TRANSPORT
Cation Transport in Packed Bed Reactor of Soil,
W82-00970 5D

IONIC INTERFERENCE
Effects of Ion-Pairing on Calculations of Ionic Activities of Major Ions in Freshwater,
W82-00823 2K

IONS
Effects of Ion-Pairing on Calculations of Ionic Activities of Major Ions in Freshwater,
W82-00823 2K

Methods of Investigating the State of Metal Ions in Natural Waters,
W82-00859 5A

IRON
Interaction of Orthophosphate with Iron (III) and Aluminum Hydroxides,
W82-00783 2H

Factors Influencing the Occurrence of Bursts in Iron Water Mains,
W82-00960 8A

IRRIGATION
Evaluation of the Oldman River Basin Irrigation Proposals: Implications for Interbasin Transfers,
W82-00519 6B

A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
W82-00532 5A

Irrigation and Drainage Waters of a New Irrigation Zone in the Hungry Steppe and Possibilities of their Use,
W82-00658 3C

Ratio Between Evapotranspiration of Irrigated Crops from Floating Lysimeters and Class A Pan Evaporation,
W82-01050 2D

IRRIGATION CANALS
Sizing Rice Irrigation Canals,
W82-00895 3F

IRRIGATION DITCHES
Operational Evaluation of Village Level Irrigation Conveyance Systems,
W82-00696 3F

IRRIGATION EFFECTS
Quality of Irrigation Water and Effects of Sulfuric Acid and Gypsum on Soil Properties and Sundangrass Yields,
W82-00767 3C

Water Stress and Cold Hardiness in Field-Grown Citrus,
W82-00864 2I

Effects of Water Quality on Forage Production,
W82-01002 3C

IRRIGATION EFFICIENCY
Yield and Water Use of Vegetable Crops with Seepage and Drip Irrigation Systems,
W82-00544 3F

Research and Development to Service a Sustainable Agriculture,
W82-00669 3F

Watertable Management Saves Water and Energy,
W82-00943 3F

IRRIGATION ENGINEERING
Laser Drip Irrigation.
W82-00771 3F

IRRIGATION PRACTICES
Saline Irrigation Water.
W82-00512 3F

The Uncertainty of Crop Models in Irrigation Optimization,
W82-00940 3F

Lateral Sizes for Efficient Level-Basin Irrigation,
W82-00942 3F

IRRIGATION REQUIREMENTS
Transpiration, Stomatal Conductance, and Photosynthesis of Tomato Plants With Various Proportions of Root System Supplied With Water,
W82-00504 2I

IRRIGATION SYSTEMS
Traveling Sprinkler System and Method,
W82-00561 3F

Evaluating Irrigation Systems,
W82-00772 6B

IRRIGATION WATER
Estimation of the Salt Burden of Irrigation Drainage Waters,
W82-00563 5B

2,500 Acres of Wastewater Irrigation,
W82-00769 3C

ISOLATION
New Waterborne Bacteriophages Active on Yersinia Enterocolitica,
W82-00662 5A

ISOTOPE STUDIES
Determination of Picogram Amounts of Technetium-99 by Resin Bead Mass Spectrometric Isotope Dilution,
W82-00999 5A

ISOTOPIC TRACERS
The Distribution of Sea Ice Meltwater in the Eastern Canadian Arctic,
W82-00966 2C

ISRAEL
Transport of Salts in Soils and Subsoils,
W82-00930 5B

Environmental Effects of Water Reuse Scheme,
W82-00973 3C

JAMES BAY
Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay, Canada. I: Bacteriological Aspects,
W82-00921 2L

Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay II. Mycological Aspects,
W82-00922 2L

JAMES RIVER
Kepone in the James River,
W82-00631 5B

JAPAN
Chemical Composition of Labile Fractions in DOM,
W82-00917 2H

JETTIES
Large Rubble-Mound Breakwater Failures,
W82-00862 8D

JUDICIAL DECISIONS
Freedom from the Navigation Servitude Through Private Investment,
W82-01030 6E

KANSAS
Floods in Kansas City, Missouri and Kansas, September 12-13,
W82-00724 2E

The Declining Ground-Water Resources of Alluvial Valleys: A Case Study,
W82-00832 4B

KANSAS CITY
Floods in Kansas City, Missouri and Kansas, September 12-13,
W82-00724 2E

KARST HYDROLOGY
Reliability of Underground Flood Control System,
W82-00556 8A

Resistivity Study of a Coastal Karst Terrain, Florida,
W82-00817 2F

KENNEDY SPACE CENTER
Acid Rain at Kennedy Space Center, Florida: Recent Observations,
W82-00533 5B

KENTUCKY
Evaluation of Stripmine Sediment Detention Basins in Kentucky,
W82-00893 5G

Groundwater Pollution in Kentucky: A Status Report,
W82-01053 4B

KENYA
Organochlorine Residues in Kenya's Rift Valley Lakes,
W82-00690 5A

KEPONE
Kepone in the James River,
W82-00631 5B

KINETICS
Kinetics of Nitrate and Ammonium Uptake by the Tropical Freshwater Macrophyte Pistia Stratiotes L.,
W82-00937 5D

KNIGHT INLET
Circulation and Energetics of a Deep, Strongly Stratified Inlet,
W82-00547 2L

LABORATORY EQUIPMENT
Sampling Ground Water for Organic Contaminants,
W82-00820 5A

LAGOONS
Bentonite Liners for Power Plant Lagoons,
W82-00617 5E

LAKE BASINS
1980 Annual Report - A Perspective on the Problem of Hazardous Substances in the Great Lakes Basin Ecosystem,
W82-00707 5C

LAKE CLASSIFICATION
Classification of Central Amazon Lakes on the Basis of their Microbiological and Physico-Chemical Characteristics,
W82-00666 2H

LAKE GEORGE
Influence of Seasonal Temperature on the Temperature Optima of Bacteria in Sediments of Lake George, New York,
W82-00606 2H

LAKE KISSIMMEE
Diel Variations of Selected Physico-Chemical Parameters in Lake Kissimmee, Florida,
W82-00535 2H

LAKE MICHIGAN
Trace Element Concentrations Over Midlake Michigan as a Function of Meteorology and Source Region,
W82-00550 5B

Chlorinated Hydrocarbons as a Factor in the Reproduction and Survival of Lake Trout (Salvelinus Namaycush) in Lake Michigan.
W82-01079 5C

LAKE ONTARIO
Mean Summer Circulation in Lake Ontario Within the Coastal Zone,
W82-00967 2H

LAKE REHABILITATION
1980 Report on Great Lakes Water Quality - Appendix,
W82-00708 5C

LAKE RESTORATION
Prediction of Phosphorus and Nitrogen Concentrations in Lakes from Both Internal and External Loading Rates,
W82-00928 2H

Reviving Acidified Lakes,
W82-00933 2H

LAKE SEDIMENTS
Sediments as a Source of Phosphate: A Study of 38 Impoundments,
W82-00653 2H

LAKE TAHOE
An In Situ Method for Measuring the Primary Productivity and Standing Crop of the Epilithic Periphyton Community in Lentic Systems,
W82-00756 7B

LAKE WASHINGTON
The Effect of Changes in the Nutrient Income on the Condition of Lake Washington,
W82-00987 2H

LAKE-WATERSHED SYSTEMS
Simulation of Lake-Watershed Systems, I. Description and Sensitivity Analysis of the Model,
W82-00926 2A

Simulation of Lake-Watershed Systems, II. Application to Baptiste Lake, Alberta, Canada,
W82-00927 2A

LAKES
Anthropogenic Trace Elements and Polycyclic Aromatic Hydrocarbon Levels in Sediment Cores From Two Lakes in the Adirondack Acid Lake Region,
W82-00501 5B

Relationship Between Thermal Stability and Summer Oxygen Depletion in a Prairie Pothole Lake,
W82-00545 2H

A Procedure Using Modeling and Error Analysis for the Prediction of Lake Phosphorus Concentration from Land Use Information,
W82-00546 5G

Model of the Seasonal Dynamics of an Ecosystem of a Shallow Lake,
W82-00552 2H

Microbial Metabolism of N-Nitrosodiethanolamine in Lake Water and Sewage,
W82-00585 2H

Vertical Distribution of Monosaccharides in Lake Water,
W82-00665 2H

Chemical Composition of Interstitial Waters in Bottom Sediments of Some Polish Lakes of the Wigry Group (Northern Poland),
W82-00675 2H

Organochlorine Residues in Kenya's Rift Valley Lakes,
W82-00690 5A

Great Lakes International Surveillance Plan,
W82-00701 6E

LAKES

Phosphorus Management for the Great Lakes: Final Report of the Phosphorus Management Strategies Task Force,
W82-00702 6E

Health Implications of Non-NTA Detergent Builders,
W82-00703 5G

Ecological Effects of Non-Phosphate Detergent Builders: Final Report on Organic Builders other than NTA,
W82-00704 5G

Report of the Aquatic Ecosystem Objectives Committee,
W82-00705 5G

1980 Annual Report, Committee on the Assessment of Human Health Effects of Great Lakes Water Quality,
W82-00706 5C

Assessment of Airborne Organic Contaminants in the Great Lakes Ecosystem,
W82-00709 5B

Assessment of Airborne Inorganic Contaminants in the Great Lakes,
W82-00710 5B

Formation of N-Nitrosodiethanolamine from Diethanolamine in Lake Water and Sewage,
W82-00796 5A

Chemistry of Lake Water and Groundwater in Areas of Contrasting Glacial Drifts in Eastern Minnesota,
W82-00821 2K

Nitrogen and Phosphorus Recycling in Lake Sammamish, A Temperate Mesotrophic Lake,
W82-00824 2H

On Lake Bottom Dynamics--The Energy-Topography Factor,
W82-00837 2H

Absorption of Fenitrothion by Plankton and Benthic Algae,
W82-00874 5B

Mercury and Selenium Concentrations in Fish, Sediments, and Water of Two Northwestern Quebec Lakes,
W82-00876 5B

Ammonia and Nitrate Uptake in the Lower Great Lakes,
W82-00882 2H

Limnological Characteristics of Several Lakes on the Lake Wales Ridge, South-Central Florida,
W82-00914 2H

Influence of Phosphorus Loads and of Some Limnological Processes on the Purity of Lake Water,
W82-00923 2H

Heavy Metal Contents in Some Macrophytes from Saginaw Bay (Lake Huron, U.S.A.),
W82-01000 5B

The Effect of Continuous Advanced Wastewater Treatment by the City of Spokane on the Trophic Status of Long Lake, WA During 1979.
W82-01070 2H

An Assessment of the Trophic Status of Deer, Loon, and Diamond Lakes,
W82-01072 2H

LAND DISPOSAL

Movement of Endotoxin Through Soil Columns,
W82-00586 5B

Land Treatment of Municipal Wastewater in Small Communities,
W82-00588 5D

Trace Element Accumulation, Movement, and Distribution in the Soil Profile From Massive Applications of Sewage Sludge,
W82-00640 5E

Persistence and Distribution of Erysipelothrix Rhusiopathiae and Bacterial Indicator Organisms on Land Used for Disposal of Piggery Effluent,
W82-00686 5B

Vegetative Filter Treatment of Livestock Feedlot Runoff,
W82-00794 5D

Dairy Liquid Waste Distribution in an Overland Flow Vegetative-Soil Filter System,
W82-00897 5D

Potential for Land Disposal of Two Nonbiodegradable Wastes,
W82-00939 5D

Evaluation of Winter Application of Liquid Sludge to Farmland,
W82-00952 5B

Removal of Volatile Trace Organics from Wastewater by Overland Flow Land Treatment,
W82-01042 5D

LAND FORMING

Land Forming Effects on Dryland Sorghum Production in the Southern Great Plains,
W82-00764 3F

LAND RECLAMATION

Modeling Water Flux on Strip-Mined Land,
W82-00944 2G

LAND USE

A Procedure Using Modeling and Error Analysis for the Prediction of Lake Phosphorus Concentration from Land Use Information,
W82-00546 5G

Federal Participation in Land Use Decision-Making at the Water's Edge--Floodplains and Wetlands,
W82-00799 6E

LANDFILLS

An Industrial and Hazardous Waste Inventory of Washington's Manufacturing Industries (1980),
W82-01065 5B

LANDSLIDES

Effects of Tropical Cyclone Wally in Southeast Viti Levu, Fiji, Easter 1980,
W82-00670 2A

LASERS

Laser Drip Irrigation.
W82-00771 3F

LEACHATES

Effect of Leachate Flow Rate on Metal Migration Through Soil,
W82-00565 5E

Distribution of Silvex, 2,4-D, and TCDD Applied to Turf in Chambers and Field Plots,
W82-00568 5B

LEACHING

The Breakdown of Poultry Manure Aggregates by Rainfall Impact,
W82-00513 5B

Groundwater Contaminant Transport with Adsorption and Ion Exchange Chemistry: Method of Characteristics for the Case Without Dispersion,
W82-00551 5B

Groundwater Leaching of Organic Pollutants From in Situ Retorted Oil Shale. A Mass Transfer Analysis,
W82-00626 5B

Metal Leaching from Sewage Sludge Ash,
W82-00770 5B

Separation of Selenium from Sulfide Leach Liquors,
W82-00905 5D

Trenching of Digested Sludge,
W82-00974 5E

Leach Characteristics of Coal-Gasification Char,
W82-01025 5B

Effects of Nitrapyrin on Nitrate Movement in Soil Columns,
W82-01048 5G

LEAD

Occurrence of Tetraalkylead Compounds in the Aquatic Environment,
W82-00878 5A

LEAVES

Leaf Litter Processing in a Regulated Rocky Mountain Stream,
W82-00542 6G

Leaf and Environmental Parameters Influencing Transpiration: Theory and Field Measurements,
W82-00979 2D

Seasonal Patterns of Leaf Water Relations in Four Co-Occurring Forest Tree Species: Parameters from Pressure-Volume Curves,
W82-01011 2I

The Role of Substratum in Benthic Macroinvertebrate Microdistribution and Litter Decomposition in a Woodland Stream,
W82-01037 2E

LEGAL ASPECTS

The Waterway That Cannot be Stopped,
W82-00510 6E

Groundwater Strategies,
W82-00620 5G

Executive Summary; Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in the Seven Mid-Western States.
W82-00718 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in Illinois.
W82-00719 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Rhode Island.
W82-00720 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New Hampshire.
W82-00721 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New Jersey.
W82-00742 6E

Summary of the Mid-Atlantic Conference on Small-Scale Hydro-Power in the Mid-Atlantic States: Resolution of the Barriers Impeding Its Development.
W82-00743 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Virginia,
W82-00744 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Maryland.
W82-00745 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in Wisconsin.
W82-00746 6E

A Case Study Analysis of the Legal and Institutional Obstacles and Incentives to the Development of the Hydrolelectric Power of the Boardman River at Traverse City, Michigan.
W82-00747 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Indiana.
W82-00748 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Ohio.
W82-00749 6E

Analysis of Legal Obstacles and Incentives to the Development of Low-Head Hydroelectric Power in Maine.
W82-00750 6E

A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Development of the Hydroelectric Potential at Goose River, Maine.
W82-00751 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Pennsylvania.
W82-00752 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in West Virginia.
W82-00753 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New York.
W82-00754 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Delaware.
W82-00755 6E

Western Coal Mining in the 1980s: A Study in Federal/State Conflicts,
W82-00972 6E

Experience Gained with the U.S. Pollution Control Policies,
W82-00996 6E

Enforcement Under the Resource Conservation and Recovery Act of 1976,
W82-01013 6E

Distribution System Liability,
W82-01028 5F

Freedom from the Navigation Servitude Through Private Investment,
W82-01030 6E

A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Potential Hydroelectric Development at High Falls State Park, Georgia.
W82-01078 6E

LEGISLATION
Groundwater Problems in North Carolina,
W82-01056 4B

Pennsylvania Ground Water Problems and Needs,
W82-01058 4B

Ground Water Problems in West Virginia,
W82-01060 4B

LEGUMES
Growth and Nitrogen Fixation of Aeschynomene Under Water Stressed Conditions,
W82-00758 2I

LENTIC ENVIRONMENT
An In Situ Method for Measuring the Primary Productivity and Standing Crop of the Epilithic Periphyton Community in Lentic Systems,
W82-00756 7B

LIGHT PENETRATION
Light Penetration and the Interrelationships Between Optical Parameters in a Turbid Subtropical Impoundment,
W82-00667 2H

LIMITING NUTRIENTS
Ammonia and Nitrate Uptake in the Lower Great Lakes,
W82-00882 2H

LIMNOLOGY
Theory of Ecological Prediction of Limnetic Ecosystems,
W82-00597 6G

Factors Influencing Fish Distribution in Two Desert Reservoirs, Central Arizona,
W82-00814 2H

On Lake Bottom Dynamics--The Energy-Topography Factor,
W82-00837 2H

LINDANE
Uptake and Transfer of the Chlorinated Hydrocarbon Lindane (Gamma-BHC) in a Laboratory Freshwater Food Chain,
W82-01033 5C

LININGS
Succeeding with Liner Installation,
W82-00909 8G

LINURON
Search for Linuron Residues in Tributaries of the Chesapeake Bay,
W82-00569 5A

LIQUID CHROMATOGRAPHY
New Liquid Chromatographic Detection System for Environmental Pollutants,
W82-00740 5A

LITERATURE REVIEWS
Temporal and Spatial Scales in Phytoplankton Ecology. Mechanisms, Methods, Models and Management,
W82-00594 5G

LITTER
Leaf Litter Processing in a Regulated Rocky Mountain Stream,
W82-00542 6G

LITTORAL ZONE
Grazing Rate Determination of Corynoneura Scutellata Winnertz (Chironomidae:Diptera),
W82-00822 2H

LOGGING
Seston Dynamics in Southern Appalachian Streams: Effects of Clear-Cutting,
W82-00543 4C

LOGGING (RECORDING)
Hydrogeological and Geophysical Logging.
W82-00511 7B

LONG ISLAND SOUND
Trace Metal Fluxes to Nearshore Long Island Sound Sediments,
W82-01040 5B

LONG LAKE
The Effect of Continuous Advanced Wastewater Treatment by the City of Spokane on the Trophic Status of Long Lake, WA During 1979.
W82-01070 2H

LONG-TERM PLANNING
Proposed Water Quality Control Plan for Indio Subarea of the Whitewater Hydrologic Unit, West Colorado River Basin.
W82-00716 6F

Federal Water Resources Research: A Review of the Proposed Five-Year Program Plan.
W82-01051 6E

Pennsylvania Ground Water Problems and Needs,
W82-01058 4B

State of Washington Water Quality Assessment Report 1980.
W82-01067 6E

LOTIC ENVIRONMENT
Insect Community Structure as an Index of Heavy-Metal Pollution in Lotic Ecosystems,
W82-00596 5C

LOTIC PERIPHYTON
A Portable Pump Sampler for Lotic Periphyton,
W82-00826 7B

LOUISIANA
Potentiometric Surface of the Wilcox-Carrizo Aquifer; Bienville, Red River, Northern Natchitoches, and Southern Webster Parishes, Louisana,
W82-00728 7C

Modeling Hydrology and Eutrophication in a Louisiana Swamp Forest Ecosystem,
W82-00890 4A

Degradation of Hydrocarbons in Oxidized and Reduced Sediments,
W82-00907 5B

LOW FLOW
The Organic Pollution of River Cubillas (Granada, South Spain),
W82-00674 5B

Transformations of Nitrogen in a Polluted Estuary: Nonlinearities in the Demand for Oxygen at Low Flow,
W82-00777 5B

MACROINVERTEBRATES
Leaf Litter Processing in a Regulated Rocky Mountain Stream,
W82-00542 6G

A Comparative Study of Four Dredges Used for Sampling Benthic Macroinvertebrates in Rivers,
W82-00833 7B

The Role of Substratum in Benthic Macroinvertebrate Microdistribution and Litter Decomposition in a Woodland Stream,
W82-01037 2E

MACROPHYTES
Sediment-Based Nutrition of Submersed Macrophytes,
W82-00843 2H

Retention of Radionuclides by Some Aquatic Fresh Water Plants,
W82-00853 5B

Heavy Metal Contents in Some Macrophytes from Saginaw Bay (Lake Huron, U.S.A.),
W82-01000 5B

MAGNESIUM
Microbial Mobilization of Calcium and Magnesium in Waterlogged Soils,
W82-00560 2G

Water Hardness Determination by the Catalytic Polarographic Wave of Magnesium Ion,
W82-01083 5A

MAINE
Analysis of Legal Obstacles and Incentives to the Development of Low-Head Hydroelectric Power in Maine.
W82-00750 6E

MAINTENANCE COSTS
Good Looks, Low Maintenance Guide Water Tank Choice,
W82-00868 5A

MANAGEMENT
Management Provoked Conflict in Fisheries,
W82-00780 6A

MANAGEMENT PLANNING
Management Training is the Key to Good Operator Performance,
W82-00623 5D

Answers: A Model for Watershed Planning,
W82-00898 6A

Federal Water Resources Research: A Review of the Proposed Five-Year Program Plan.
W82-01051 6E

MANGANESE DIOXIDE
Manganese Dioxide as an Adsorbant for Heavy Metals,
W82-00775 5F

MANITOBA
Enteric Viruses in Renovated Water in Manitoba,
W82-01090 5A

MANURE
The Breakdown of Poultry Manure Aggregates by Rainfall Impact,
W82-00513 5B

MAPS
Summary Appraisal of Water Resources in the Redmond Quadrangle, Sanpete and Sevier Counties, Utah,
W82-00725 7C

Potentiometric-Surface Map for the Cretaceous Aquifer, Virginia Coastal Plain, 1978,
W82-00727 7C

Potentiometric Surface of the Wilcox-Carrizo Aquifer; Bienville, Red River, Northern Natchitoches, and Southern Webster Parishes, Louisana,
W82-00728 7C

Generalized Thickness of the Floridan Aquifer, Southwest Florida Water Management District,
W82-00729 7C

Approximate Ground-Water-Level Contours, April 1981, for the Soquel-Aptos Area, Santa Cruz County, California,
W82-00734 7C

MARINE
Effects of a Cattleskin Tannery of Stream Quality and Benthic Macroinvertebrates in Central Maine,
W82-00872 5C

MARINE SEDIMENTS
Effect of pH and Redox Potential on Concentration of Dissolved Nutrients in an Estuarine Sediment,
W82-00795 2L

Measurement of in situ Rates of Nitrification in Sediment,
W82-00798 5A

Trace Metal Fluxes to Nearshore Long Island Sound Sediments,
W82-01040 5B

MARSH PLANTS
Dieback of Salt-Water Cordgrass (Spartina Alterniflora Loisel.) in the Lower Cape Fear Estuary of North Carolina: An Experimental Approach to Re-Establishment,
W82-00889 2L

MARSHES
The Impact of a Natural Drawdown on the Growth of Four Emergent Species in a Prairie Glacial Marsh,
W82-01096 2H

MARYLAND
Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Maryland.
W82-00745 6E

Coordinated Effort Stems Sediment and Erosion,
W82-00766 4D

Ground Water in the Ohio River Basin Portion of Maryland: Problems and Needs,
W82-01054 4B

MASS SPECTROMETRY
Detection of Volatile Nitrosamines in Waste Water from Chemical Plants by Combined Capillary Gas Chromatography-Mass Spectrometry,
W82-00856 5A

Determination of Picogram Amounts of Technetium-99 by Resin Bead Mass Spectrometric Isotope Dilution,
W82-00999 5A

MATHEMATICAL MODELS
Price Elasticities for Water: A Case of Increasing Block Rates,
W82-00536 6C

Model of the Seasonal Dynamics of an Ecosystem of a Shallow Lake,
W82-00552 2H

Modeling of Processes of Decomposition of Organic Matter in Bottom Sediments,
W82-00553 5B

Estimation of the Salt Burden of Irrigation Drainage Waters,
W82-00563 5B

Modeling the Transformation of Nitrogen Compounds for Water-Quality Management in Streams,
W82-00598 6A

A Mathematical Model for Consolidation in a Thermoelastic Aquifer Due to Hot Water Injection or Pumping,
W82-00602 2F

Influence of Gaseous Nitric Acid on Sulfate Production and Acidity in Rain,
W82-00642 5B

Multivariate Hydrologic Time Series Analysis,
W82-00647 2A

Moisture Transport in a Soil-Plant System: A Mathematical Model and Finite Element Analysis,
W82-00648 2I

Frontal Jump Conditions for Models of Shallow, Buoyant Surface Layer Hydrodynamics,
W82-00804 8B

Predictive Depositional Model for Glacial Aquifers,
W82-00828 2F

Subsurface Drainage and Sediment Transport Model,
W82-00894 2G

Adaptive Hydrological Forecasting - A Review,
W82-00984 2A

Overland Flow on a Diverging Surface,
W82-00986 2A

Mathematical Modeling Techniques for Groundwater Management,
W82-01062 4B

Development of Makeup-Line Safe-Operating Criteria,
W82-01095 8B

MATHEMATICAL STUDIES
Probability-Theoretical Analysis of Fluctuations in the Level of a Closed Water Body,
W82-00571 2H

The Development of Methods for Determining Aquifer Characteristics,
W82-00827 2F

Evaluation of Areal Versus Point Rainfall with Sparse Data,
W82-00835 2B

MEASUREMENT TECHNIQUES
Methods of Investigating the State of Metal Ions in Natural Waters,
W82-00859 5A

MEASURING INSTRUMENTS
Hydrogeological and Geophysical Logging.
W82-00511 7B

Measurement of PH in the Estuarine Environment on the NBS Scale. (LA Mesure Du PH En Milieu Estuarien Sur L'Echelle NBS),
W82-00521 7B

Identification of Organic Compounds,
W82-00635 5A

Effects of Joule Heating on Thermocouple Psychrometer Water Potential Determinations,
W82-00892 7B

MEMBRANE FILTERS
Mechanism of Charged Membrane Ultrafiltration of Salt Solutions,
W82-00641 5D

MERCURY
Dynamics of Selenium in Mercury-Contaminated Experimental Freshwater Ecosystems,
W82-00595 5B

Mercury and Selenium Concentrations in Fish, Sediments, and Water of Two Northwestern Quebec Lakes,
W82-00876 5B

Relation Between Trophic Position and Mercury Accumulation Among Fishes from the Tongue River Reservoir, Montana,
W82-01041 5A

MESOTROPHIC LAKES
The Effect of Continuous Advanced Wastewater Treatment by the City of Spokane on the Trophic Status of Long Lake, WA During 1979.
W82-01070 2H

An Assessment of the Trophic Status of Deer, Loon, and Diamond Lakes,
W82-01072 2H

METABOLISM
Microbial Metabolism of N-Nitrosodiethanolamine in Lake Water and Sewage,
W82-00585 2H

METAL-FINISHING WASTES
The Nonfuel Minerals Industry: Regulatory Impacts,
W82-00612 5B

The Effects of Heavy Metals on Microbial Biomass in Sediments of Palestine Lake,
W82-00925 5C

METALS
Effect of Leachate Flow Rate on Metal Migration Through Soil,
W82-00565 5E

Metal Speciation. Effects on Aquatic Toxicity,
W82-00610 5A

Adsorption as a Control of Metal Concentrations in Sediment Extracts,
W82-00614 5A

Effect of Irrigating Loamy Sand Soil by Liquid Sewage Sludge on its Content of some Micronutrients,
W82-00661 5E

Metal Leaching from Sewage Sludge Ash,
W82-00770 5B

Methods of Investigating the State of Metal Ions in Natural Waters,
W82-00859 5A

Determination of Alkaline Earth and Divalent Transition Metal Cations by Ion Chromatography with Sulfate-Suppressed Barium and Lead Eluents,
W82-01082 5A

METEOROLOGICAL DATA COLLECTION
Atmospheric Water Content Over the Tropical Pacific Derived from the Nimbus-6 Scanning Microwave Spectrometer,
W82-01004 7B

METHANE
Methane Formation in the Acid Peats of Okefenokee Swamp, Georgia,
W82-00936 2H

METHYLATION
Methylation of Trimethyltin Compounds by Estuarine Sediments,
W82-00801 5B

METHYLMERCURY
Thin Layer Chromatographic and Atomic Absorption Spectrophotometric Determination of Methyl Mercury,
W82-00503 5A

METROPOLITAN WATER MANAGEMENT
Distribution System Liability,
W82-01028 5F

MICHIGAN
A Case Study Analysis of the Legal and Institutional Obstacles and Incentives to the Development of the Hydrolelectric Power of the Boardman River at Traverse City, Michigan.
W82-00747 6E

Waterborne Methylene Bis(2-Chloroaniline) and 2-Chloroaniline Contamination Around Adrian, Michigan,
W82-00873 5B

Ferric Chloride Takes Over,
W82-00954 5F

MICROBIAL DEGRADATION
Correlation of Microbial Degradation Rates With Chemical Structure,
W82-00621 2K

MICROBIAL STUDIES
Factor Analysis of the Impact of the Environment on Microbial Communities in the Tvarminne Area, Southern Coast of Finland,
W82-00672 5C

Effects of Environmental Factors on Microbial Populations in Brackish Waters off the Southern Coast of Finland,
W82-00683 2L

MICROBIOLOGICAL STUDIES
Classification of Central Amazon Lakes on the Basis of their Microbiological and Physico-Chemical Characteristics,
W82-00666 2H

Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay, Canada. I: Bacteriological Aspects,
W82-00921 2L

Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay II. Mycological Aspects,
W82-00922 2L

MICROSCOPIC ANALYSIS
Interim Method for Determining Asbestos in Water,
W82-00741 5A

MICROSCOPY
Aluminum Shadowing-Direct Projection Photomicroscopy of Diatom Frustules,
W82-00884 5A

MID-ATLANTIC STATES
Summary of the Mid-Atlantic Conference on Small-Scale Hydro-Power in the Mid-Atlantic States: Resolution of the Barriers Impeding Its Development.
W82-00743 6E

MIDGES
Sampling Emerging Chironomidae (Diptera) With Submerged Funnel Traps in a New Northern Canadian Reservoir, Southern Indian Lake, Manitoba,
W82-00520 2H

Grazing Rate Determination of Corynoneura Scutellata Winnertz (Chironomidae:Diptera),
W82-00822 2H

MIDWESTERN STATES
Executive Summary; Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in the Seven Mid-Western States.
W82-00718 6E

MIGRATION
Effect of Leachate Flow Rate on Metal Migration Through Soil,
W82-00565 5E

MINE DRAINAGE
Hydrogeochemistry and Simulated Solute Transport, Piceance Basin, Northwestern Colorado,
W82-00723 5B

MINERAL INDUSTRY
The Nonfuel Minerals Industry: Regulatory Impacts,
W82-00612 5B

MINING ENGINEERING
Reliability of Underground Flood Control System,
W82-00556 8A

Numerical Simulation of Potentiometric Surface Changes Caused by a Proposed Open-Pit Anthracite Mine,
W82-00819 6A

MINNESOTA
Empire Controlled by Computer,
W82-00529 5D

Chemistry of Lake Water and Groundwater in Areas of Contrasting Glacial Drifts in Eastern Minnesota,
W82-00821 2K

MISSISSIPPI DELTA
Sediment Yield from a Flatland Watershed,
W82-00941 2J

MISSISSIPPI RIVER
Sediment Yield from a Flatland Watershed,
W82-00941 2J

MISSOURI
Floods in Kansas City, Missouri and Kansas, September 12-13,
W82-00724 2E

MITA HILLS DAM
Settlement of a Compacted Unsaturated Earth Embankment,
W82-00678 8D

MOBILE
Scott Brings Unique $25-Million Waste Treatment Facilities On-Line,
W82-01007 5D

MODEL STUDIES
A Procedure Using Modeling and Error Analysis for the Prediction of Lake Phosphorus Concentration from Land Use Information,
W82-00546 5G

Circulation and Energetics of a Deep, Strongly Stratified Inlet,
W82-00547 2L

Towards a Predictive Model for the Economic Regulation of Commercial Fisheries,
W82-00549 6A

Identification of Streamflow Stochastic Models,
W82-00555 2A

Temporal and Spatial Scales in Phytoplankton Ecology. Mechanisms, Methods, Models and Management,
W82-00594 5G

A Leaky Reservoir Model for Ephemeral Flow Recession,
W82-00600 2E

A Non-Equilibrium Thermodynamics Approach to Transport Phenomena in Capillary Porous Media,
W82-00697 2F

A Comparison of Rainfall-Runoff Models,
W82-00911 2A

Simulation of Lake-Watershed Systems, I. Description and Sensitivity Analysis of the Model,
W82-00926 2A

Simulation of Lake-Watershed Systems, II. Application to Baptiste Lake, Alberta, Canada,
W82-00927 2A

Phosphate Models, a Gap to Bridge,
W82-00929 2H

The Uncertainty of Crop Models in Irrigation Optimization,
W82-00940 3F

Modeling Water Flux on Strip-Mined Land,
W82-00944 2G

Effectiveness of River Models,
W82-00961 6A

A Simulation Model for Sludge Decomposition in Soil,
W82-01001 5E

Dissolution of Salt Deposits by Brine Density Flow,
W82-01016 2F

Simulation Modeling of Primary Clarifiers,
W82-01027 6A

Groundwater Quality Models - State of the Art,
W82-01061 5G

Mathematical Modeling Techniques for Groundwater Management,
W82-01062 4B

The Impact of Effluent from the Renton Wastewater Treatment Plant on the Dissolved Oxygen Regimen of the Lower Green/Duwamish River,
W82-01064 5D

MOISTURE AVAILABILITY
Water Vapor Conductance and CO2 Uptake for Leaves of a C4 Desert Grass, Hilaria Rigida,
W82-01039 2I

Response of Fababean Yield, Protein Production and Water Use to Irrigation,
W82-01089 2I

MOLLUSKS
Relationships Between Water Chemistry and Respiration Rate in Several Populations of Lymnaea Peregra Muller (Gastropoda:Mollusca),
W82-00854 2K

MOLYBDENUM
Determination of Molybdenum in Sea and Estuarine Water with Beta-Naphthoin Oxime and Neutron Activation,
W82-01098 5A

MONITORING
A Portable Pump Sampler for Lotic Periphyton,
W82-00826 7B

Evaluation of an Automatic System for Detection of Toxic Substances in Surface Water Using Trout,
W82-00855 5A

Assessment of Some Aqueous Residual Chlorine Measurements,
W82-00867 5F

Evaluation of Stripmine Sediment Detention Basins in Kentucky,
W82-00893 5G

MONOCHLORAMINES
Health Effects of Monochloramines in Drinking Water,
W82-01091 5C

MONOSACCHARIDES
Vertical Distribution of Monosaccharides in Lake Water,
W82-00665 2H

MONTANA
The Relationship Between Fracture Traces and Joints in a Tertiary Basin, Southwest Montana,
W82-00829 7B

Relation Between Trophic Position and Mercury Accumulation Among Fishes from the Tongue River Reservoir, Montana,
W82-01041 5A

MORTALITY
Chlorinated Hydrocarbons as a Factor in the Reproduction and Survival of Lake Trout (Salvelinus Namaycush) in Lake Michigan.
W82-01079 5C

MOSSES
Aquatic Mosses as Monitors of Heavy Metal Contamination in the River Etherow, Great Britain,
W82-00787 5A

MT. ST. HELENS
Submersible Pumps Help Quell Damage From Mount St. Helens Mudflow.
W82-00509 4D

MUD FLATS
Sedimentological and Biological Changes in the Windsor Mudflat, an Area of Induced Siltation,
W82-00548 5C

MUDFLOWS
Submersible Pumps Help Quell Damage From Mount St. Helens Mudflow.
W82-00509 4D

Mechanics of Mudflow Mobilization in Low-Angled Clay Slopes,
W82-00989 2J

MULCHING
Effect of Soil Water Content and a Growing Season Straw Mulch on Grain Sorghum,
W82-00765 3F

MULTI-OBJECTIVE PLANNING
Proposed Water Quality Control Plan for Indio Subarea of the Whitewater Hydrologic Unit, West Colorado River Basin.
W82-00716 6F

MULTIOBJECTIVE PLANNING
Federal Water Resources Research: A Review of the Proposed Five-Year Program Plan.
W82-01051 6E

MUNICIPAL WASTEWATER
Midwestern Wastewater Characteristics,
W82-00534 5D

Land Treatment of Municipal Wastewater in Small Communities,
W82-00588 5D

Toxics in Municipal and Industrial Wastewaters,
W82-00712 5A

MUNICIPAL WATER
Distribution System Liability,
W82-01028 5F

Giardia Prevalence in Commercially Trapped Mammals,
W82-01046 5A

MUNITIONS WASTES
Industrial Effluent Monitoring Incorporating a Recent Automated Fish Biomonitoring System,
W82-00530 5A

MUTAGENESIS
Bacterial DNA Repair Assay of Selected Compounds in Pulp and Paper Mill Effluents,
W82-00687 5C

NASSAU COUNTY
Fluidized Bed for Biological Wastewater Treatment,
W82-00968 5D

NATIONAL PARKS
Interpreting Dynamics of Aquatic Resources: A Perspective for Resource Managers,
W82-00539 6A

NATURAL FLOW
Buoyancy Force Reversals in Vertical Natural Convection Flows in Cold Water,
W82-00981 1A

NATURAL WATERS
Correlation of Microbial Degradation Rates With Chemical Structure,
W82-00621 2K

Voltammetric Characterization and Chemical Behavior of Inorganic Tin in Natural Waters,
W82-00627 5A

Effects of Ion-Pairing on Calculations of Ionic Activities of Major Ions in Freshwater,
W82-00823 2K

Determination of Chromium Speciation in Natural Waters by Electrodeposition on Graphite Tubes for Electrothermal Atomization,
W82-01084 5A

NAVAJO GENERATING STATION
Development of Makeup-Line Safe-Operating Criteria,
W82-01095 8B

NAVIGATION
Freedom from the Navigation Servitude Through Private Investment,
W82-01030 6E

NEGOTIATIONS
Game Theory Analyses Applied to Water Resource Problems,
W82-00802 6A

NEMATODES
A Rapid Simple Long-Term Toxicity Assay for Aquatic Contaminants Using the Nematode Panagrellus Redivivus,
W82-01017 5A

NETHERLANDS
Residence Times of Water and Solutes Within and Below the Root Zone,
W82-00932 2G

NEUTRALIZATION
Reviving Acidified Lakes,
W82-00933 2H

NEW HAMPSHIRE
Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New Hampshire.
W82-00721 6E

NEW JERSEY
Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New Jersey.
W82-00742 6E

Composting Is Working in Camden,
W82-00948 5E

NEW MEXICO
Nutrient Budget Studies for Forests Along an Elevational Gradient in New Mexico,
W82-01036 2K

NEW YORK
Anthropogenic Trace Elements and Polycyclic Aromatic Hydrocarbon Levels in Sediment Cores From Two Lakes in the Adirondack Acid Lake Region,
W82-00501 5B

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New York.
W82-00754 6E

Groundwater Problems and Needs in New York,
W82-01055 4B

NEW ZEALAND
Control of Water Weeds by Grass Carp in Two Small Lakes,
W82-00609 3B

Distribution and Biological Availability of Reactive High Molecular Weight Phosphorus in Natural Waters in New Zealand,
W82-00659 2H

Debris Flow Deposits of Early Miocene Age, Deadman Stream, Marlborough, New Zealand,
W82-00694 2J

NICKEL
The Fate of Heavy Metals in the Ruhr System and Their Influence on Drinking Water Quality,
W82-00962 5B

Determination of Nickel by Differential Pulse Polarography at a Dropping Mercury Electrode,
W82-01100 5A

NIGERIA
Water Relations of Three Cowpea Cultivars (Vigna Unguiculata L.),
W82-00607 2I

NITRAPYRIN
Effects of Nitrapyrin on Nitrate Movement in Soil Columns,
W82-01048 5G

NITRATES
Relationships Between Sulfate and Nitrate Ion Concentrations and Rainfall PH for Use in Modeling Applications,
W82-00507 5B

Removal of Nitrate from Public Water Supply Abstractions,
W82-00774 5F

Effects of Nitrapyrin on Nitrate Movement in Soil Columns,
W82-01048 5G

NITRIC ACID
Influence of Gaseous Nitric Acid on Sulfate Production and Acidity in Rain,
W82-00642 5B

Acid Precipitation: The Importance of Nitric Acid,
W82-00643 2K

NITRIFICATION
Transformations of Nitrogen in a Polluted Estuary: Nonlinearities in the Demand for Oxygen at Low Flow,
W82-00777 5B

Measurement of in situ Rates of Nitrification in Sediment,
W82-00798 5A

Effects of Temperature, pH, Salinity, and Inorganic Nitrogen on the Rate of Ammonium Oxidation by Nitrifiers Isolated from Wetland Environments,
W82-00910 2L

NITROGEN
Nitrogen and Phosphorus Recycling in Lake Sammamish, A Temperate Mesotrophic Lake,
W82-00824 2H

Ammonia and Nitrate Uptake in the Lower Great Lakes,
W82-00882 2H

Kinetics of Nitrate and Ammonium Uptake by the Tropical Freshwater Macrophyte Pistia Stratiotes L.,
W82-00937 5D

The Effect of Changes in the Nutrient Income on the Condition of Lake Washington,
W82-00987 2H

Experimental Manipulation of Algal Bloom Composition by Nitrogen Addition,
W82-00998 5C

NITROGEN COMPOUNDS
Microbial Metabolism of N-Nitrosodiethanolamine in Lake Water and Sewage,
W82-00585 2H

Modeling the Transformation of Nitrogen Compounds for Water-Quality Management in Streams,
W82-00598 6A

Prediction of Phosphorus and Nitrogen Concentrations in Lakes from Both Internal and External Loading Rates,
W82-00928 2H

NITROGEN FIXATION
Growth and Nitrogen Fixation of Aeschynomene Under Water Stressed Conditions,
W82-00758 2I

NITROSAMINES *DIETHANOLAMINE
Formation of N-Nitrosodiethanolamine from Diethanolamine in Lake Water and Sewage,
W82-00796 5A

NONBIODEGRADABLE WASTES
Potential for Land Disposal of Two Nonbiodegradable Wastes,
W82-00939 5D

NONLINEAR PROGRAMMING
A Geomorphologic Synthesis of Nonlinearity in Surface Runoff,
W82-00604 2A

NONPOINT POLLUTION SOURCES
Sample Intake Position and Loading Rates from Nonpoint Source Pollution,
W82-00778 5A

Water Quality Management in River Basins: US National Experience,
W82-00800 6E

Answers: A Model for Watershed Planning,
W82-00898 6A

NORTH CAROLINA
The Role of Substratum in Benthic Macroinvertebrate Microdistribution and Litter Decomposition in a Woodland Stream,
W82-01037 2E

Groundwater Problems in North Carolina,
W82-01056 4B

NORTH DAKOTA
Watertable Management Saves Water and Energy,
W82-00943 3F

NORTH FORK STANISLAUS RIVER
Final Environmental Impact Statement: North Fork Stanislaus River Project No. 2409 - California.
W82-00737 6G

NORTH INLET
Estimation of Material Fluxes in an Estuarine Cross Section: A Critical Analysis of Spatial Measurement Density and Errors,
W82-00816 7A

NORWICH
Automation of Norwich Sewage-Treatment Works: Early Cost Considerations,
W82-00955 5D

NOVA SCOTIA
Sedimentological and Biological Changes in the Windsor Mudflat, an Area of Induced Siltation,
W82-00548 5C

Hydraulic Model Study for the Design of the Wreck Cove Control Gates,
W82-00880 8B

NUCLEAR POWERPLANTS
The Effect of Season and Location on Phosphoadenylate Concentrations and Adenylate Energy Charge in Two Species of Freshwater Clams,
W82-00810 2H

Determination of Picogram Amounts of Technetium-99 by Resin Bead Mass Spectrometric Isotope Dilution,
W82-00999 5A

NUMERICAL ANALYSIS
A Numerical Comparison Between Lagrangian and Eulerian Rainfall Statistics,
W82-00803 2B

NUTRIENTS
Sediments as a Source of Phosphate: A Study of 38 Impoundments,
W82-00653 2H

Effect of pH and Redox Potential on Concentration of Dissolved Nutrients in an Estuarine Sediment,
W82-00795 2L

Nitrogen and Phosphorus Recycling in Lake Sammamish, A Temperate Mesotrophic Lake,
W82-00824 2H

Sediment-Based Nutrition of Submersed Macrophytes,
W82-00843 2H

Limnological Characteristics of Several Lakes on the Lake Wales Ridge, South-Central Florida,
W82-00914 2H

The Use of Algal Assays and Chlorophyll Concentrations to Determine Fertility of Water in Small Impoundments in West Virginia,
W82-00919 2H

Influence of Phosphorus Loads and of Some Limnological Processes on the Purity of Lake Water,
W82-00923 2H

The Effect of Changes in the Nutrient Income on the Condition of Lake Washington,
W82-00987 2H

Phosphorus, Nirogen, and Organic Carbon Flux in a Headwater Stream,
W82-01021 2K

Water Relations, Soil Fertility, and Plant Nutrient Composition of a Pygmy Oak Ecosystem,
W82-01034 2I

Nutrient Budget Studies for Forests Along an Elevational Gradient in New Mexico,
W82-01036 2K

Water Chemistry Changes During Artificial Aeration of Spruce Knob Lake, West Virginia,
W82-01049 5G

ODOR CONTROL
Chloramine-T as A Potential Scrubbing Agent: Removal of Odorous Sulfur-Containing Environmental Pollutants,
W82-00871 5D

ODOR REMOVAL
What Caused the Bad Odor in the Drinking Water,
W82-00527 5F

ODORS
What Caused the Bad Odor in the Drinking Water,
W82-00527 5F

OHIO
Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Ohio.
W82-00749 6E

Ohio's Ground Water Resources and Problem Areas,
W82-01057 4B

OHIO RIVER BASIN
Ground Water in the Ohio River Basin Portion of Maryland: Problems and Needs,
W82-01054 4B

Ground Water Problems Virginia Portion Ohio River Basin,
W82-01059 4B

OIL
Effect of Crude Oil and Petroleum-Degrading Microorganisms on the Growth of Freshwater and Soil Protozoa,
W82-00517 5C

OIL INDUSTRY
Mixing Technology Reduces Energy Use,
W82-00634 5D

Floc/Float System Cleans Desalter Effluent,
W82-00906 5D

Managing Oil and Gas Activities in Coastal Environments: Refuge Manual,
W82-01081 5G

OIL POLLUTION
Partitioning of No. 2 Fuel Oil in Controlled Estuarine Ecosystems. Sediments and Suspended Particulate Matter,
W82-00541 2L

System for Oil and Water Separation,
W82-00611 5D

OIL SHALE
Groundwater Leaching of Organic Pollutants From in Situ Retorted Oil Shale. A Mass Transfer Analysis,
W82-00626 5B

Hydrogeochemistry and Simulated Solute Transport, Piceance Basin, Northwestern Colorado,
W82-00723 5B

OKEFENOKEE SWAMP
Methane Formation in the Acid Peats of Okefenokee Swamp, Georgia,
W82-00936 2H

OLDMAN RIVER
Evaluation of the Oldman River Basin Irrigation Proposals: Implications for Interbasin Transfers,
W82-00519 6B

ONTARIO
Ratio Between Evapotranspiration of Irrigated Crops from Floating Lysimeters and Class A Pan Evaporation,
W82-01050 2D

OPTIMIZATION
The Uncertainty of Crop Models in Irrigation Optimization,
W82-00940 3F

ORGANIC COMPOUNDS
A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
W82-00532 5A

Distribution of Silvex, 2,4-D, and TCDD Applied to Turf in Chambers and Field Plots,
W82-00568 5B

Biodegradability of Halogen-Substituted Diphenylmethanes,
W82-00599 5B

Correlation of Microbial Degradation Rates With Chemical Structure,
W82-00621 2K

Determining Volatile Organics in Water,
W82-00630 5A

Identification of Organic Compounds,
W82-00635 5A

Removal of Priority Pollutants,
W82-00639 5D

Assessment of Airborne Organic Contaminants in the Great Lakes Ecosystem,
W82-00709 5B

Pilot Plant Performances in Municipal Wastewater Treatment by Activated Carbon Adsorption,
W82-00851 5D

Waterborne Methylene Bis(2-Chloroaniline) and 2-Chloroaniline Contamination Around Adrian, Michigan,
W82-00873 5B

Determination of Low NG/L Levels of Polychlorinated Biphenyls in Drinking Water by Extraction with Macroreticular Resin and Analysis Using a Capillary Column,
W82-00875 5A

ORGANIC MATTER
The Effects of Sodium and Organic Matter In Sewage Effluent on Water Retention Properties of Soils,
W82-00663 3C

Vertical Distribution of Monosaccharides in Lake Water,
W82-00665 2H

The Organic Pollution of River Cubillas (Granada, South Spain),
W82-00674 5B

The Removal of Organic Matter from Demineralised Water,
W82-00888 5F

Chemical Composition of Labile Fractions in DOM,
W82-00917 2H

ORGANIC WASTES
Assessment of Airborne Organic Contaminants in the Great Lakes Ecosystem,
W82-00709 5B

Removal of Volatile Trace Organics from Wastewater by Overland Flow Land Treatment,
W82-01042 5D

ORGANIZATIONS
Point-of-Use Water Treatment...An Enlarging Reality,
W82-00784 10D

ORGANOPHOSPHORUS COMPOUNDS
Gas Chromatographic Determination of Trialkyl/Aryl Phosphates in Drinking Water, Following Isolation Using Macroreticular Resin,
W82-00502 5A

ORGEON
Plan of Study for the Regional Aquifer-System Analysis of the Snake River Plain, Idaho and Eastern Oregon,
W82-00730 6A

OVERLAND FLOW
Movement of Loose, Sandy Detritus by Shallow Water Flows: An Experimental Study,
W82-00776 2J

Overland Flow on a Diverging Surface,
W82-00986 2A

OXIDATION
Chloramine-T as A Potential Scrubbing Agent: Removal of Odorous Sulfur-Containing Environmental Pollutants,
W82-00871 5D

Effects of Temperature, pH, Salinity, and Inorganic Nitrogen on the Rate of Ammonium Oxidation by Nitrifiers Isolated from Wetland Environments,
W82-00910 2L

Mass-Transport Limitation to the Rate of Reaction of Gases in Liquid Droplets: Application to Oxidation of SO2 in Aqueous Solutions,
W82-00994 2K

OXIDATION-REDUCTION POTENTIAL
Effect of pH and Redox Potential on Concentration of Dissolved Nutrients in an Estuarine Sediment,
W82-00795 2L

OXYGEN DEMAND
Transformations of Nitrogen in a Polluted Estuary: Nonlinearities in the Demand for Oxygen at Low Flow,
W82-00777 5B

OXYGEN DEPLETION
Relationship Between Thermal Stability and Summer Oxygen Depletion in a Prairie Pothole Lake,
W82-00545 2H

OZONATION
Effect of Ozonation and Chlorination on the Mutagenic Potential of Drinking Water,
W82-00649 5A

PAKISTAN
Operational Evaluation of Village Level Irrigation Conveyance Systems,
W82-00696 3F

PALESTINE LAKE
The Effects of Heavy Metals on Microbial Biomass in Sediments of Palestine Lake,
W82-00925 5C

PARAQUAT
Toxicities of Paraquat and Diquat Herbicides to Freshwater Copepods (Diaptomus Sp. and Eucyclops Sp.),
W82-00589 5C

PARKS
Interpreting Dynamics of Aquatic Resources: A Perspective for Resource Managers,
W82-00539 6A

PARTICLE SIZE
Sediment Sizes Eroded from Crop Row Sideslopes,
W82-00903 2J

PARTICULATE MATTER
Aquasols: The Behavior of Small Particles in Aquatic Systems,
W82-00540 1B

PATENTS
Traveling Sprinkler System and Method,
W82-00561 3F

Detoxification of Residual Quaternaries,
W82-00562 5G

System for Oil and Water Separation,
W82-00611 5D

Aquatic Weed Cutting Apparatus,
W82-00624 4A

PATH OF POLLUTANTS
Distribution of Silvex, 2,4-D, and TCDD Applied to Turf in Chambers and Field Plots,
W82-00568 5B

Water-To-Air Fractionation of Bacteria,
W82-00575 5B

Dynamics of Selenium in Mercury-Contaminated Experimental Freshwater Ecosystems,
W82-00595 5B

Trace Element Accumulation, Movement, and Distribution in the Soil Profile From Massive Applications of Sewage Sludge,
W82-00640 5E

PATHOGENS
Isolation and Identification of Pathogenic Microorganisms at Wastewater-Irrigated Fields: Ratios in Air and Wastewater,
W82-00579 5A

Behavior and Transport of Microbial Pathogens and Indicator Organisms in Soils Treated with Organic Wastes,
W82-00797 5B

PEABODY LAKE
Absorption of Fenitrothion by Plankton and Benthic Algae,
W82-00874 5B

PENNSYLVANIA
Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Pennsylvania.
W82-00752 6E

Pennsylvania Ground Water Problems and Needs,
W82-01058 4B

PERCOLATING FILTERS
A Note on the Fate of El Tor Cholera and Other Vibrios in Percolating Filters,
W82-00566 5D

PERCOLATION
Soil Percolation Tests,
W82-01044 2G

PERIPHYTON
Monitoring River Periphyton With Artificial Benthic Substrates,
W82-00581 5A

PERU
Modeling Gradual Dam Breaches,
W82-00554 8D

PESTICIDE RESIDUES
A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
W82-00532 5A

Residues of Nonylphenol in Spruce Foliage, Forest Soil, Stream Water and Sediment After its Aerial Application,
W82-00559 5B

Organochlorine Residues in Kenya's Rift Valley Lakes,
W82-00690 5A

PESTICIDES
Kepone in the James River,
W82-00631 5B

Absorption of Fenitrothion by Plankton and Benthic Algae,
W82-00874 5B

Bioconcentration of Pesticides by Egg Masses of the Caddisfly, Triaenodes Tardus Milne,
W82-00982 5B

PHENOLIC PESTICIDES
Residues of Nonylphenol in Spruce Foliage, Forest Soil, Stream Water and Sediment After its Aerial Application,
W82-00559 5B

PHENOLS
Foam Control and Degradation of Nonionic Detergents,
W82-00637 5D

Determination of Low NG/L Levels of Polychlorinated Biphenyls in Drinking Water by Extraction with Macroreticular Resin and Analysis Using a Capillary Column,
W82-00875 5A

Determination of Polyhalogenated Phenolic Compounds in Drinking Water, Human Blood Serum and Adipose Tissue,
W82-00879 5A

PHOSPHATES
Sediments as a Source of Phosphate: A Study of 38 Impoundments,
W82-00653 2H

Phosphorus Management for the Great Lakes: Final Report of the Phosphorus Management Strategies Task Force,
W82-00702 6E

Ecological Effects of Non-Phosphate Detergent Builders: Final Report on Organic Builders other than NTA,
W82-00704 5G

The Use of Algal Assays and Chlorophyll Concentrations to Determine Fertility of Water in Small Impoundments in West Virginia,
W82-00919 2H

Phosphate Models, a Gap to Bridge,
W82-00929 2H

PHOSPHATES *LAKES
Interaction of Orthophosphate with Iron (III) and Aluminum Hydroxides,
W82-00783 2H

PHOSPHOROUS REMOVAL
Health Implications of Non-NTA Detergent Builders,
W82-00703 5G

Ecological Effects of Non-Phosphate Detergent Builders: Final Report on Organic Builders other than NTA,
W82-00704 5G

PHOSPHORUS
A Procedure Using Modeling and Error Analysis for the Prediction of Lake Phosphorus Concentration from Land Use Information,
W82-00546 5G

Distribution and Biological Availability of Reactive High Molecular Weight Phosphorus in Natural Waters in New Zealand,
W82-00659 2H

Nitrogen and Phosphorus Recycling in Lake Sammamish, A Temperate Mesotrophic Lake,
W82-00824 2H

Potential Impact of Size-Selective Planktivory on Phosphorus Release by Zooplankton,
W82-00825 2H

Inorganic Transformation of Applied Phosphorus in Brackish Water Fish Pond Soil Under Different Water Salinity Levels,
W82-00920 2H

The Effect of Changes in the Nutrient Income on the Condition of Lake Washington,
W82-00987 2H

PHOSPHORUS COMPOUNDS
Influence of Phosphorus Loads and of Some Limnological Processes on the Purity of Lake Water,
W82-00923 2H

Prediction of Phosphorus and Nitrogen Concentrations in Lakes from Both Internal and External Loading Rates,
W82-00928 2H

PHOSPHORUS REMOVAL
Phosphorus Management for the Great Lakes: Final Report of the Phosphorus Management Strategies Task Force,
W82-00702 6E

1980 Report on Great Lakes Water Quality - Appendix,
W82-00708 5C

PHOTOGRAPHY
Aluminum Shadowing-Direct Projection Photomicroscopy of Diatom Frustules,
W82-00884 5A

PHOTOSYNTHESIS
Photosynthetic Recovery of Resurrection Spikemosses from Different Hydration Regimes,
W82-01010 2I

PHYSICAL PROPERTIES
Aquasols: The Behavior of Small Particles in Aquatic Systems,
W82-00540 1B

PHYSICOCHEMICAL PROPERTIES
Diel Variations of Selected Physico-Chemical Parameters in Lake Kissimmee, Florida,
W82-00535 2H

Classification of Central Amazon Lakes on the Basis of their Microbiological and Physico-Chemical Characteristics,
W82-00666 2H

PHYTOPLANKTON
Temporal and Spatial Scales in Phytoplankton Ecology. Mechanisms, Methods, Models and Management,
W82-00594 5G

Annual Succession of Phytoplankton in One Heated Pond in Central Finland,
W82-00673 5C

Measurement of Particulates Extrained in Some Great Lakes Power Plant Cooling Water: An Exercise in Futility,
W82-00782 6G

Grazing Rate Determination of Corynoneura Scutellata Winnertz (Chironomidae:Diptera),
W82-00822 2H

Phosphate Models, a Gap to Bridge,
W82-00929 2H

Uptake of Polychlorinated Biphenyls by Natural Phytoplankton Assemblages: Field and Laboratory Determination of C14-PCB Particle-Water Index of Sorption,
W82-01032 5B

PILOT PLANTS
Pilot Plant Performances in Municipal Wastewater Treatment by Activated Carbon Adsorption,
W82-00851 5D

PINE ISLAND
Macrobenthos of Pine Island Bayou in the Big Thicket National Preserve, Texas,
W82-00924 5C

PIPE FAILURE
Factors Influencing the Occurrence of Bursts in Iron Water Mains,
W82-00960 8A

PIPELINES
A New Look at Design of Raw Water Piping,
W82-01029 8A

Development of Makeup-Line Safe-Operating Criteria,
W82-01095 8B

PIPES
Backfill Alteration Effects on Pipe Drainage of a Clay Soil,
W82-00763 4A

Factors Influencing the Occurrence of Bursts in Iron Water Mains,
W82-00960 8A

Asbestos Cement Pipe and Cancer in Connecticut 1955-1974,
W82-01094 5C

PITCHER PLANT
The Effect of Environmental Uncertainty on Morphological Design and Fluid Balance in Sarracenia Purpurea L.,
W82-00811 2I

PLANKTON
Comparison of a Few Systems for the Determination of Saprobic and Trophic Degree on the Basis of Plankton Data,
W82-00664 2H

Enrichment of the Agricultural Herbicide Atrazine in the Microsurface Water of an Estuary,
W82-00877 5B

Description of a New Submersible Filter-Pump Apparatus for Sampling Plankton,
W82-01012 7B

PLANNING
Evaluation of the Oldman River Basin Irrigation Proposals: Implications for Interbasin Transfers,
W82-00519 6B

Richards Bay: An Ecological Dilemma,
W82-00679 6A

Environmental Aspects of Rural Development with Particular Reference to the Keiskamma River Basin Study,
W82-00685 6D

PLANT GROWTH
The Effect of Height of Water Table on the Growth of Holcus Lanatus With Reference to Lolium Perenne,
W82-00654 2I

Temperature and Water Relation Patterns in Subalpine Understory Plants,
W82-00760 2I

Comparative Field Water Relations of Four Co-Occuring Chaparral Shrub Species,
W82-00762 2I

Plant-Water Relations and Adaptation to Stress,
W82-00812 2I

Dieback of Salt-Water Cordgrass (Spartina Alterniflora Loisel.) in the Lower Cape Fear Estuary of North Carolina: An Experimental Approach to Re-Establishment,
W82-00889 2L

Photosynthesis and Growth in Populations of Populus Deltoides from Constrating Habitats,
W82-00935 2I

PLANT GROWTH SUBSTANCES
Investigations of Control Mechanisms of Germination Under Water Stress,
W82-00912 2I

PLANT MORPHOLOGY
The Effect of Environmental Uncertainty on Morphological Design and Fluid Balance in Sarracenia Purpurea L.,
W82-00811 2I

PLANT POPULATIONS
Vegetational Analysis of Big Run Bog, A Nonglaciated Sphagnum Bog in West Virginia,
W82-00992 2I

PLANT WATER POTENTIAL
Some Aspects of Plant Water Relations in Alaskan Arctic Tundra Species,
W82-00846 2I

Investigations of Control Mechanisms of Germination Under Water Stress,
W82-00912 2I

PLATINUM
Application of Immobilized Hydrogenase for the Detritiation of Water,
W82-00768 5D

POLAND
Chemical Composition of Interstitial Waters in Bottom Sediments of Some Polish Lakes of the Wigry Group (Northern Poland),
W82-00675 2H

POLICY MAKING
Experience Gained with the U.S. Pollution Control Policies,
W82-00996 6E

POLITICAL ASPECTS
Potential Political Influences Affecting the Water Industry,
W82-00861 6C

POLLEN
Spatial Distributions of Pollen in Surface Sediments of the Potomac Estuary,
W82-00757 2L

POLLUTANT IDENTIFICATION
Gas Chromatographic Determination of Trialkyl/Aryl Phosphates in Drinking Water, Following Isolation Using Macroreticular Resin,
W82-00502 5A

Thin Layer Chromatographic and Atomic Absorption Spectrophotometric Determination of Methyl Mercury,
W82-00503 5A

Monitoring Trace Amounts of Cadmium in Natural Waters,
W82-00516 5A

Industrial Effluent Monitoring Incorporating a Recent Automated Fish Biomonitoring System,
W82-00530 5A

Determining Volatile Organics in Water,
W82-00630 5A

Identification of Organic Compounds,
W82-00635 5A

Toxics in Municipal and Industrial Wastewaters,
W82-00712 5A

New Liquid Chromatographic Detection System for Environmental Pollutants,
W82-00740 5A

Determination of Low NG/L Levels of Polychlorinated Biphenyls in Drinking Water by Extraction with Macroreticular Resin and Analysis Using a Capillary Column,
W82-00875 5A

Determination of Picogram Amounts of Technetium-99 by Resin Bead Mass Spectrometric Isotope Dilution,
W82-00999 5A

POLLUTION CONTROL
Groundwater Strategies,
W82-00620 5G

The Control of Bacterial Pollution Caused by Sea Discharges of Sewage,
W82-00699 5D

The Design and Interpretation of Marine Pollution Surveys,
W82-00700 6E

POLLUTION EFFECTS
State of Washington Water Quality Assessment Report 1980.
W82-01067 6E

POLLUTION LOAD
Anthropogenic Trace Elements and Polycyclic Aromatic Hydrocarbon Levels in Sediment Cores From Two Lakes in the Adirondack Acid Lake Region,
W82-00501 5B

POLYCHLORINATED BIPHENYLS
New Liquid Chromatographic Detection System for Environmental Pollutants,
W82-00740 5A

Determination of Low NG/L Levels of Polychlorinated Biphenyls in Drinking Water by Extraction with Macroreticular Resin and Analysis Using a Capillary Column,
W82-00875 5A

Uptake of Polychlorinated Biphenyls by Natural Phytoplankton Assemblages: Field and Laboratory Determination of C14-PCB Particle-Water Index of Sorption,
W82-01032 5B

Chlorinated Hydrocarbons as a Factor in the Reproduction and Survival of Lake Trout (Salvelinus Namaycush) in Lake Michigan.
W82-01079 5C

POLYCHLORINATED BYPHENYLS
1980 Annual Report - A Perspective on the Problem of Hazardous Substances in the Great Lakes Basin Ecosystem,
W82-00707 5C

POLYMERS
Flocculation of Clay Particles with a Synthetic Anionic Polymer,
W82-00773 5F

PONDS
Residues of Isobornyl Thiocyanoacetate (Thanite) and a Metabolite in Fish and Treated Ponds,
W82-00570 5B

POPULATION DENSITY
Sampling Emerging Chironomidae (Diptera) With Submerged Funnel Traps in a New Northern Canadian Reservoir, Southern Indian Lake, Manitoba,
W82-00520 2H

POPULUS DELTOIDES
Photosynthesis and Growth in Populations of Populus Deltoides from Constrating Habitats,
W82-00935 2I

PORE PRESSURE
A Mathematical Model for Predicting Moisture Flow in an Unsaturated Soil Under Hydraulic and Temperature Gradients,
W82-00605 2G

POROUS MEDIA
A Non-Equilibrium Thermodynamics Approach to Transport Phenomena in Capillary Porous Media,
W82-00697 2F

POTABLE WATER
European Communities Directive Relating to the Quality of Water Intended for Human Consumption,
W82-00506 6D

Assessment of Some Aqueous Residual Chlorine Measurements,
W82-00867 5F

POTENTIOMETRIC LEVEL
Potentiometric-Surface Map for the Cretaceous Aquifer, Virginia Coastal Plain, 1978,
W82-00727 7C

Potentiometric Surface of the Wilcox-Carrizo Aquifer; Bienville, Red River, Northern Natchitoches, and Southern Webster Parishes, Louisana,
W82-00728 7C

Numerical Simulation of Potentiometric Surface Changes Caused by a Proposed Open-Pit Anthracite Mine,
W82-00819 6A

POTOMAC RIVER
Spatial Distributions of Pollen in Surface Sediments of the Potomac Estuary,
W82-00757 2L

Transformations of Nitrogen in a Polluted Estuary: Nonlinearities in the Demand for Oxygen at Low Flow,
W82-00777 5B

POULTRY
The Breakdown of Poultry Manure Aggregates by Rainfall Impact,
W82-00513 5B

POWERPLANTS
Trace Element Inputs From a Coal Burning Power Plant to Adjacent Terrestrial and Aquatic Environments,
W82-00557 5B

Bentonite Liners for Power Plant Lagoons,
W82-00617 5E

Measurement of Particulates Extrained in Some Great Lakes Power Plant Cooling Water: An Exercise in Futility,
W82-00782 6G

Effects of Thermal Effluents on Communities of Benthic Marine Macroalgae,
W82-00870 5C

The Removal of Organic Matter from Demineralised Water,
W82-00888 5F

Numerical Simulation of the Effects of Cooling Tower Complexes on Clouds and Severe Storms,
W82-00995 2B

Development of Makeup-Line Safe-Operating Criteria,
W82-01095 8B

PRECIPITATION
Acid Rain: Facts and Fallacies,
W82-00518 5C

Assessment of Airborne Organic Contaminants in the Great Lakes Ecosystem,
W82-00709 5B

Assessment of Airborne Inorganic Contaminants in the Great Lakes,
W82-00710 5B

Sources and Control of Organic Air Pollutants,
W82-00711 5B

A Numerical Comparison Between Lagrangian and Eulerian Rainfall Statistics,
W82-00803 2B

PREDATION
Potential Impact of Size-Selective Planktivory on Phosphorus Release by Zooplankton,
W82-00825 2H

PREDICTION
Theory of Ecological Prediction of Limnetic Ecosystems,
W82-00597 6G

PREDICTIONS
Potential Eutrophication of the Rideau River by an Urban Drainage Waterway,
W82-00834 5C

PRESSURE-MEASURING INSTRUMENTS
Determination of Hydrogeological Parameters Using Sinusoidal Pressure Tests: A Theoretical Appraisal,
W82-00603 7B

PRICING
Potential Political Influences Affecting the Water Industry,
W82-00861 6C

PRIMARY PRODUCTIVITY
An In Situ Method for Measuring the Primary Productivity and Standing Crop of the Epilithic Periphyton Community in Lentic Systems,
W82-00756 7B

Ammonia and Nitrate Uptake in the Lower Great Lakes,
W82-00882 2H

Limnological Characteristics of Several Lakes on the Lake Wales Ridge, South-Central Florida,
W82-00914 2H

Factors Controlling Phytoplankton Primary Productivity in Byram Lake, Mt. Kisco, N.Y., Summer, 1977,
W82-00915 2H

PROBABLE MAXIMUM PRECIPITATION
The Magnitude of the Hydrological Frequency Factor in Maximum Rainfall Estimation,
W82-00983 2B

PRODUCTIVITY
Diel Variations of Selected Physico-Chemical Parameters in Lake Kissimmee, Florida,
W82-00535 2H

Limnological Characteristics of Several Lakes on the Lake Wales Ridge, South-Central Florida,
W82-00914 2H

PROJECT PLANNING
Plan of Study for the Regional Aquifer-System Analysis of the Snake River Plain, Idaho and Eastern Oregon,
W82-00730 6A

PROTOZOA
Effect of Crude Oil and Petroleum-Degrading Microorganisms on the Growth of Freshwater and Soil Protozoa,
W82-00517 5C

PUBLIC HEALTH
Environmental Virology and its Problems,
W82-00505 5A

Environmental Health Hazards,
W82-00625 5F

Health Aspects of Urban Water Conservation,
W82-01047 3C

An Intangible Benefit of Water Pollution Control Programs,
W82-01092 6B

PUBLIC PARTICIPATION
Potential Political Influences Affecting the Water Industry,
W82-00861 6C

PUBLIC POLICY
The Distribution of the Costs of Federal Water Pollution Control Policy,
W82-00537 6B

PUGET SOUND
Factors Affecting Puget Sound Coho Salmon (Oncorhynchus Kisutch) Runs,
W82-00883 8I

New Secondary Treatment System Brought On-Line at Georgia-Pacific,
W82-01009 5D

PULLMAN-MOSCOW BASIN
Uranium Concentration in the Ground Waters of the Pullman-Moscow Basin, Whitman County, Washington, and Latah County, Idaho,
W82-00809 5B

PULP AND PAPER INDUSTRY
Bacterial DNA Repair Assay of Selected Compounds in Pulp and Paper Mill Effluents,
W82-00687 5C

Receiving Stream Fisheries Studies Relative to Secondary Treated Pulp and Paper Mill Effluents,
W82-00688 5C

Fungal Decolorization of Kraft Bleach Plant Effluents,
W82-00689 5D

New Secondary Treatment System Brought On-Line at Georgia-Pacific,
W82-01009 5D

Water Quality Conditions in the Bellingham Bay Area 1979-1980,
W82-01068 5B

PULP WASTES
Scott Brings Unique $25-Million Waste Treatment Facilities On-Line,
W82-01007 5D

Mutant Bacteria Control Filamentous Growth in Mill Wastewater Treatment,
W82-01008 5D

PYGMY OAKS
Water Relations, Soil Fertility, and Plant Nutrient Composition of a Pygmy Oak Ecosystem,
W82-01034 2I

QUEBEC
Mercury and Selenium Concentrations in Fish, Sediments, and Water of Two Northwestern Quebec Lakes,
W82-00876 5B

RADAR
Relation of Satellite-Based Thunderstorm Intensity to Radar-Estimated Rainfall,
W82-00806 2B

RADIOACTIVE WASTE DISPOSAL
Dissolution of Salt Deposits by Brine Density Flow,
W82-01016 2F

RADIOACTIVE WASTES
Application of Immobilized Hydrogenase for the Detritiation of Water,
W82-00768 5D

Retention of Radionuclides by Some Aquatic Fresh Water Plants,
W82-00853 5B

RADIOACTIVITY
Retention of Radionuclides by Some Aquatic Fresh Water Plants,
W82-00853 5B

RAIN
Trace Constituents in Cloud Water, Rainwater and Aerosol Samples Collected near the West Coast of India During the Southwest Monsoon,
W82-00676 2B

RAINFALL
Satellite Rain Estimation in the U.S. High Plains,
W82-00808 2B

Sulfur and Associated Elements and Acidity in Continental and Marine Rain from North Florida,
W82-00965 2B

The Magnitude of the Hydrological Frequency Factor in Maximum Rainfall Estimation,
W82-00983 2B

Adaptive Hydrological Forecasting - A Review,
W82-00984 2A

RAINFALL DISTRIBUTION
On August Mean Temperature and the Succeeding Season's Rainfall Over South Africa,
W82-00692 2B

Evaluation of Areal Versus Point Rainfall with Sparse Data,
W82-00835 2B

RAINFALL IMPACT
The Breakdown of Poultry Manure Aggregates by Rainfall Impact,
W82-00513 5B

RAINFALL RATE
Annual Plant Production-Precipitation Relations in Arid and Semi-Arid Regions,
W82-00693 2I

RAINFALL-RUNOFF RELATIONSHIPS
Effects of Recent Increases in Rainfall on Floods and Runoff in the Upper Hunter Valley,
W82-00668 2E

Evaluation of Areal Versus Point Rainfall with Sparse Data,
W82-00835 2B

A Comparison of Rainfall-Runoff Models,
W82-00911 2A

RAINFALL SIMULATORS
Apparatus for the Simulation of Rain in the Laboratory,
W82-00807 2B

RECESSION
A Leaky Reservoir Model for Ephemeral Flow Recession,
W82-00600 2E

RECHARGE BASINS
Management of Recharge Basins on the Southern High Plains,
W82-00938 4B

RECLAIMED WATER
Recycling Urban Stormwater for Profit,
W82-00524 3C

RECYCLING
Growth of the Bay Scallop, Argopecten Irradians, in a Waste Recycling Aquaculture System,
W82-00842 3C

RED TIDE
Potential Management of Florida Red Tide Through Selective Photodynamic Action,
W82-00515 5G

REEDSWAMP
The Changing Status of Reedswamp in the Norfolk Broads,
W82-00691 5C

REGIONAL ANALYSIS *GEOHYDROLOGY
Plan of Study for the Regional Aquifer-System Analysis of the Snake River Plain, Idaho and Eastern Oregon,
W82-00730 6A

REGULATIONS
Towards a Predictive Model for the Economic Regulation of Commercial Fisheries,
W82-00549 6A

Fundamental Economic Issues in the Development of Small Scale Hydro.
W82-00722 6C

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New Jersey.
W82-00742 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Virginia,
W82-00744 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Maryland.
W82-00745 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in Wisconsin.
W82-00746 6E

Analysis of Legal Obstacles and Incentives to the Development of Low-Head Hydroelectric Power in Maine.
W82-00750 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in West Virginia.
W82-00753 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New York.
W82-00754 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Delaware.
W82-00755 6E

Water Quality Management in River Basins: US National Experience,
W82-00800 6E

Enforcement Under the Resource Conservation and Recovery Act of 1976,
W82-01013 6E

REHABILITATION
Why EPA's I/I Control Program Fails,
W82-00790 8A

REMOTE SENSING
Quantitative Assessment of Tidal Wetlands Using Remote Sensing,
W82-00781 7B

Interpretation of Surface-Water Circulation, Aransas Pass, Texas, Using Landsat Imagery,
W82-00904 7B

Atmospheric Water Content Over the Tropical Pacific Derived from the Nimbus-6 Scanning Microwave Spectrometer,
W82-01004 7B

REPRESENTATIVE BASINS
Study of the Factors and Regularities of River Runoff on the Basis of Data of Observations on Representative Basins,
W82-00652 2A

RESEARCH PRIORITIES
Research and Development to Service a Sustainable Agriculture,
W82-00669 3F

Federal Water Resources Research: A Review of the Proposed Five-Year Program Plan.
W82-01051 6E

RESERVOIR CONSTRUCTION
Theory of Ecological Prediction of Limnetic Ecosystems,
W82-00597 6G

RESERVOIR FISHERIES
Gonad Development, Fecundity, and Spawning Season of Largemouth Bass in Newly Impounded West Point Reservoir, Alabama-Georgia,
W82-01080 2H

RESERVOIR LININGS
Succeeding with Liner Installation,
W82-00909 8G

RESERVOIR RELEASES
Effects of Hypolimnetic Discharge on Fish Health Below a Reservoir,
W82-00805 5C

Glen Canyon Dam Is Killing the Grand Canyon and Your Tax Dollars Are Paying for It.
W82-00813 6G

RESERVOIRS
Light Penetration and the Interrelationships Between Optical Parameters in a Turbid Subtropical Impoundment,
W82-00667 2H

Factors Influencing Fish Distribution in Two Desert Reservoirs, Central Arizona,
W82-00814 2H

Hydraulic Model Study for the Design of the Wreck Cove Control Gates,
W82-00880 8B

Relation Between Trophic Position and Mercury Accumulation Among Fishes from the Tongue River Reservoir, Montana,
W82-01041 5A

Morphological Changes of River Channels Consequent Upon Headwater Impoundment,
W82-01087 6G

RESIDUAL CHLORINE
Residues in Cutthroat Trout (Salmo Clarki) and California Newts (Tarichia Torosa) From a Lake Treated With Technical Chlordane,
W82-00558 5C

Assessment of Some Aqueous Residual Chlorine Measurements,
W82-00867 5F

RESISTIVITY
Resistivity Study of a Coastal Karst Terrain, Florida,
W82-00817 2F

RESOURCES MANAGEMENT
The Caspian Sea Problem,
W82-00657 4A

Management of Recharge Basins on the Southern High Plains,
W82-00938 4B

RESPIRATION
Relationships Between Water Chemistry and Respiration Rate in Several Populations of Lymnaea Peregra Muller (Gastropoda:Mollusca),
W82-00854 2K

RHODE ISLAND
Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Rhode Island.
W82-00720 6E

Grazing Rate Determination of Corynoneura Scutellata Winnertz (Chironomidae:Diptera),
W82-00822 2H

RICE
Sizing Rice Irrigation Canals,
W82-00895 3F

RICHARDS BAY
Richards Bay: An Ecological Dilemma,
W82-00679 6A

RIPARIAN RIGHTS
Executive Summary; Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in the Seven Mid-Western States.
W82-00718 6E

RIVER BASIN
Impact of Water Resource Development on Salinization of Semi-Arid Lands,
W82-01024 5B

RIVER BASIN DEVELOPMENT
Debris Flow Deposits of Early Miocene Age, Deadman Stream, Marlborough, New Zealand,
W82-00694 2J

Water Resources Appraisal for Hydroelectric Licensing: Jordan River Basin, Utah.
W82-00736 6D

RIVER BASINS
Water Quality Management in River Basins: US National Experience,
W82-00800 6E

RIVER BEDS
Monitoring River Periphyton With Artificial Benthic Substrates,
W82-00581 5A

RIVERS
Kepone in the James River,
W82-00631 5B

The Organic Pollution of River Cubillas (Granada, South Spain),
W82-00674 5B

Graphed Equilibrium Parameters of Channels Formed in Sediment,
W82-00881 2J

A Comparison of Rainfall-Runoff Models,
W82-00911 2A

Effectiveness of River Models,
W82-00961 6A

ROOT DEVELOPMENT
Transpiration, Stomatal Conductance, and Photosynthesis of Tomato Plants With Various Proportions of Root System Supplied With Water,
W82-00504 2I

ROOT ZONE
Residence Times of Water and Solutes Within and Below the Root Zone,
W82-00932 2G

ROOTED AQUATIC PLANTS
Sediment-Based Nutrition of Submersed Macrophytes,
W82-00843 2H

RUHR RIVER
The Fate of Heavy Metals in the Ruhr System and Their Influence on Drinking Water Quality,
W82-00962 5B

RUNOFF
Multivariate Hydrologic Time Series Analysis,
W82-00647 2A

Effects of Recent Increases in Rainfall on Floods and Runoff in the Upper Hunter Valley,
W82-00668 2E

Sample Intake Position and Loading Rates from Nonpoint Source Pollution,
W82-00778 5A

RUNOFF FORECASTING
Study of the Factors and Regularities of River Runoff on the Basis of Data of Observations on Representative Basins,
W82-00652 2A

Evaluation of Areal Versus Point Rainfall with Sparse Data,
W82-00835 2B

Adaptive Hydrological Forecasting - A Review,
W82-00984 2A

SAGINAW BAY
Heavy Metal Contents in Some Macrophytes from Saginaw Bay (Lake Huron, U.S.A.),
W82-01000 5B

SALINE-FRESHWATER INTERFACES
Circulation and Energetics of a Deep, Strongly Stratified Inlet,
W82-00547 2L

Resistivity Study of a Coastal Karst Terrain, Florida,
W82-00817 2F

SALINE WATER
Saline Irrigation Water.
W82-00512 3F

Saline Water Use and Disposal Opportunities; Colorado River Water Quality Improvement Program,
W82-00717 3C

SALINITY
The Effect of Temperature on Salt Uptake by Tomato Plants With Diurnal and Nocturnal Waterlogging of Salinized Rootzones,
W82-00608 2I

The Azov Sea Problem,
W82-00651 6G

Inorganic Transformation of Applied Phosphorus in Brackish Water Fish Pond Soil Under Different Water Salinity Levels,
W82-00920 2H

Role of Solute-Transport Models in the Analysis of Groundwater Salinity Problems in Agricultural Areas,
W82-00993 5B

Dryland Management for Salinity Control,
W82-01018 2G

Saline Seep Development and Control in the North American Great Plains - Hydrogeological Aspects,
W82-01022 5B

Dryland Cropping Strategies for Efficient Water-Use to Control Saline Seeps in the Northern Great Plains, U.S.A.,
W82-01023 3F

SALMON
Factors Affecting Puget Sound Coho Salmon (Oncorhynchus Kisutch) Runs,
W82-00883 8I

SALMONELLA
Simultaneous Concentration of Salmonella and Enterovirus From Surface Water by Using Micro-Fiber Glass Filters,
W82-00573 5A

Dispersal of Salmonella from a Polluted Stream to Neighboring Terrestrial Habitats,
W82-01043 5A

SALT BALANCE
Impact of Water Resource Development on Salinization of Semi-Arid Lands,
W82-01024 5B

SALT MARSHES
The Assay of Adenosine 5'Triphosphate Extracted from Salt-Marsh Microbiota,
W82-00838 2L

Degradation of Hydrocarbons in Oxidized and Reduced Sediments,
W82-00907 5B

SALTS
Estimation of the Salt Burden of Irrigation Drainage Waters,
W82-00563 5B

Transport of Salts in Soils and Subsoils,
W82-00930 5B

Dissolution of Salt Deposits by Brine Density Flow,
W82-01016 2F

SAMPLING
Sampling Emerging Chironomidae (Diptera) With Submerged Funnel Traps in a New Northern Canadian Reservoir, Southern Indian Lake, Manitoba,
W82-00520 2H

Evaluation of Various Soil Water Samplers for Virological Sampling,
W82-00572 5A

Accurate and Efficient Estimation of Benthic Populations: A Comparison Between Removal Estimation and Conventional Sampling Techniques,
W82-00633 5A

Sample Intake Position and Loading Rates from Nonpoint Source Pollution,
W82-00778 5A

Estimation of Material Fluxes in an Estuarine Cross Section: A Critical Analysis of Spatial Measurement Density and Errors,
W82-00816 7A

A Comparative Study of Four Dredges Used for Sampling Benthic Macroinvertebrates in Rivers,
W82-00833 7B

Evidence of the Unsuitability of Gravity Coring for Collecting Sediment in Pollution and Sedimentation Rate Studies,
W82-00840 7B

Description of a New Submersible Filter-Pump Apparatus for Sampling Plankton,
W82-01012 7B

SAN JOAQUIN RIVER
Impact of Water Resource Development on Salinization of Semi-Arid Lands,
W82-01024 5B

SAND
Movement of Loose, Sandy Detritus by Shallow Water Flows: An Experimental Study,
W82-00776 2J

SAPROBIC INDEX
Comparison of a Few Systems for the Determination of Saprobic and Trophic Degree on the Basis of Plankton Data,
W82-00664 2H

SASKATCHEWAN
The Nature of Selected Prairie Lake and Stream Sediments,
W82-00815 2J

SATELLITE TECHNOLOGY
Quantitative Assessment of Tidal Wetlands Using Remote Sensing,
W82-00781 7B

Relation of Satellite-Based Thunderstorm Intensity to Radar-Estimated Rainfall,
W82-00806 2B

Satellite Rain Estimation in the U.S. High Plains,
W82-00808 2B

Interpretation of Surface-Water Circulation, Aransas Pass, Texas, Using Landsat Imagery,
W82-00904 7B

SAVANNAH RIVER IMPOUNDMENTS
The Effect of Season and Location on Phosphoadenylate Concentrations and Adenylate Energy Charge in Two Species of Freshwater Clams,
W82-00810 2H

SAW MILLS
Potential Eutrophication of the Rideau River by an Urban Drainage Waterway,
W82-00834 5C

SCALLOPS
Growth of the Bay Scallop, Argopecten Irradians, in a Waste Recycling Aquaculture System,
W82-00842 3C

SCOTLAND
The Design and Interpretation of Marine Pollution Surveys,
W82-00700 6E

SEA ICE
The Distribution of Sea Ice Meltwater in the Eastern Canadian Arctic,
W82-00966 2C

SEA WALLS
Large Rubble-Mound Breakwater Failures,
W82-00862 8D

SEASONAL DISTRIBUTION
On August Mean Temperature and the Succeeding Season's Rainfall Over South Africa,
W82-00692 2B

Gonad Development, Fecundity, and Spawning Season of Largemouth Bass in Newly Impounded West Point Reservoir, Alabama-Georgia,
W82-01080 2H

SEASONAL VARIATION
Model of the Seasonal Dynamics of an Ecosystem of a Shallow Lake,
W82-00552 2H

Annual Succession of Phytoplankton in One Heated Pond in Central Finland,
W82-00673 5C

SEATTLE
Effects of Renton Wastewater Treatment Plant Effluent on Water Quality of the Lower Green/Duwamish River,
W82-01063 5D

The Impact of Effluent from the Renton Wastewater Treatment Plant on the Dissolved Oxygen Regimen of the Lower Green/Duwamish River,
W82-01064 5D

SEAWATER
Survival of Human Enteroviruses in the Hawaiian Ocean Environment: Evidence for Virus-Inactivating Microorganisms,
W82-00587 5C

Modification of the Standard Most-Probable-Number Procedure for Fecal Coliform Bacteria in Seawater and Shellfish,
W82-00646 5A

Simultaneous Determination of Iron, Cadmium, Zinc, Copper, Nickel, Lead, and Uranium in Seawater by Stable Isotope Dilution Spark Source Mass Spectrometry,
W82-00786 5A

Sea Urchin Sperm Bioassay for Sewage and Chlorinated Seawater and Its Relation to Fish Bioassays,
W82-00988 5A

Organic Matrix Modifiers for Direct Graphite Furnace Atomic Absorption Determination of Cadmium in Seawater,
W82-01085 5A

Comparison of Methods for the Determination of Trace Elements in Seawater,
W82-01086 5A

SECONDARY PRODUCTIVITY
Sedimentological and Biological Changes in the Windsor Mudflat, an Area of Induced Siltation,
W82-00548 5C

SECONDARY WASTEWATER TREATMENT
An Alternative Wastewater Disinfectant,
W82-00950 5D

New Secondary Treatment System Brought On-Line at Georgia-Pacific,
W82-01009 5D

SEDIMENT SAMPLER
The Kyholm Corer--A Diver-Operated Sediment Corer,
W82-00793 7B

SEDIMENT TRANSPORT
Movement of Loose, Sandy Detritus by Shallow Water Flows: An Experimental Study,
W82-00776 2J

Subsurface Drainage and Sediment Transport Model,
W82-00894 2G

Interpretation of Surface-Water Circulation, Aransas Pass, Texas, Using Landsat Imagery,
W82-00904 7B

SEDIMENTATION
Sedimentological and Biological Changes in the Windsor Mudflat, an Area of Induced Siltation,
W82-00548 5C

Sediment Surveys in the Department of Water Affairs,
W82-00680 7B

Holocene Sequences on an Embayed High-Energy Coast: An Evolutionary Model,
W82-00695 2J

Coordinated Effort Stems Sediment and Erosion,
W82-00766 4D

Sedimentation of Zeolite Type A in Water and Waste Water,
W82-00848 5D

Costs of Alternative Policies for Controlling Agricultural Soil Loss and Associated Stream Sedimentation,
W82-00869 4D

Sediment Yield from a Flatland Watershed,
W82-00941 2J

SEDIMENTATION BASINS
Evaluation of Stripmine Sediment Detention Basins in Kentucky,
W82-00893 5G

SEDIMENTOLOGY
General Morphology and Sediment Patterns in Tidal Inlets,
W82-00792 2L

SEDIMENTS
Anthropogenic Trace Elements and Polycyclic Aromatic Hydrocarbon Levels in Sediment Cores From Two Lakes in the Adirondack Acid Lake Region,
W82-00501 5B

Partitioning of No. 2 Fuel Oil in Controlled Estuarine Ecosystems. Sediments and Suspended Particulate Matter,
W82-00541 2L

Relationships Between Environmental Factors, Bacterial Indicators, and the Occurrence of Enteric Viruses in Estuarine Sediments,
W82-00574 5A

Adsorption as a Control of Metal Concentrations in Sediment Extracts,
W82-00614 5A

Debris Flow Deposits of Early Miocene Age, Deadman Stream, Marlborough, New Zealand,
W82-00694 2J

Spatial Distributions of Pollen in Surface Sediments of the Potomac Estuary,
W82-00757 2L

Measurement of in situ Rates of Nitrification in Sediment,
W82-00798 5A

Methylation of Trimethyltin Compounds by Estuarine Sediments,
W82-00801 5B

The Nature of Selected Prairie Lake and Stream Sediments,
W82-00815 2J

Evidence of the Unsuitability of Gravity Coring for Collecting Sediment in Pollution and Sedimentation Rate Studies,
W82-00840 7B

Sediment-Based Nutrition of Submersed Macrophytes,
W82-00843 2H

Mercury and Selenium Concentrations in Fish, Sediments, and Water of Two Northwestern Quebec Lakes,
W82-00876 5B

Sediment Sizes Eroded from Crop Row Sideslopes,
W82-00903 2J

Degradation of Hydrocarbons in Oxidized and Reduced Sediments,
W82-00907 5B

The Effects of Heavy Metals on Microbial Biomass in Sediments of Palestine Lake,
W82-00925 5C

A Review on Sediment Traps in Aquatic Environments,
W82-01020 7B

SEEPAGE
Saline Seep Development and Control in the North American Great Plains - Hydrogeological Aspects,
W82-01022 5B

SEEPAGE CONTROL
Dryland Cropping Strategies for Efficient Water-Use to Control Saline Seeps in the Northern Great Plains, U.S.A.,
W82-01023 3F

SELENIUM
Dynamics of Selenium in Mercury-Contaminated Experimental Freshwater Ecosystems,
W82-00595 5B

Mercury and Selenium Concentrations in Fish, Sediments, and Water of Two Northwestern Quebec Lakes,
W82-00876 5B

Separation of Selenium from Sulfide Leach Liquors,
W82-00905 5D

SEMIARID LANDS
Annual Plant Production-Precipitation Relations in Arid and Semi-Arid Regions,
W82-00693 2I

SENSITIVITY ANALYSIS
A Comparison of Sensitivity Analysis and Error Analysis Based on a Stream Ecosystem Model,
W82-00991 7A

SEPARATION TECHNIQUES
System for Oil and Water Separation,
W82-00611 5D

Superseparation: Soret Effect Reversed,
W82-00791 3A

SEPTIC TANKS
Mutlichamber Septic Tanks,
W82-00969 5D

SESTON
Seston Dynamics in Southern Appalachian Streams: Effects of Clear-Cutting,
W82-00543 4C

SEWAGE BACTERIA
R Factors in Coliform-Fecal Coliform Sewage Flora of the Prairies and Northwest Territories of Canada,
W82-00508 5A

SEWAGE EFFLUENT
Serum Enzymes in Rainbow Trout as Tools in the Diagnosis of Water Quality,
W82-00857 5A

SEWER SYSTEMS
Pressure Sewer Systems,
W82-00528 5D

Why EPA's I/I Control Program Fails,
W82-00790 8A

SHALLOW WATER
Diel Variations of Selected Physico-Chemical Parameters in Lake Kissimmee, Florida,
W82-00535 2H

SHELLFISH
Toxic Dinoflagellates and Tidal Power Generation in the Bay of Fundy, Canada,
W82-00908 6G

SIERRA NEVADA
Hydrogeology of the Sierra Nevada Foothill Lineament Near Oakhurst, California,
W82-00831 2F

SILTING
Sedimentological and Biological Changes in the Windsor Mudflat, an Area of Induced Siltation,
W82-00548 5C

Sediment Surveys in the Department of Water Affairs,
W82-00680 7B

SIMULATED RAINFALL
Apparatus for the Simulation of Rain in the Laboratory,
W82-00807 2B

SIMULATION ANALYSIS
Simulation Modeling of Primary Clarifiers,
W82-01027 6A

SLOPE DEGRADATION
Effect of Slope Length on Erosion from Low Slopes,
W82-00896 2J

SLUDGE
Effects of Wastewater Sludge and Its Detergents on the Stability of Rotavirus,
W82-00576 5A

Extracting Heavy Metals and Toxic Organics from Sludge,
W82-00947 5D

Control Systems for Return and Waste Sludge,
W82-00949 5D

Evaluation of Winter Application of Liquid Sludge to Farmland,
W82-00952 5B

Vacuum Filtration of Metal Hydroxide Sludges,
W82-00976 5D

SLUDGE ASH
Metal Leaching from Sewage Sludge Ash,
W82-00770 5B

SLUDGE CONDITIONING
Extracting Heavy Metals and Toxic Organics from Sludge,
W82-00947 5D

SLUDGE DISPOSAL
Trace Element Accumulation, Movement, and Distribution in the Soil Profile From Massive Applications of Sewage Sludge,
W82-00640 5E

Extracting Heavy Metals and Toxic Organics from Sludge,
W82-00947 5D

Composting Is Working in Camden,
W82-00948 5E

Trenching of Digested Sludge,
W82-00974 5E

A Simulation Model for Sludge Decomposition in Soil,
W82-01001 5E

Chemicals Disinfect Sludge,
W82-01003 5D

Treatability Manual; Volume III. Technologies for Control/Removal of Pollutants.
W82-01075 5D

SLUDGE DRYING
Better Dewatering Improves Sludge Recycling and Gives Significant Energy Savings,
W82-00526 5E

SLUDGES
Destruction by Anaerobic Mesophilic and Thermophilic Digestion of Viruses and Indicator Bacteria Indigenous to Domestic Sludges,
W82-00580 5A

SNAKE RIVER PLAIN
Plan of Study for the Regional Aquifer-System Analysis of the Snake River Plain, Idaho and Eastern Oregon,
W82-00730 6A

SNOWMELT
Spring Flood: Meltwater or Groundwater,
W82-00531 7B

Study of the Factors and Regularities of River Runoff on the Basis of Data of Observations on Representative Basins,
W82-00652 2A

The Effects of Surface Dust on Snowmelt Rates,
W82-00845 2C

SNOWPACK
Occurrence of Ice Layers at the Base of High Arctic Snowpacks,
W82-00844 2C

SOCIAL ASPECTS
State Water Use and Socioeconomic Data Related to the Second National Water Assessment,
W82-00739 6D

Management Provoked Conflict in Fisheries,
W82-00780 6A

SODIUM
The Effects of Sodium and Organic Matter In Sewage Effluent on Water Retention Properties of Soils,
W82-00663 3C

SOIL CHEMISTRY
Acidity Fluctuations at a Broadland Site in Norfolk,
W82-00656 2K

SOIL COLUMNS
Effects of Nitrapyrin on Nitrate Movement in Soil Columns,
W82-01048 5G

SOIL COMPACTION
Settlement of a Compacted Unsaturated Earth Embankment,
W82-00678 8D

SOIL CONSERVATION
Coordinated Effort Stems Sediment and Erosion,
W82-00766 4D

Costs of Alternative Policies for Controlling Agricultural Soil Loss and Associated Stream Sedimentation,
W82-00869 4D

SOIL DISPOSAL FIELDS
Cation Transport in Packed Bed Reactor of Soil,
W82-00970 5D

SOIL EROSION
Effect of Slope Length on Erosion from Low Slopes,
W82-00896 2J

Aerial Photography as an Aid to Cropland Erosion Analysis,
W82-00902 2J

Sediment Sizes Eroded from Crop Row Sideslopes,
W82-00903 2J

SOIL MECHANICS
Mechanics of Mudflow Mobilization in Low-Angled Clay Slopes,
W82-00989 2J

SOIL MOISTURE
Soil Moisture Relations in the Southern California Chaparral,
W82-01035 2D

SOIL MOISTURE RETENTION
The Effects of Sodium and Organic Matter In Sewage Effluent on Water Retention Properties of Soils,
W82-00663 3C

SOIL PROPERTIES
A Mathematical Model for Predicting Moisture Flow in an Unsaturated Soil Under Hydraulic and Temperature Gradients,
W82-00605 2G

Quality of Irrigation Water and Effects of Sulfuric Acid and Gypsum on Soil Properties and Sundangrass Yields,
W82-00767 3C

Estimation of Soil-Moisture Characteristics from Mechanical Properties of Soils,
W82-00785 2G

Behavior and Transport of Microbial Pathogens and Indicator Organisms in Soils Treated with Organic Wastes,
W82-00797 5B

Soil Percolation Tests,
W82-01044 2G

SOIL TYPES
Photosynthesis and Growth in Populations of Populus Deltoides from Constrating Habitats,
W82-00935 2I

SOIL WATER
Microbial Mobilization of Calcium and Magnesium in Waterlogged Soils,
W82-00560 2G

Evaluation of Various Soil Water Samplers for Virological Sampling,
W82-00572 5A

Water Dynamics in the Soil-Plant-Atmosphere System,
W82-00759 2I

Water Status of Soil and Vegetation in a Shortgrass Steppe,
W82-00761 2I

Effect of Soil Water Content and a Growing Season Straw Mulch on Grain Sorghum,
W82-00765 3F

Estimation of Soil-Moisture Characteristics from Mechanical Properties of Soils,
W82-00785 2G

Effects of Joule Heating on Thermocouple Psychrometer Water Potential Determinations,
W82-00892 7B

Transport of Salts in Soils and Subsoils,
W82-00930 5B

Residence Times of Water and Solutes Within and Below the Root Zone,
W82-00932 2G

Modeling Water Flux on Strip-Mined Land,
W82-00944 2G

Soil Percolation Tests,
W82-01044 2G

SOIL-WATER-PLANT RELATIONSHIPS
Moisture Transport in a Soil-Plant System: A Mathematical Model and Finite Element Analysis,
W82-00648 2I

The Effect of Height of Water Table on the Growth of Holcus Lanatus With Reference to Lolium Perenne,
W82-00654 2I

Water Dynamics in the Soil-Plant-Atmosphere System,
W82-00759 2I

Plant-Water Relations and Adaptation to Stress,
W82-00812 2I

Photosynthesis and Growth in Populations of Populus Deltoides from Constrating Habitats,
W82-00935 2I

Dryland Cropping Strategies for Efficient Water-Use to Control Saline Seeps in the Northern Great Plains, U.S.A.,
W82-01023 3F

Soil Moisture Relations in the Southern California Chaparral,
W82-01035 2D

Water Vapor Conductance and CO2 Uptake for Leaves of a C4 Desert Grass, Hilaria Rigida,
W82-01039 2I

Response of Fababean Yield, Protein Production and Water Use to Irrigation,
W82-01089 2I

SOIL WATER POTENTIAL
Effects of Joule Heating on Thermocouple Psychrometer Water Potential Determinations,
W82-00892 7B

SOLUTE TRANSPORT
Groundwater Contaminant Transport with Adsorption and Ion Exchange Chemistry: Method of Characteristics for the Case Without Dispersion,
W82-00551 5B

The Use of Na/Cl Ratios to Trace Solute Sources in a Semiarid Zone,
W82-00601 7B

Temperature and Solute-Transport Simulation in Streamflow Using a Lagrangian Reference Frame,
W82-00726 2E

Transport of Salts in Soils and Subsoils,
W82-00930 5B

Residence Times of Water and Solutes Within and Below the Root Zone,
W82-00932 2G

Phosphorus, Nirogen, and Organic Carbon Flux in a Headwater Stream,
W82-01021 2K

SOLVENTS
Adsorption on Carbon: Solvent Effects on Adsorption,
W82-00619 5F

SORGHUM
Land Forming Effects on Dryland Sorghum Production in the Southern Great Plains,
W82-00764 3F

Effect of Soil Water Content and a Growing Season Straw Mulch on Grain Sorghum,
W82-00765 3F

SORPTION
Uptake of Polychlorinated Biphenyls by Natural Phytoplankton Assemblages: Field and Laboratory Determination of C14-PCB Particle-Water Index of Sorption,
W82-01032 5B

SOUTH AFRICA
Sediments as a Source of Phosphate: A Study of 38 Impoundments,
W82-00653 2H

Light Penetration and the Interrelationships Between Optical Parameters in a Turbid Subtropical Impoundment,
W82-00667 2H

The Pongolo Floodplain: A Unique Ecosystem Threatened,
W82-00684 6G

Environmental Aspects of Rural Development with Particular Reference to the Keiskamma River Basin Study,
W82-00685 6D

On August Mean Temperature and the Succeeding Season's Rainfall Over South Africa,
W82-00692 2B

The Cape Flats Sewage Treatment Works,
W82-00957 5D

SOUTH CAROLINA
Estimation of Material Fluxes in an Estuarine Cross Section: A Critical Analysis of Spatial Measurement Density and Errors,
W82-00816 7A

SPAIN
The Organic Pollution of River Cubillas (Granada, South Spain),
W82-00674 5B

SPARTINA
Dieback of Salt-Water Cordgrass (Spartina Alterniflora Loisel.) in the Lower Cape Fear Estuary of North Carolina: An Experimental Approach to Re-Establishment,
W82-00889 2L

SPATIAL DISTRIBUTION
Spatial Distributions of Pollen in Surface Sediments of the Potomac Estuary,
W82-00757 2L

SPAWNING
Gonad Development, Fecundity, and Spawning Season of Largemouth Bass in Newly Impounded West Point Reservoir, Alabama-Georgia,
W82-01080 2H

SPECIES COMPOSITION
Experimental Manipulation of Algal Bloom Composition by Nitrogen Addition,
W82-00998 5C

SPECIES DIVERSITY
Accurate and Efficient Estimation of Benthic Populations: A Comparison Between Removal Estimation and Conventional Sampling Techniques,
W82-00633 5A

SPECTROPHOTOMETRY
A Reduction-Spectrophotometric Method for the Determination of Sulphate in Waters,
W82-00850 5A

SPRINKLER IRRIGATION
Saline Irrigation Water.
W82-00512 3F

Traveling Sprinkler System and Method,
W82-00561 3F

SPRUCE KNOB LAKE
Water Chemistry Changes During Artificial Aeration of Spruce Knob Lake, West Virginia,
W82-01049 5G

STABILITY ANALYSIS
Gravitational Stability of Water Over Steam in Vapor-Dominated Geothermal Systems,
W82-00963 1A

STABILIZATION LAGOONS
New Secondary Treatment System Brought On-Line at Georgia-Pacific,
W82-01009 5D

STANDARDS
European Communities Directive Relating to the Quality of Water Intended for Human Consumption,
W82-00506 6D

STANDING CROPS
An In Situ Method for Measuring the Primary Productivity and Standing Crop of the Epilithic Periphyton Community in Lentic Systems,
W82-00756 7B

STATE JURISDICTION
Water - Its Use and the Implications for Arkansas Agriculture.
W82-00714 6D

Ground Water Problems Virginia Portion Ohio River Basin,
W82-01059 4B

STATISTICAL ANALYSIS
Assessment of Thermal Discharges on Zooplankton in Conowingo Pond, Pennsylvania,
W82-00592 5C

STEPPES
Water Status of Soil and Vegetation in a Shortgrass Steppe,
W82-00761 2I

STILLING BASINS
Hydraulic Design for the Two-Stage Stilling Basin,
W82-00849 8B

STOCHASTIC PROCESSES
Identification of Streamflow Stochastic Models,
W82-00555 2A

STOMATAL TRANSPIRATION
Seasonal Changes in Leaf Area, Stomatal and Canopy Conductances and Transpiration From Bracken Below a Forest Canopy,
W82-00655 2D

STORAGE COEFFICIENT
The Development of Methods for Determining Aquifer Characteristics,
W82-00827 2F

STORAGE TANKS
Coal Tar Coatings of Storage Tanks. A Source of Contamination of the Potable Water Supply,
W82-00616 5B

STORM RUNOFF
Recycling Urban Stormwater for Profit,
W82-00524 3C

STORM WATER
Modeling Hydrology and Eutrophication in a Louisiana Swamp Forest Ecosystem,
W82-00890 4A

STORMS
Numerical Simulation of the Effects of Cooling Tower Complexes on Clouds and Severe Storms,
W82-00995 2B

STREAM DEGRADATION
The Impact of an Industrially Contaminated Lake on Heavy Metal Levels in it's Effluent Stream,
W82-00886 5B

STREAM POLLUTION
Residues of Nonylphenol in Spruce Foliage, Forest Soil, Stream Water and Sediment After its Aerial Application,
W82-00559 5B

Effects of Renton Wastewater Treatment Plant Effluent on Water Quality of the Lower Green/Duwamish River,
W82-01063 5D

STREAM POLLUTION INDEX
Insect Community Structure as an Index of Heavy-Metal Pollution in Lotic Ecosystems,
W82-00596 5C

STREAMFLOW
Spring Flood: Meltwater or Groundwater,
W82-00531 7B

Temperature and Solute-Transport Simulation in Streamflow Using a Lagrangian Reference Frame,
W82-00726 2E

Factors Affecting Puget Sound Coho Salmon (Oncorhynchus Kisutch) Runs,
W82-00883 8I

STREAMFLOW DEPLETION
A Leaky Reservoir Model for Ephemeral Flow Recession,
W82-00600 2E

STREAMFLOW FORECASTING
Identification of Streamflow Stochastic Models,
W82-00555 2A

A Leaky Reservoir Model for Ephemeral Flow Recession,
W82-00600 2E

Multivariate Hydrologic Time Series Analysis,
W82-00647 2A

STREAMS
Seston Dynamics in Southern Appalachian Streams: Effects of Clear-Cutting,
W82-00543 4C

Effects of a Cattleskin Tannery of Stream Quality and Benthic Macroinvertebrates in Central Maine,
W82-00872 5C

Macrobenthos of Pine Island Bayou in the Big Thicket National Preserve, Texas,
W82-00924 5C

A Comparison of Sensitivity Analysis and Error Analysis Based on a Stream Ecosystem Model,
W82-00991 7A

Phosphorus, Nirogen, and Organic Carbon Flux in a Headwater Stream,
W82-01021 2K

The Role of Substratum in Benthic Macroinvertebrate Microdistribution and Litter Decomposition in a Woodland Stream,
W82-01037 2E

Assessment of Water Quality Conditions in Skamokawa Creek, Washington,
W82-01066 5C

Morphological Changes of River Channels Consequent Upon Headwater Impoundment,
W82-01087 6G

STREETER-PHELPS EQUATION
The Impact of Effluent from the Renton Wastewater Treatment Plant on the Dissolved Oxygen Regimen of the Lower Green/Duwamish River,
W82-01064 5D

STRIP MINE WASTES
Evaluation of Stripmine Sediment Detention Basins in Kentucky,
W82-00893 5G

SUBLETHAL EFFECTS
Effects of Hypolimnetic Discharge on Fish Health Below a Reservoir,
W82-00805 5C

SUBMERSIBLE PUMPS
Submersible Pumps Help Quell Damage From Mount St. Helens Mudflow.
W82-00509 4D

Description of a New Submersible Filter-Pump Apparatus for Sampling Plankton,
W82-01012 7B

SUBSIDENCE
A Mathematical Model for Consolidation in a Thermoelastic Aquifer Due to Hot Water Injection or Pumping,
W82-00602 2F

SUBSTRATES
Monitoring River Periphyton With Artificial Benthic Substrates,
W82-00581 5A

A Portable Pump Sampler for Lotic Periphyton,
W82-00826 7B

The Role of Substratum in Benthic Macroinvertebrate Microdistribution and Litter Decomposition in a Woodland Stream,
W82-01037 2E

SUBSURFACE DRAINAGE
Backfill Alteration Effects on Pipe Drainage of a Clay Soil,
W82-00763 4A

Subsurface Drainage and Sediment Transport Model,
W82-00894 2G

SUDAN
A Combination of Electrical Resistivity, Seismic Refraction, and Gravity Measurements for Groundwater Exploration in Sudan,
W82-00852 2F

SUGARCANE
Water Requirement for Sugarcane Production,
W82-00899 3F

SULFATES
Relationships Between Sulfate and Nitrate Ion Concentrations and Rainfall PH for Use in Modeling Applications,
W82-00507 5B

A Reduction-Spectrophotometric Method for the Determination of Sulphate in Waters,
W82-00850 5A

Analysis of Precipitation Chemistry at a Central Pennsylvania Site,
W82-00980 2K

SULFUR
Chloramine-T as A Potential Scrubbing Agent: Removal of Odorous Sulfur-Containing Environmental Pollutants,
W82-00871 5D

Sulfur and Associated Elements and Acidity in Continental and Marine Rain from North Florida,
W82-00965 2B

SULFUR COMPOUNDS
Mass-Transport Limitation to the Rate of Reaction of Gases in Liquid Droplets: Application to Oxidation of SO2 in Aqueous Solutions,
W82-00994 2K

SULFURIC ACID
Acid Precipitation: The Importance of Nitric Acid,
W82-00643 2K

Acidity Fluctuations at a Broadland Site in Norfolk,
W82-00656 2K

Quality of Irrigation Water and Effects of Sulfuric Acid and Gypsum on Soil Properties and Sundangrass Yields,
W82-00767 3C

SUPPLEMENTAL IRRIGATION
Risk and the Demand for Supplemental Irrigation: A Case Study in the Corn Belt,
W82-00522 6A

SURFACE-GROUNDWATER RELATIONS
Spring Flood: Meltwater or Groundwater,
W82-00531 7B

Ground Water in the Ohio River Basin Portion of Maryland: Problems and Needs,
W82-01054 4B

SURFACE RUNOFF
A Geomorphologic Synthesis of Nonlinearity in Surface Runoff,
W82-00604 2A

SURFACE WATER
Simultaneous Concentration of Salmonella and Enterovirus From Surface Water by Using Micro-Fiber Glass Filters,
W82-00573 5A

Summary Appraisal of Water Resources in the Redmond Quadrangle, Sanpete and Sevier Counties, Utah,
W82-00725 7C

Water Resources Data for Illinois, Water Year 1980--Volume 1. Illinois Except Illinois River Basin.
W82-00731 7C

Water Resources Data for Illinois, Water Year 1980--Volume 2. Illinois River Basin.
W82-00732 7C

Water Resources Data for Utah, Water Year 1980.
W82-00733 7C

Evaluation of an Automatic System for Detection of Toxic Substances in Surface Water Using Trout,
W82-00855 5A

SURFACTANTS
Foam Control and Degradation of Nonionic Detergents,
W82-00637 5D

Electrical Aspects of Adsorbing Colloid Flotation. XI. Surfactant Adsorption Isotherms, Particle Displacement, and Differential Capacitance,
W82-00788 1B

SUSPENDED SEDIMENTS
Light Penetration and the Interrelationships Between Optical Parameters in a Turbid Subtropical Impoundment,
W82-00667 2H

SUSPENDED SOLIDS
A Review on Sediment Traps in Aquatic Environments,
W82-01020 7B

SWAMPS
Modeling Hydrology and Eutrophication in a Louisiana Swamp Forest Ecosystem,
W82-00890 4A

Methane Formation in the Acid Peats of Okefenokee Swamp, Georgia,
W82-00936 2H

SWEDEN
Spring Flood: Meltwater or Groundwater,
W82-00531 7B

Reviving Acidified Lakes,
W82-00933 2H

SWIMMING POOLS
Are Metals from Highway Dustfall Hazardous in Swimming Pools,
W82-01093 5B

TAMPA BAY REGION
Tampa Bay Water Guarded by Computer,
W82-00934 4B

TANNERY WASTES
Chemical Treatment Solves Tannery Waste Problems,
W82-00638 5D

Effects of a Cattleskin Tannery of Stream Quality and Benthic Macroinvertebrates in Central Maine,
W82-00872 5C

TECHNOLOGY
Dredging and Disposal of Toxic Material Using Japanese Technology Suggested for United States,
W82-01026 5E

TEMPERATURE
Temperature and Solute-Transport Simulation in Streamflow Using a Lagrangian Reference Frame,
W82-00726 2E

TEMPERATURE CONTROL
On August Mean Temperature and the Succeeding Season's Rainfall Over South Africa,
W82-00692 2B

TEMPERATURE EFFECTS
Relationship Between Thermal Stability and Summer Oxygen Depletion in a Prairie Pothole Lake,
W82-00545 2H

Effect of Temperature on Mineralization by Heterotrophic Bacteria,
W82-00583 5C

Influence of Seasonal Temperature on the Temperature Optima of Bacteria in Sediments of Lake George, New York,
W82-00606 2H

The Effect of Temperature on Salt Uptake by Tomato Plants With Diurnal and Nocturnal Waterlogging of Salinized Rootzones,
W82-00608 2I

Annual Succession of Phytoplankton in One Heated Pond in Central Finland,
W82-00673 5C

Temperature and Water Relation Patterns in Subalpine Understory Plants,
W82-00760 2I

Buoyancy Force Reversals in Vertical Natural Convection Flows in Cold Water,
W82-00981 1A

Numerical Simulation of the Effects of Cooling Tower Complexes on Clouds and Severe Storms,
W82-00995 2B

TENNESSEE
Heavy Metal Concentrations in the Holston River Basin (Tennessee),
W82-00959 5A

TENNESSEE-TOMBIGBEE WATERWAY
The Waterway That Cannot be Stopped,
W82-00510 6E

TERBUTRYN
Determination of Terbutryn and its Degradation Products in Water, Sediments, Aquatic Plants, and Fish,
W82-00567 5A

TETRAALKYLEAD COMPOUNDS
Occurrence of Tetraalkylead Compounds in the Aquatic Environment,
W82-00878 5A

TEXAS
Interpretation of Surface-Water Circulation, Aransas Pass, Texas, Using Landsat Imagery,
W82-00904 7B

Macrobenthos of Pine Island Bayou in the Big Thicket National Preserve, Texas,
W82-00924 5C

Effects of Water Quality on Forage Production,
W82-01002 3C

Variations in Precipitation Parameters Between Drought and Non-Drought Periods in Texas and Some Implications for Cloud Seeding,
W82-01006 2B

TEXTILE MILL WASTES
Foam Control and Degradation of Nonionic Detergents,
W82-00637 5D

Does Improved Waste Treatment Have Demonstrable Biological Benefits,
W82-00779 5C

THERMAL POLLUTION
Effect of Temperature on Mineralization by Heterotrophic Bacteria,
W82-00583 5C

Assessment of Thermal Discharges on Zooplankton in Conowingo Pond, Pennsylvania,
W82-00592 5C

Effects of Hypolimnetic Discharge on Fish Health Below a Reservoir,
W82-00805 5C

Effects of Thermal Effluents on Communities of Benthic Marine Macroalgae,
W82-00870 5C

THERMAL WATER
A Mathematical Model for Consolidation in a Thermoelastic Aquifer Due to Hot Water Injection or Pumping,
W82-00602 2F

THERMOCOUPLES
Effects of Joule Heating on Thermocouple Psychrometer Water Potential Determinations,
W82-00892 7B

THOREU'S BOG
Biogeochemistry of Thoreau's Bog, Concord, Massachusetts,
W82-00887 2K

THUNDERSTORMS
Relation of Satellite-Based Thunderstorm Intensity to Radar-Estimated Rainfall,
W82-00806 2B

TIDAL EFFECTS
Circulation and Energetics of a Deep, Strongly Stratified Inlet,
W82-00547 2L

General Morphology and Sediment Patterns in Tidal Inlets,
W82-00792 2L

TIDAL MARSHES
Sedimentological and Biological Changes in the Windsor Mudflat, an Area of Induced Siltation,
W82-00548 5C

Quantitative Assessment of Tidal Wetlands Using Remote Sensing,
W82-00781 7B

TIDAL POWERPLANTS
Sedimentological and Biological Changes in the Windsor Mudflat, an Area of Induced Siltation,
W82-00548 5C

Toxic Dinoflagellates and Tidal Power Generation in the Bay of Fundy, Canada,
W82-00908 6G

TILE DRAINAGE
Impact of Water Resource Development on Salinization of Semi-Arid Lands,
W82-01024 5B

TIN
Voltammetric Characterization and Chemical Behavior of Inorganic Tin in Natural Waters,
W82-00627 5A

TIN COMPOUNDS
Methylation of Trimethyltin Compounds by Estuarine Sediments,
W82-00801 5B

TISSUE ANALYSIS
Determination of Polyhalogenated Phenolic Compounds in Drinking Water, Human Blood Serum and Adipose Tissue,
W82-00879 5A

TOMATOES
Transpiration, Stomatal Conductance, and Photosynthesis of Tomato Plants With Various Proportions of Root System Supplied With Water,
W82-00504 2I

The Effect of Temperature on Salt Uptake by Tomato Plants With Diurnal and Nocturnal Waterlogging of Salinized Rootzones,
W82-00608 2I

TONGUE RIVER RESERVOIR
Relation Between Trophic Position and Mercury Accumulation Among Fishes from the Tongue River Reservoir, Montana,
W82-01041 5A

TOXICITY
Toxicity of Five Forest Insecticides to Cutthroat Trout and Two Species of Aquatic Invertebrates,
W82-00590 5C

Effect of Metals on the Biomass Production Kinetics of Freshwater Copepods,
W82-00593 5C

Effect of Ozonation and Chlorination on the Mutagenic Potential of Drinking Water,
W82-00649 5A

Acute and Chronic Effects of Alum to Midge Larva (Diptera: Chironomidae),
W82-00650 5F

1980 Annual Report, Committee on the Assessment of Human Health Effects of Great Lakes Water Quality,
W82-00706 5C

Acute Toxicity of Zinc to Some Fishes in High Alkalinity Water,
W82-00713 5C

Evaluation of an Automatic System for Detection of Toxic Substances in Surface Water Using Trout,
W82-00855 5A

Serum Enzymes in Rainbow Trout as Tools in the Diagnosis of Water Quality,
W82-00857 5A

Occurrence of Tetraalkylead Compounds in the Aquatic Environment,
W82-00878 5A

Toxic Dinoflagellates and Tidal Power Generation in the Bay of Fundy, Canada,
W82-00908 6G

Extracting Heavy Metals and Toxic Organics from Sludge,
W82-00947 5D

The Activity of Environmental Samples in a Cell Culture Test for Asbestos Toxicity,
W82-01031 5C

Chlorinated Hydrocarbons as a Factor in the Reproduction and Survival of Lake Trout (Salvelinus Namaycush) in Lake Michigan.
W82-01079 5C

TOXINS
Toxics in Municipal and Industrial Wastewaters,
W82-00712 5A

TRACE ELEMENTS
Trace Element Concentrations Over Midlake Michigan as a Function of Meteorology and Source Region,
W82-00550 5B

Trace Element Inputs From a Coal Burning Power Plant to Adjacent Terrestrial and Aquatic Environments,
W82-00557 5B

Effect of Leachate Flow Rate on Metal Migration Through Soil,
W82-00565 5E

Trace Element Accumulation, Movement, and Distribution in the Soil Profile From Massive Applications of Sewage Sludge,
W82-00640 5E

Simultaneous Determination of Iron, Cadmium, Zinc, Copper, Nickel, Lead, and Uranium in Seawater by Stable Isotope Dilution Spark Source Mass Spectrometry,
W82-00786 5A

Comparison of Methods for the Determination of Trace Elements in Seawater,
W82-01086 5A

TRACE LEVELS
Trace Constituents in Cloud Water, Rainwater and Aerosol Samples Collected near the West Coast of India During the Southwest Monsoon,
W82-00676 2B

TRACE METALS
Monitoring Trace Amounts of Cadmium in Natural Waters,
W82-00516 5A

Trace Metal Catalysis in Aquatic Environments,
W82-00629 5B

Trace Metal Fluxes to Nearshore Long Island Sound Sediments,
W82-01040 5B

TRACERS
The Use of Na/Cl Ratios to Trace Solute Sources in a Semiarid Zone,
W82-00601 7B

TRACTIVE FORCES
Tractive Force Design of Vegetated Channels,
W82-00901 4D

TRAINING
Management Training is the Key to Good Operator Performance,
W82-00623 5D

TRANSMISSIVITY
The Development of Methods for Determining Aquifer Characteristics,
W82-00827 2F

A Method for Estimating Recharge and Boundary Flux from Groundwater Level Observations,
W82-00985 2F

TRANSPIRATION
Transpiration, Stomatal Conductance, and Photosynthesis of Tomato Plants With Various Proportions of Root System Supplied With Water,
W82-00504 2I

Leaf and Environmental Parameters Influencing Transpiration: Theory and Field Measurements,
W82-00979 2D

TRAP EFFICIENCY
A Review on Sediment Traps in Aquatic Environments,
W82-01020 7B

TRAVERSE CITY
Direct Filtration Studies at Traverse City Water Treatment Plant,
W82-00945 5F

TRAWLING
Effect of Otter Prawn Trawling on the Macrobenthos of a Sandy Substratum in a New South Wales Estuary,
W82-00677 5C

TREES
Clonal Variations in the Water Relations of Red Osier Dogwood During Cold Acclimation,
W82-00839 2I

TRENCHES
Trenching of Digested Sludge,
W82-00974 5E

TRICKLE IRRIGATION
Laser Drip Irrigation.
W82-00771 3F

TRIHALOMETHANES *CHLORINATION
Removing Trihalomethanes from Drinking Water,
W82-00953 5F

TRITIUM
Application of Immobilized Hydrogenase for the Detritiation of Water,
W82-00768 5D

Possibility of Using Tritium for Studying Global Circulation of Atmospheric Moisture,
W82-00863 2A

TROPHIC LEVEL
Comparison of a Few Systems for the Determination of Saprobic and Trophic Degree on the Basis of Plankton Data,
W82-00664 2H

The Effect of Continuous Advanced Wastewater Treatment by the City of Spokane on the Trophic Status of Long Lake, WA During 1979.
W82-01070 2H

An Assessment of the Trophic Status of Deer, Loon, and Diamond Lakes,
W82-01072 2H

TROPICAL CYCLONES
Effects of Tropical Cyclone Wally in Southeast Viti Levu, Fiji, Easter 1980,
W82-00670 2A

TROPICAL REGIONS
Growth and Nitrogen Fixation of Aeschynomene Under Water Stressed Conditions,
W82-00758 2I

Atmospheric Water Content Over the Tropical Pacific Derived from the Nimbus-6 Scanning Microwave Spectrometer,
W82-01004 7B

TROUT
Residues in Cutthroat Trout (Salmo Clarki) and California Newts (Tarichia Torosa) From a Lake Treated With Technical Chlordane,
W82-00558 5C

Toxicity of Five Forest Insecticides to Cutthroat Trout and Two Species of Aquatic Invertebrates,
W82-00590 5C

Evaluation of an Automatic System for Detection of Toxic Substances in Surface Water Using Trout,
W82-00855 5A

Chlorinated Hydrocarbons as a Factor in the Reproduction and Survival of Lake Trout (Salvelinus Namaycush) in Lake Michigan.
W82-01079 5C

TUNDRA
Some Aspects of Plant Water Relations in Alaskan Arctic Tundra Species,
W82-00846 2I

TURBIDITY
Light Penetration and the Interrelationships Between Optical Parameters in a Turbid Subtropical Impoundment,
W82-00667 2H

Effect of Turbidity on Chlorination Efficiency and Bacterial Persistence in Drinking Water,
W82-00865 5A

Direct Filtration Studies at Traverse City Water Treatment Plant,
W82-00945 5F

Low Turbidity Water from Fast Processes,
W82-00946 5F

Ferric Chloride Takes Over,
W82-00954 5F

ULTRAFILTRATION
Mechanism of Charged Membrane Ultrafiltration of Salt Solutions,
W82-00641 5D

UNITED KINGDOM
The Control of Bacterial Pollution Caused by Sea Discharges of Sewage,
W82-00699 5D

UNITED STATES
Experience Gained with the U.S. Pollution Control Policies,
W82-00996 6E

UNSATURATED FLOW
A Mathematical Model for Predicting Moisture Flow in an Unsaturated Soil Under Hydraulic and Temperature Gradients,
W82-00605 2G

UPTAKE
Absorption of Fenitrothion by Plankton and Benthic Algae,
W82-00874 5B

URANIUM
Uranium Concentration in the Ground Waters of the Pullman-Moscow Basin, Whitman County, Washington, and Latah County, Idaho,
W82-00809 5B

URBAN HYDROLOGY
Evaluation of Areal Versus Point Rainfall with Sparse Data,
W82-00835 2B

URBAN RUNOFF
Recycling Urban Stormwater for Profit,
W82-00524 3C

Wilson Creek Drainage - Surface and Ground Water Quality, July 1978 to July 1979.
W82-01069 5B

URBAN WATERSHEDS
Potential Eutrophication of the Rideau River by an Urban Drainage Waterway,
W82-00834 5C

USSR
Theory of Ecological Prediction of Limnetic Ecosystems,
W82-00597 6G

Irrigation and Drainage Waters of a New Irrigation Zone in the Hungry Steppe and Possibilities of their Use,
W82-00658 3C

UTAH
Summary Appraisal of Water Resources in the Redmond Quadrangle, Sanpete and Sevier Counties, Utah,
W82-00725 7C

Water Resources Data for Utah, Water Year 1980.
W82-00733 7C

Water Resources Appraisal for Hydroelectric Licensing: Jordan River Basin, Utah.
W82-00736 6D

UTILITIES
Potential Political Influences Affecting the Water Industry,
W82-00861 6C

Distribution System Liability,
W82-01028 5F

VACUUM FILTRATION
Vacuum Filtration of Metal Hydroxide Sludges,
W82-00976 5D

VEGETABLE CROPS
Yield and Water Use of Vegetable Crops with Seepage and Drip Irrigation Systems,
W82-00544 3F

Ratio Between Evapotranspiration of Irrigated Crops from Floating Lysimeters and Class A Pan Evaporation,
W82-01050 2D

VEGETATION
The Changing Status of Reedswamp in the Norfolk Broads,
W82-00691 5C

Water Status of Soil and Vegetation in a Shortgrass Steppe,
W82-00761 2I

Quantitative Assessment of Tidal Wetlands Using Remote Sensing,
W82-00781 7B

Vegetational Analysis of Big Run Bog, A Nonglaciated Sphagnum Bog in West Virginia,
W82-00992 2I

VEGETATION EFFECTS
Tractive Force Design of Vegetated Channels,
W82-00901 4D

The Influence of Plant Communities Upon the Hydrology of Catchments,
W82-00931 2D

Ratio Between Evapotranspiration of Irrigated Crops from Floating Lysimeters and Class A Pan Evaporation,
W82-01050 2D

VIBRIO
A Note on the Fate of El Tor Cholera and Other Vibrios in Percolating Filters,
W82-00566 5D

VIRGINA
Potentiometric-Surface Map for the Cretaceous Aquifer, Virginia Coastal Plain, 1978,
W82-00727 7C

VIRGINIA
Kepone in the James River,
W82-00631 5B

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Virginia,
W82-00744 6E

Ground Water Problems Virginia Portion Ohio River Basin,
W82-01059 4B

VIRUSES
Environmental Virology and its Problems,
W82-00505 5A

Evaluation of Various Soil Water Samplers for Virological Sampling,
W82-00572 5A

Relationships Between Environmental Factors, Bacterial Indicators, and the Occurrence of Enteric Viruses in Estuarine Sediments,
W82-00574 5A

Effects of Wastewater Sludge and Its Detergents on the Stability of Rotavirus,
W82-00576 5A

Destruction by Anaerobic Mesophilic and Thermophilic Digestion of Viruses and Indicator Bacteria Indigenous to Domestic Sludges,
W82-00580 5A

1980 Annual Report, Committee on the Assessment of Human Health Effects of Great Lakes Water Quality,
W82-00706 5C

Enteric Viruses in Renovated Water in Manitoba,
W82-01090 5A

VOLATILITY
Detection of Volatile Nitrosamines in Waste Water from Chemical Plants by Combined Capillary Gas Chromatography-Mass Spectrometry,
W82-00856 5A

VOLCANOES
Submersible Pumps Help Quell Damage From Mount St. Helens Mudflow.
W82-00509 4D

VOLUMETRIC ANALYSIS
Voltammetric Characterization and Chemical Behavior of Inorganic Tin in Natural Waters,
W82-00627 5A

WASHINGTON
An Industrial and Hazardous Waste Inventory of Washington's Manufacturing Industries (1980),
W82-01065 5B

Assessment of Water Quality Conditions in Skamokawa Creek, Washington,
W82-01066 5C

State of Washington Water Quality Assessment Report 1980.
W82-01067 6E

Water Quality Conditions in the Bellingham Bay Area 1979-1980,
W82-01068 5B

Wilson Creek Drainage - Surface and Ground Water Quality, July 1978 to July 1979.
W82-01069 5B

The Effect of Continuous Advanced Wastewater Treatment by the City of Spokane on the Trophic Status of Long Lake, WA During 1979.
W82-01070 2H

Biological Testing Methods - Compliance with Hazardous Waste Regulation Chapter 173-302 WAC.
W82-01071 5A

An Assessment of the Trophic Status of Deer, Loon, and Diamond Lakes,
W82-01072 2H

WASTE CHARACTERISTICS
Biological Testing Methods - Compliance with Hazardous Waste Regulation Chapter 173-302 WAC.
W82-01071 5A

Treatability Manual: Volume II. Industrial Descriptions.
W82-01074 5D

WASTE DISPOSAL
The Toxic Waste Dump Problem and a Suggested Insurance Program,
W82-00591 5E

Bentonite Liners for Power Plant Lagoons,
W82-00617 5E

Illinois Groundwater Problems and Needs,
W82-01052 4B

Groundwater Pollution in Kentucky: A Status Report,
W82-01053 4B

WASTE DUMPS
The Toxic Waste Dump Problem and a Suggested Insurance Program,
W82-00591 5E

WASTE HEAT
Waste Heat Balance in Aquifers Calculated by a Computer Programme,
W82-00830 7B

WASTE IDENTIFICATION
Biological Testing Methods - Compliance with Hazardous Waste Regulation Chapter 173-302 WAC.
W82-01071 5A

WASTE MANAGEMENT
An Industrial and Hazardous Waste Inventory of Washington's Manufacturing Industries (1980),
W82-01065 5B

WASTE WATER
Detection of Volatile Nitrosamines in Waste Water from Chemical Plants by Combined Capillary Gas Chromatography-Mass Spectrometry,
W82-00856 5A

WASTE WATER DISPOSAL
1980 Annual Report - A Perspective on the Problem of Hazardous Substances in the Great Lakes Basin Ecosystem,
W82-00707 5C

Saline Water Use and Disposal Opportunities; Colorado River Water Quality Improvement Program,
W82-00717 3C

WASTEWATER
Enumeration of Bacteriophages and Host Bacteria in Sewage and the Activated-Sludge Treatment Process,
W82-00584 5A

Microbial Metabolism of N-Nitrosodiethanolamine in Lake Water and Sewage,
W82-00585 2H

Thames Rears Carp in Sewage.
W82-00681 3C

Formation of N-Nitrosodiethanolamine from Diethanolamine in Lake Water and Sewage,
W82-00796 5A

Waterborne Methylene Bis(2-Chloroaniline) and 2-Chloroaniline Contamination Around Adrian, Michigan,
W82-00873 5B

Sea Urchin Sperm Bioassay for Sewage and Chlorinated Seawater and Its Relation to Fish Bioassays,
W82-00988 5A

WASTEWATER ANALYSIS
Grab Versus Composite Sampling: A Primer for the Manager and Engineer,
W82-00891 5A

Ammonia Electrode with Immobilized Nitrifying Bacteria,
W82-01099 5A

WASTEWATER COLLECTION
Pressure Sewer Systems,
W82-00528 5D

WASTEWATER COMPOSITION
Midwestern Wastewater Characteristics,
W82-00534 5D

WASTEWATER DILUTION
Effects of Renton Wastewater Treatment Plant Effluent on Water Quality of the Lower Green/Duwamish River,
W82-01063 5D

WASTEWATER DISPOSAL
The Control of Bacterial Pollution Caused by Sea Discharges of Sewage,
W82-00699 5D

Dairy Liquid Waste Distribution in an Overland Flow Vegetative-Soil Filter System,
W82-00897 5D

WASTEWATER FACILITIES
Management Training is the Key to Good Operator Performance,
W82-00623 5D

Low-Cost Wastewater Treatment,
W82-00841 5D

The Cape Flats Sewage Treatment Works,
W82-00957 5D

Effects of Renton Wastewater Treatment Plant Effluent on Water Quality of the Lower Green/Duwamish River,
W82-01063 5D

WASTEWATER FARMING
Effects of Municipal Waste Water Effluent on Performance and Feed Quality of Maize Vs. Reed Canarygrass,
W82-00564 3C

WASTEWATER IRRIGATION
Isolation and Identification of Pathogenic Microorganisms at Wastewater-Irrigated Fields: Ratios in Air and Wastewater,
W82-00579 5A

Effect of Irrigating Loamy Sand Soil by Liquid Sewage Sludge on its Content of some Micronutrients,
W82-00661 5E

The Effects of Sodium and Organic Matter In Sewage Effluent on Water Retention Properties of Soils,
W82-00663 3C

2,500 Acres of Wastewater Irrigation,
W82-00769 3C

WASTEWATER MANAGEMENT
Water Quality Evaluation of Regional Wastewater Management,
W82-00977 5D

WASTEWATER PLANT OPERATORS
The Relationship of Environmental Epidemiology to Water and Wastewater Plant Operators,
W82-00789 5C

WASTEWATER POLLUTION
The Impact of Effluent from the Renton Wastewater Treatment Plant on the Dissolved Oxygen Regimen of the Lower Green/Duwamish River,
W82-01064 5D

WASTEWATER RENOVATION
Environmental Effects of Water Reuse Scheme,
W82-00973 3C

Enteric Viruses in Renovated Water in Manitoba,
W82-01090 5A

WASTEWATER TREATMENT
Better Dewatering Improves Sludge Recycling and Gives Significant Energy Savings,
W82-00526 5E

Empire Controlled by Computer,
W82-00529 5D

Enumeration of Bacteriophages and Host Bacteria in Sewage and the Activated-Sludge Treatment Process,
W82-00584 5A

Land Treatment of Municipal Wastewater in Small Communities,
W82-00588 5D

Cold Weather Waste Treatment,
W82-00636 5D

Foam Control and Degradation of Nonionic Detergents,
W82-00637 5D

Chemical Treatment Solves Tannery Waste Problems,
W82-00638 5D

Removal of Priority Pollutants,
W82-00639 5D

Mechanism of Charged Membrane Ultrafiltration of Salt Solutions,
W82-00641 5D

Anaerobic Biological Treatment of Food Industry Wastewaters,
W82-00698 5D

Ecological Effects of Non-Phosphate Detergent Builders: Final Report on Organic Builders other than NTA,
W82-00704 5G

Application of Immobilized Hydrogenase for the Detritiation of Water,
W82-00768 5D

Manganese Dioxide as an Adsorbant for Heavy Metals,
W82-00775 5F

Does Improved Waste Treatment Have Demonstrable Biological Benefits,
W82-00779 5C

The Relationship of Environmental Epidemiology to Water and Wastewater Plant Operators,
W82-00789 5C

Purification of Wastewater by Electrolysis,
W82-00847 5D

Sedimentation of Zeolite Type A in Water and Waste Water,
W82-00848 5D

Pilot Plant Performances in Municipal Wastewater Treatment by Activated Carbon Adsorption,
W82-00851 5D

Facts Fix Fund Finding,
W82-00885 9A

Separation of Selenium from Sulfide Leach Liquors,
W82-00905 5D

Floc/Float System Cleans Desalter Effluent,
W82-00906 5D

Extracting Heavy Metals and Toxic Organics from Sludge,
W82-00947 5D

Control Systems for Return and Waste Sludge,
W82-00949 5D

Sludge Blanket in Activated Final Clarifiers,
W82-00951 5D

Automation of Norwich Sewage-Treatment Works: Early Cost Considerations,
W82-00955 5D

Guideline Tables to Industrial Wastes Problems.
W82-00956 5D

Vacuum Filtration of Metal Hydroxide Sludges,
W82-00976 5D

Chemicals Disinfect Sludge,
W82-01003 5D

Mutant Bacteria Control Filamentous Growth in Mill Wastewater Treatment,
W82-01008 5D

New Secondary Treatment System Brought On-Line at Georgia-Pacific,
W82-01009 5D

Simulation Modeling of Primary Clarifiers,
W82-01027 6A

Removal of Volatile Trace Organics from Wastewater by Overland Flow Land Treatment,
W82-01042 5D

The Impact of Effluent from the Renton Wastewater Treatment Plant on the Dissolved Oxygen Regimen of the Lower Green/Duwamish River,
W82-01064 5D

Water Quality Conditions in the Bellingham Bay Area 1979-1980,
W82-01068 5B

The Effect of Continuous Advanced Wastewater Treatment by the City of Spokane on the Trophic Status of Long Lake, WA During 1979.
W82-01070 2H

Treatability Manual; Volume I. Treatability Data.
W82-01073 5D

Treatability Manual: Volume II. Industrial Descriptions.
W82-01074 5D

Treatability Manual; Volume III. Technologies for Control/Removal of Pollutants.
W82-01075 5D

Treatability Manual; Volume IV. Cost Estimating.
W82-01076 5D

Treatability Manual; Volume V. Summary.
W82-01077 5D

WASTEWATER TREATMENT FACILITIES
Scott Brings Unique $25-Million Waste Treatment Facilities On-Line,
W82-01007 5D

WATER
Determination of Terbutryn and its Degradation Products in Water, Sediments, Aquatic Plants, and Fish,
W82-00567 5A

WATER ALLOCATION
The Azov Sea Problem,
W82-00651 6G

Game Theory Analyses Applied to Water Resource Problems,
W82-00802 6A

WATER ANALYSIS
Gas Chromatographic Determination of Trialkyl/Aryl Phosphates in Drinking Water, Following Isolation Using Macroreticular Resin,
W82-00502 5A

Adsorption as a Control of Metal Concentrations in Sediment Extracts,
W82-00614 5A

Evaluation of Standard and Modified M-FC, Macconkey, and Teepol Media for Membrane Filtration Counting of Fecal Coliforms in Water,
W82-00644 5A

Modification of the Standard Most-Probable-Number Procedure for Fecal Coliform Bacteria in Seawater and Shellfish,
W82-00646 5A

New Liquid Chromatographic Detection System for Environmental Pollutants,
W82-00740 5A

Interim Method for Determining Asbestos in Water,
W82-00741 5A

Simultaneous Determination of Iron, Cadmium, Zinc, Copper, Nickel, Lead, and Uranium in Seawater by Stable Isotope Dilution Spark Source Mass Spectrometry,
W82-00786 5A

A Reduction-Spectrophotometric Method for the Determination of Sulphate in Waters,
W82-00850 5A

Methods of Investigating the State of Metal Ions in Natural Waters,
W82-00859 5A

Heavy Metal Concentrations in the Holston River Basin (Tennessee),
W82-00959 5A

Determination of Alkaline Earth and Divalent Transition Metal Cations by Ion Chromatography with Sulfate-Suppressed Barium and Lead Eluents,
W82-01082 5A

Water Hardness Determination by the Catalytic Polarographic Wave of Magnesium Ion,
W82-01083 5A

Determination of Chromium Speciation in Natural Waters by Electrodeposition on Graphite Tubes for Electrothermal Atomization,
W82-01084 5A

Multielement Preconcentration of Trace Heavy Metals in Water by Coprecipitation and Flotation with Indium Hydroxide for Inductively Coupled Plasma-Atomic Emission Spectrometry,
W82-01097 5A

Determination of Molybdenum in Sea and Estuarine Water with Beta-Naphthoin Oxime and Neutron Activation,
W82-01098 5A

Determination of Nickel by Differential Pulse Polarography at a Dropping Mercury Electrode,
W82-01100 5A

WATER CIRCULATION
Water Movement for Water Quality in Catfish Production,
W82-00866 5G

Mean Summer Circulation in Lake Ontario Within the Coastal Zone,
W82-00967 2H

WATER CONSERVATION
The Declining Ground-Water Resources of Alluvial Valleys: A Case Study,
W82-00832 4B

Ground-Water Use for Cooling: Associated Aquifer Temperature Changes,
W82-01014 3E

WATER DEMAND
Price Elasticities for Water: A Case of Increasing Block Rates,
W82-00536 6C

Water Resources Appraisal for Hydroelectric Licensing: Jordan River Basin, Utah.
W82-00736 6D

State Water Use and Socioeconomic Data Related to the Second National Water Assessment,
W82-00739 6D

Tampa Bay Water Guarded by Computer,
W82-00934 4B

Health Aspects of Urban Water Conservation,
W82-01047 3C

WATER DEPTH
Depths of Flow in Level Basins,
W82-00900 3F

Factors Controlling Phytoplankton Primary Productivity in Byram Lake, Mt. Kisco, N.Y., Summer, 1977,
W82-00915 2H

WATER LAW
Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in Illinois.
W82-00719 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Rhode Island.
W82-00720 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New Hampshire.
W82-00721 6E

WATER LEVEL
Approximate Ground-Water-Level Contours, April 1981, for the Soquel-Aptos Area, Santa Cruz County, California,
W82-00734 7C

A Method for Estimating Recharge and Boundary Flux from Groundwater Level Observations,
W82-00985 2F

WATER LOSS
Operational Evaluation of Village Level Irrigation Conveyance Systems,
W82-00696 3F

WATER MAINS
Factors Influencing the Occurrence of Bursts in Iron Water Mains,
W82-00960 8A

WATER MANAGEMENT
The Azov Sea Problem,
W82-00651 6G

Proposed Water Quality Control Plan for Indio Subarea of the Whitewater Hydrologic Unit, West Colorado River Basin.
W82-00716 6F

The U.S. Geological Survey Federal-State Cooperative Water Resources Program,
W82-00735 6B

Potential Eutrophication of the Rideau River by an Urban Drainage Waterway,
W82-00834 5C

Management of Recharge Basins on the Southern High Plains,
W82-00938 4B

WATER POLICY

Arkansas Water Policy.
W82-00715 6D

Potential Political Influences Affecting the Water Industry,
W82-00861 6C

WATER POLLUTION

Aquasols: The Behavior of Small Particles in Aquatic Systems,
W82-00540 1B

Trace Element Inputs From a Coal Burning Power Plant to Adjacent Terrestrial and Aquatic Environments,
W82-00557 5B

Human Health Hazards Associated With Chemical Contamination of Aquatic Environment,
W82-00632 5C

Effects of a Cattleskin Tannery of Stream Quality and Benthic Macroinvertebrates in Central Maine,
W82-00872 5C

Occurrence of Tetraalkylead Compounds in the Aquatic Environment,
W82-00878 5A

WATER POLLUTION CONTROL

The Distribution of the Costs of Federal Water Pollution Control Policy,
W82-00537 6B

Preliminary Pollutant Limit Values for Human Health Effects,
W82-00628 5G

Trace Metal Catalysis in Aquatic Environments,
W82-00629 5B

Receiving Stream Fisheries Studies Relative to Secondary Treated Pulp and Paper Mill Effluents,
W82-00688 5C

Evaluation of Stripmine Sediment Detention Basins in Kentucky,
W82-00893 5G

Experience Gained with the U.S. Pollution Control Policies,
W82-00996 6E

Effects of Nitrapyrin on Nitrate Movement in Soil Columns,
W82-01048 5G

Groundwater Pollution in Kentucky: A Status Report,
W82-01053 4B

Treatability Manual; Volume I. Treatability Data.
W82-01073 5D

Treatability Manual; Volume III. Technologies for Control/Removal of Pollutants.
W82-01075 5D

Treatability Manual; Volume V. Summary.
W82-01077 5D

WATER POLLUTION EFFECTS

Effect of Metals on the Biomass Production Kinetics of Freshwater Copepods,
W82-00593 5C

Receiving Stream Fisheries Studies Relative to Secondary Treated Pulp and Paper Mill Effluents,
W82-00688 5C

The Relationship of Environmental Epidemiology to Water and Wastewater Plant Operators,
W82-00789 5C

A Rapid Simple Long-Term Toxicity Assay for Aquatic Contaminants Using the Nematode Panagrellus Redivivus,
W82-01017 5A

An Assessment of the Trophic Status of Deer, Loon, and Diamond Lakes,
W82-01072 2H

WATER POLLUTION SOURCES

Aromatic Amines in and Near the Buffalo River,
W82-00622 5B

Assessment of Airborne Organic Contaminants in the Great Lakes Ecosystem,
W82-00709 5B

Assessment of Airborne Inorganic Contaminants in the Great Lakes,
W82-00710 5B

Wilson Creek Drainage - Surface and Ground Water Quality, July 1978 to July 1979.
W82-01069 5B

WATER POLLUTION TREATMENT

System for Oil and Water Separation,
W82-00611 5D

WATER POTENTIALS

The Effect of Environmental Uncertainty on Morphological Design and Fluid Balance in Sarracenia Purpurea L.,
W82-00811 2I

Investigations of Control Mechanisms of Germination Under Water Stress,
W82-00912 2I

WATER PURIFICATION

The Removal of Organic Matter from Demineralised Water,
W82-00888 5F

WATER QUALITY

Diel Variations of Selected Physico-Chemical Parameters in Lake Kissimmee, Florida,
W82-00535 2H

Phosphorus Management for the Great Lakes: Final Report of the Phosphorus Management Strategies Task Force,
W82-00702 6E

Health Implications of Non-NTA Detergent Builders,
W82-00703 5G

Ecological Effects of Non-Phosphate Detergent Builders: Final Report on Organic Builders other than NTA,
W82-00704 5G

Report of the Aquatic Ecosystem Objectives Committee,
W82-00705 5G

1980 Annual Report, Committee on the Assessment of Human Health Effects of Great Lakes Water Quality,
W82-00706 5C

1980 Report on Great Lakes Water Quality - Appendix,
W82-00708 5C

Summary Appraisal of Water Resources in the Redmond Quadrangle, Sanpete and Sevier Counties, Utah,
W82-00725 7C

Water Resources Data for Illinois, Water Year 1980--Volume 1. Illinois Except Illinois River Basin.
W82-00731 7C

Water Resources Data for Illinois, Water Year 1980--Volume 2. Illinois River Basin.
W82-00732 7C

Water Resources Data for Utah, Water Year 1980.
W82-00733 7C

A Portable Pump Sampler for Lotic Periphyton,
W82-00826 7B

Limnological Characteristics of Several Lakes on the Lake Wales Ridge, South-Central Florida,
W82-00914 2H

Influence of Phosphorus Loads and of Some Limnological Processes on the Purity of Lake Water,
W82-00923 2H

Macrobenthos of Pine Island Bayou in the Big Thicket National Preserve, Texas,
W82-00924 5C

Effectiveness of River Models,
W82-00961 6A

Giardia Prevalence in Commercially Trapped Mammals,
W82-01046 5A

Water Chemistry Changes During Artificial Aeration of Spruce Knob Lake, West Virginia,
W82-01049 5G

WATER QUALITY ASSOCIATION

Point-of-Use Water Treatment...An Enlarging Reality,
W82-00784 10D

WATER QUALITY CONTROL

European Communities Directive Relating to the Quality of Water Intended for Human Consumption,
W82-00506 6D

Does Improved Waste Treatment Have Demonstrable Biological Benefits,
W82-00779 5C

Point-of-Use Water Treatment...An Enlarging Reality,
W82-00784 10D

Water Quality Management in River Basins: US National Experience,
W82-00800 6E

Water Movement for Water Quality in Catfish Production,
W82-00866 5G

Water Quality Evaluation of Regional Wastewater Management,
W82-00977 5D

State of Washington Water Quality Assessment Report 1980.
W82-01067 6E

An Intangible Benefit of Water Pollution Control Programs,
W82-01092 6B

WATER QUALITY MANAGEMENT
Potential Management of Florida Red Tide Through Selective Photodynamic Action,
W82-00515 5G

A Procedure Using Modeling and Error Analysis for the Prediction of Lake Phosphorus Concentration from Land Use Information,
W82-00546 5G

Modeling the Transformation of Nitrogen Compounds for Water-Quality Management in Streams,
W82-00598 6A

Great Lakes International Surveillance Plan,
W82-00701 6E

Dryland Management for Salinity Control,
W82-01018 2G

State of Washington Water Quality Assessment Report 1980.
W82-01067 6E

Water Quality Conditions in the Bellingham Bay Area 1979-1980,
W82-01068 5B

WATER QUALITY STANDARDS
Preliminary Pollutant Limit Values for Human Health Effects,
W82-00628 5G

Great Lakes International Surveillance Plan,
W82-00701 6E

Assessment of Water Quality Conditions in Skamokawa Creek, Washington,
W82-01066 5C

State of Washington Water Quality Assessment Report 1980.
W82-01067 6E

WATER RATES
Price Elasticities for Water: A Case of Increasing Block Rates,
W82-00536 6C

WATER RECLAMATION
Massive Cultivation of Microalgae: Results and Prospects,
W82-00913 5D

WATER RECOVERY
Growth of the Bay Scallop, Argopecten Irradians, in a Waste Recycling Aquaculture System,
W82-00842 3C

WATER REQUIREMENTS
Temperature and Water Relation Patterns in Subalpine Understory Plants,
W82-00760 2I

Comparative Field Water Relations of Four Co-Occuring Chaparral Shrub Species,
W82-00762 2I

Water Requirement for Sugarcane Production,
W82-00899 3F

WATER RESOURCES DEVELOPMENT
Evaluation of the Oldman River Basin Irrigation Proposals: Implications for Interbasin Transfers,
W82-00519 6B

The Caspian Sea Problem,
W82-00657 4A

Richards Bay: An Ecological Dilemma,
W82-00679 6A

Environmental Aspects of Rural Development with Particular Reference to the Keiskamma River Basin Study,
W82-00685 6D

Arkansas Water Policy.
W82-00715 6D

Water Resources Appraisal for Hydroelectric Licensing: Jordan River Basin, Utah.
W82-00736 6D

Game Theory Analyses Applied to Water Resource Problems,
W82-00802 6A

Tampa Bay Water Guarded by Computer,
W82-00934 4B

Great Lakes Environmental Protection Policies from a Fisheries Perspective,
W82-00978 6G

WATER RESOURCES MANAGEMENT
Interpreting Dynamics of Aquatic Resources: A Perspective for Resource Managers,
W82-00539 6A

WATER REUSE
Recycling Urban Stormwater for Profit,
W82-00524 3C

The Cape Flats Sewage Treatment Works,
W82-00957 5D

Environmental Effects of Water Reuse Scheme,
W82-00973 3C

Health Aspects of Urban Water Conservation,
W82-01047 3C

WATER RIGHTS
Executive Summary; Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in the Seven Mid-Western States.
W82-00718 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Indiana.
W82-00748 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Ohio.
W82-00749 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Pennsylvania.
W82-00752 6E

WATER SAMPLING
A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
W82-00532 5A

Sampling Ground Water for Organic Contaminants,
W82-00820 5A

Assessment of Some Aqueous Residual Chlorine Measurements,
W82-00867 5F

Determination of Polyhalogenated Phenolic Compounds in Drinking Water, Human Blood Serum and Adipose Tissue,
W82-00879 5A

Grab Versus Composite Sampling: A Primer for the Manager and Engineer,
W82-00891 5A

WATER SOFTENING
Home Water Softeners, Water Softness and Possible Health Implications,
W82-01045 5F

WATER STORAGE
Good Looks, Low Maintenance Guide Water Tank Choice,
W82-00868 5A

WATER STRESS
Water Relations of Three Cowpea Cultivars (Vigna Unguiculata L.),
W82-00607 2I

Growth and Nitrogen Fixation of Aeschynomene Under Water Stressed Conditions,
W82-00758 2I

Plant-Water Relations and Adaptation to Stress,
W82-00812 2I

Investigations of Control Mechanisms of Germination Under Water Stress,
W82-00912 2I

The Manifestation of Dehydration Avoidance in Wheat Breeding Germplasm,
W82-00958 2I

Water Relations, Soil Fertility, and Plant Nutrient Composition of a Pygmy Oak Ecosystem,
W82-01034 2I

WATER SUPPLY
Environmental Virology and its Problems,
W82-00505 5A

Water-Treatment Chemicals,
W82-00618 5F

State Water Use and Socioeconomic Data Related to the Second National Water Assessment,
W82-00739 6D

Design and Construction of the Danvers, Massachusetts Water Processing Plant,
W82-01088 5F

WATER SUPPLY DEVELOPMENT
Long Distance Mass Transfer of Water,
W82-00858 6D

Dryland Cropping Strategies for Efficient Water-Use to Control Saline Seeps in the Northern Great Plains, U.S.A.,
W82-01023 3F

WATER TABLE
The Effect of Height of Water Table on the Growth of Holcus Lanatus With Reference to Lolium Perenne,
W82-00654 2I

Watertable Management Saves Water and Energy,
W82-00943 3F

WATER TANKS
Good Looks, Low Maintenance Guide Water Tank Choice,
W82-00868 5A

WATER TRANSFER
Long Distance Mass Transfer of Water,
W82-00858 6D

WATER TRANSPORT
The Waterway That Cannot be Stopped,
W82-00510 6E

Moisture Transport in a Soil-Plant System: A Mathematical Model and Finite Element Analysis,
W82-00648 2I

Long Distance Mass Transfer of Water,
W82-00858 6D

WATER TREATMENT
Detoxification of Residual Quaternaries,
W82-00562 5G

Chrysotile Asbestos Fiber Removal During Potable Water Treatment. Pilot Plant Studies,
W82-00613 5F

Water-Treatment Chemicals,
W82-00618 5F

Adsorption on Carbon: Solvent Effects on Adsorption,
W82-00619 5F

Acute and Chronic Effects of Alum to Midge Larva (Diptera: Chironomidae),
W82-00650 5F

Flocculation of Clay Particles with a Synthetic Anionic Polymer,
W82-00773 5F

Removal of Nitrate from Public Water Supply Abstractions,
W82-00774 5F

Point-of-Use Water Treatment...An Enlarging Reality,
W82-00784 10D

Assessment of Some Aqueous Residual Chlorine Measurements,
W82-00867 5F

Facts Fix Fund Finding,
W82-00885 9A

Low Turbidity Water from Fast Processes,
W82-00946 5F

Removing Trihalomethanes from Drinking Water,
W82-00953 5F

Ferric Chloride Takes Over,
W82-00954 5F

Economic Analysis of Granular-Bed Filtration,
W82-00975 5F

WATER TREATMENT FACILITIES

Foam Control in Aeration Tanks,
W82-00525 5D

Empire Controlled by Computer,
W82-00529 5D

Mixing Technology Reduces Energy Use,
W82-00634 5D

Design and Construction of the Danvers, Massachusetts Water Processing Plant,
W82-01088 5F

WATER USE

Water - Its Use and the Implications for Arkansas Agriculture.
W82-00714 6D

Proposed Water Quality Control Plan for Indio Subarea of the Whitewater Hydrologic Unit, West Colorado River Basin.
W82-00716 6F

State Water Use and Socioeconomic Data Related to the Second National Water Assessment,
W82-00739 6D

WATER USE EFFICIENCY

Yield and Water Use of Vegetable Crops with Seepage and Drip Irrigation Systems,
W82-00544 3F

WATER VAPOR

Gravitational Stability of Water Over Steam in Vapor-Dominated Geothermal Systems,
W82-00963 1A

WATERSHED MANAGEMENT

Multivariate Hydrologic Time Series Analysis,
W82-00647 2A

Answers: A Model for Watershed Planning,
W82-00898 6A

WATERSHEDS

Simulation of Lake-Watershed Systems, I. Description and Sensitivity Analysis of the Model,
W82-00926 2A

Simulation of Lake-Watershed Systems, II. Application to Baptiste Lake, Alberta, Canada,
W82-00927 2A

Nutrient Budget Studies for Forests Along an Elevational Gradient in New Mexico,
W82-01036 2K

WEATHER FORECASTING

Relation of Satellite-Based Thunderstorm Intensity to Radar-Estimated Rainfall,
W82-00806 2B

WEATHER MODIFICATION

Seeding-Opportunity Recognition in Winter Orographic Clouds,
W82-01005 3B

WEED CONTROL

Control of Water Weeds by Grass Carp in Two Small Lakes,
W82-00609 3B

WELL WATER

A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
W82-00532 5A

WELLS

Well-Field Drawdowns Using Coupled Aquifer Model,
W82-00990 2F

WEST POINT RESERVOIR

Gonad Development, Fecundity, and Spawning Season of Largemouth Bass in Newly Impounded West Point Reservoir, Alabama-Georgia,
W82-01080 2H

WEST VIRGINIA

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in West Virginia.
W82-00753 6E

The Use of Algal Assays and Chlorophyll Concentrations to Determine Fertility of Water in Small Impoundments in West Virginia,
W82-00919 2H

Vegetational Analysis of Big Run Bog, A Nonglaciated Sphagnum Bog in West Virginia,
W82-00992 2I

Ground Water Problems in West Virginia,
W82-01060 4B

WETLANDS

The Changing Status of Reedswamp in the Norfolk Broads,
W82-00691 5C

Quantitative Assessment of Tidal Wetlands Using Remote Sensing,
W82-00781 7B

Federal Participation in Land Use Decision-Making at the Water's Edge--Floodplains and Wetlands,
W82-00799 6E

Effects of Temperature, pH, Salinity, and Inorganic Nitrogen on the Rate of Ammonium Oxidation by Nitrifiers Isolated from Wetland Environments,
W82-00910 2L

WHEAT

The Manifestation of Dehydration Avoidance in Wheat Breeding Germplasm,
W82-00958 2I

WILCOX-CARRIZO AQUIFER

Potentiometric Surface of the Wilcox-Carrizo Aquifer; Bienville, Red River, Northern Natchitoches, and Southern Webster Parishes, Louisana,
W82-00728 7C

WILDLIFE REFUGES

Managing Oil and Gas Activities in Coastal Environments: Refuge Manual,
W82-01081 5G

WILSON CREEK

Wilson Creek Drainage - Surface and Ground Water Quality, July 1978 to July 1979.
W82-01069 5B

WISCONSIN

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in Wisconsin.
W82-00746 6E

Interstate Conflict Over Ground Water: Wisconsin-Illinois,
W82-00818 6E

Predictive Depositional Model for Glacial Aquifers,
W82-00828 2F

WOOD WASTES

Conversion of Abienol into Tetrahydroepimanool by Anaerobic Processes in Woodroom Debarking Effluent,
W82-00860 5C

YUCATAN PENINSULA

Chemical Mass-Wasting of the Northern Yucatan Peninsula by Groundwater Dissolution,
W82-01015 2K

ZEOLITES

Sedimentation of Zeolite Type A in Water and Waste Water,
W82-00848 5D

ZINC

Acute Toxicity of Zinc to Some Fishes in High Alkalinity Water,
W82-00713 5C

Aquatic Mosses as Monitors of Heavy Metal Contamination in the River Etherow, Great Britain,
W82-00787 5A

The Impact of an Industrially Contaminated Lake on Heavy Metal Levels in it's Effluent Stream,
W82-00886 5B

ZOOPLANKTON

Assessment of Thermal Discharges on Zooplankton in Conowingo Pond, Pennsylvania,
W82-00592 5C

Potential Impact of Size-Selective Planktivory on Phosphorus Release by Zooplankton,
W82-00825 2H

AUTHOR INDEX

ABDEL-MALIK, W. E.
Retention of Radionuclides by Some Aquatic Fresh Water Plants,
W82-00853 5B

ABDOU, F. M.
Effect of Irrigating Loamy Sand Soil by Liquid Sewage Sludge on its Content of some Micronutrients,
W82-00661 5E

ABE, J. M.
Potentiometric-Surface Map for the Cretaceous Aquifer, Virginia Coastal Plain, 1978,
W82-00727 7C

ACHER, A. J.
Dye-Sensitized Photooxidation of Bromacil in Water,
W82-00514 5B

ADAMOWSKI, K.
Multivariate Hydrologic Time Series Analysis,
W82-00647 2A

Potential Eutrophication of the Rideau River by an Urban Drainage Waterway,
W82-00834 5C

ADAMS, B. J.
Water Quality Evaluation of Regional Wastewater Management,
W82-00977 5D

ADAMS, T. G.
The Impact of an Industrially Contaminated Lake on Heavy Metal Levels in it's Effluent Stream,
W82-00886 5B

ADAMS, W. J.
An Environmental Safety Assessment of Butyl Benzyl Phthalate,
W82-00615 5A

ADLER, R. F.
Relation of Satellite-Based Thunderstorm Intensity to Radar-Estimated Rainfall,
W82-00806 2B

AGIRALIOGLU, N.
Overland Flow on a Diverging Surface,
W82-00986 2A

AGTHE, D. E.
Price Elasticities for Water: A Case of Increasing Block Rates,
W82-00536 6C

AIKEN, H. V.
Tampa Bay Water Guarded by Computer,
W82-00934 4B

ALARIE, R. L.
Simulation Modeling of Primary Clarifiers,
W82-01027 6A

ALAWI, B. J.
Quality of Irrigation Water and Effects of Sulfuric Acid and Gypsum on Soil Properties and Sundangrass Yields,
W82-00767 3C

ALBEN, K.
Coal Tar Coatings of Storage Tanks. A Source of Contamination of the Potable Water Supply,
W82-00616 5B

ALBRECHT, S. L.
Growth and Nitrogen Fixation of Aeschynomene Under Water Stressed Conditions,
W82-00758 2I

ALBRIGHT, L. J.
Residues in Cutthroat Trout (Salmo Clarki) and California Newts (Tarichia Torosa) From a Lake Treated With Technical Chlordane,
W82-00558 5C

ALESII, B. A.
Effect of Leachate Flow Rate on Metal Migration Through Soil,
W82-00565 5E

ALEXANDER, M.
Formation of N-Nitrosodiethanolamine from Diethanolamine in Lake Water and Sewage,
W82-00796 5A

Microbial Metabolism of N-Nitrosodiethanolamine in Lake Water and Sewage,
W82-00585 2H

ALLEN, H. E.
Assessment of Airborne Inorganic Contaminants in the Great Lakes,
W82-00710 5B

Metal Speciation. Effects on Aquatic Toxicity,
W82-00610 5A

ALLEN, J. L.
Residues of Isobornyl Thiocyanoacetate (Thanite) and a Metabolite in Fish and Treated Ponds,
W82-00570 5B

ALONSO, J. M.
New Waterborne Bacteriophages Active on Yersinia Enterocolitica,
W82-00662 5A

AMAVIS, R.
European Communities Directive Relating to the Quality of Water Intended for Human Consumption,
W82-00506 6D

AMEL, R. T.
Residues of Isobornyl Thiocyanoacetate (Thanite) and a Metabolite in Fish and Treated Ponds,
W82-00570 5B

AMY, G. L.
Groundwater Leaching of Organic Pollutants From in Situ Retorted Oil Shale. A Mass Transfer Analysis,
W82-00626 5B

ANAND REDDY, K.
Consumptive Use and Daily Evapotranspiration of Corn Under Different Levels of Nitrogen and Moisture Regimes,
W82-00660 2D

ANDERSON, C. H.
Interim Method for Determining Asbestos in Water,
W82-00741 5A

ANDERSON, J. A.
Water Stress and Cold Hardiness in Field-Grown Citrus,
W82-00864 2I

ANDERSON, M. P.
Groundwater Quality Models - State of the Art,
W82-01061 5G

ANDERSON, R. Y.
Dissolution of Salt Deposits by Brine Density Flow,
W82-01016 2F

ANDERSON, T. J.
Determination of Picogram Amounts of Technetium-99 by Resin Bead Mass Spectrometric Isotope Dilution,
W82-00999 5A

ANDRASKI, B.
Sample Intake Position and Loading Rates from Nonpoint Source Pollution,
W82-00778 5A

ANEJA, V. P.
Influence of Gaseous Nitric Acid on Sulfate Production and Acidity in Rain,
W82-00642 5B

ANNANDALE, G. W.
Settlement of a Compacted Unsaturated Earth Embankment,
W82-00678 8D

APLAND, J.
Risk and the Demand for Supplemental Irrigation: A Case Study in the Corn Belt,
W82-00522 6A

ARMSTRONG, J. L.
Antibiotic-Resistant Bacteria in Drinking Water,
W82-00645 5F

ARMSTRONG, R. N.
Tampa Bay Water Guarded by Computer,
W82-00934 4B

ARNOTT, E.
A Rapid Simple Long-Term Toxicity Assay for Aquatic Contaminants Using the Nematode Panagrellus Redivivus,
W82-01017 5A

ASHLEY, C. S.
Effects of Wastewater Sludge and Its Detergents on the Stability of Rotavirus,
W82-00576 5A

ATCHISON, G. J.
The Effects of Heavy Metals on Microbial Biomass in Sediments of Palestine Lake,
W82-00925 5C

The Impact of an Industrially Contaminated Lake on Heavy Metal Levels in it's Effluent Stream,
W82-00886 5B

ATHERTON, T. AND
Low Turbidity Water from Fast Processes,
W82-00946 5F

AUGUSTINE, J. A.
Satellite Rain Estimation in the U.S. High Plains,
W82-00808 2B

AVNIMELECH, Y.
A Method for the Evaluation of Conditions in a Fish Pond Sediment,
W82-01019 2H

BABA, M.
Multielement Preconcentration of Trace Heavy Metals in Water by Coprecipitation and Flotation with Indium Hydroxide for Inductively Coupled Plasma-Atomic Emission Spectrometry,
W82-01097 5A

BABALOLA, O.
Water Relations of Three Cowpea Cultivars (Vigna Unguiculata L.),
W82-00607 2I

BACK, W.
Chemical Mass-Wasting of the Northern Yucatan Peninsula by Groundwater Dissolution,
W82-01015 2K

BAILEY, G. C.
Acute and Chronic Effects of Alum to Midge Larva (Diptera: Chironomidae),
W82-00650 5F

BAIN, W. S.
A New Look at Design of Raw Water Piping,
W82-01029 8A

BAIR, E. S.
Numerical Simulation of Potentiometric Surface Changes Caused by a Proposed Open-Pit Anthracite Mine,
W82-00819 6A

BAKER, S. J.
Acidity Fluctuations at a Broadland Site in Norfolk,
W82-00656 2K

BANNING, D.
Enrichment of the Agricultural Herbicide Atrazine in the Microsurface Water of an Estuary,
W82-00877 5B

BARICA, J.
Experimental Manipulation of Algal Bloom Composition by Nitrogen Addition,
W82-00998 5C

Relationship Between Thermal Stability and Summer Oxygen Depletion in a Prairie Pothole Lake,
W82-00545 2H

BARKO, J. W.
Sediment-Based Nutrition of Submersed Macrophytes,
W82-00843 2H

BARLTROP, J.
Potential Management of Florida Red Tide Through Selective Photodynamic Action,
W82-00515 5G

BARQUET, A.
Determination of Polyhalogenated Phenolic Compounds in Drinking Water, Human Blood Serum and Adipose Tissue,
W82-00879 5A

BARROW, E. T.
Sources and Control of Organic Air Pollutants,
W82-00711 5B

BARTELL, S. M.
Potential Impact of Size-Selective Planktivory on Phosphorus Release by Zooplankton,
W82-00825 2H

BARTLETT, D. S.
Quantitative Assessment of Tidal Wetlands Using Remote Sensing,
W82-00781 7B

BATES, T.
Evaluation of Winter Application of Liquid Sludge to Farmland,
W82-00952 5B

BATLEY, G. E.
Adsorption as a Control of Metal Concentrations in Sediment Extracts,
W82-00614 5A

Determination of Chromium Speciation in Natural Waters by Electrodeposition on Graphite Tubes for Electrothermal Atomization,
W82-01084 5A

BAUGHMAN, G. L.
Correlation of Microbial Degradation Rates With Chemical Structure,
W82-00621 2K

BAUMGARDNER, R. W.
Interpretation of Surface-Water Circulation, Aransas Pass, Texas, Using Landsat Imagery,
W82-00904 7B

BAXTER, M. S.
Evidence of the Unsuitability of Gravity Coring for Collecting Sediment in Pollution and Sedimentation Rate Studies,
W82-00840 7B

BAZZAZ, F. A.
Photosynthesis and Growth in Populations of Populus Deltoides from Constrating Habitats,
W82-00935 2I

BEALL, M. L. JR.
Distribution of Silvex, 2,4-D, and TCDD Applied to Turf in Chambers and Field Plots,
W82-00568 5B

BEAR, J.
A Mathematical Model for Consolidation in a Thermoelastic Aquifer Due to Hot Water Injection or Pumping,
W82-00602 2F

BEASLEY, D. B.
Answers: A Model for Watershed Planning,
W82-00898 6A

BECKER, R. M.
Cation Chromatography With a Conductivity Detector,
W82-00582 5A

BEECH, J. A.
Are Metals from Highway Dustfall Hazardous in Swimming Pools,
W82-01093 5B

BEGG, J. E.
Plant-Water Relations and Adaptation to Stress,
W82-00812 2I

BELL, F. C.
Effects of Recent Increases in Rainfall on Floods and Runoff in the Upper Hunter Valley,
W82-00668 2E

BELL, J. B.
R Factors in Coliform-Fecal Coliform Sewage Flora of the Prairies and Northwest Territories of Canada,
W82-00508 5A

BELLUCK, D.
Bioconcentration of Pesticides by Egg Masses of the Caddisfly, Triaenodes Tardus Milne,
W82-00982 5B

BELYAKOVA, O. V.
Model of the Seasonal Dynamics of an Ecosystem of a Shallow Lake,
W82-00552 2H

BENDER, M. E.
Kepone in the James River,
W82-00631 5B

BENFIELD, E. F.
Preference-Avoidance Reactions of Crayfish to Sublethal Concentrations of Cadmium,
W82-00916 5A

BENGERT, G. A.
Occurrence of Tetraalkylead Compounds in the Aquatic Environment,
W82-00878 5A

BENNETT, J. M.
Growth and Nitrogen Fixation of Aeschynomene Under Water Stressed Conditions,
W82-00758 2I

BENOIT, F. M.
Gas Chromatographic Determination of Trialkyl/Aryl Phosphates in Drinking Water, Following Isolation Using Macroreticular Resin,
W82-00502 5A

BENZ, L. C.
Watertable Management Saves Water and Energy,
W82-00943 3F

BERG, G.
Destruction by Anaerobic Mesophilic and Thermophilic Digestion of Viruses and Indicator Bacteria Indigenous to Domestic Sludges,
W82-00580 5A

BERGATINO, R. N.
Saline Seep Development and Control in the North American Great Plains - Hydrogeological Aspects,
W82-01022 5B

BERGER, J.
Effect of Crude Oil and Petroleum-Degrading Microorganisms on the Growth of Freshwater and Soil Protozoa,
W82-00517 5C

BERGERON, M. P.
The Relationship Between Fracture Traces and Joints in a Tertiary Basin, Southwest Montana,
W82-00829 7B

BERMAN, D.
Destruction by Anaerobic Mesophilic and Thermophilic Digestion of Viruses and Indicator Bacteria Indigenous to Domestic Sludges,
W82-00580 5A

BERMAN, S. S.
Comparison of Methods for the Determination of Trace Elements in Seawater,
W82-01086 5A

BERMAN, T.
Methane Formation in the Acid Peats of Okefenokee Swamp, Georgia,
W82-00936 2H

BERNHARDT, J. C.
Effects of Renton Wastewater Treatment Plant Effluent on Water Quality of the Lower Green/Duwamish River,
W82-01063 5D

BERSELL, P. O.
Factors Influencing Fish Distribution in Two Desert Reservoirs, Central Arizona,
W82-00814 2H

BEST, B. R.
Kinetics of Nitrate and Ammonium Uptake by the Tropical Freshwater Macrophyte Pistia Stratiotes L.,
W82-00937 5D

BESZEDITS, S.
Feeding Animals Activated Sludge,
W82-00523 5D

BHAT, RAMA S.
A Reduction-Spectrophotometric Method for the Determination of Sulphate in Waters,
W82-00850 5A

BIGGS, D. C.
Uptake of Polychlorinated Biphenyls by Natural Phytoplankton Assemblages: Field and Laboratory Determination of C14-PCB Particle-Water Index of Sorption,
W82-01032 5B

BILLINGS, R. B.
Price Elasticities for Water: A Case of Increasing Block Rates,
W82-00536 6C

BILYJ, B.
Sampling Emerging Chironomidae (Diptera) With Submerged Funnel Traps in a New Northern Canadian Reservoir, Southern Indian Lake, Manitoba,
W82-00520 2H

BIRCH, R. B.
Nitrogen and Phosphorus Recycling in Lake Sammamish, A Temperate Mesotrophic Lake,
W82-00824 2H

BISHOP, C. S.
Health Aspects of Urban Water Conservation,
W82-01047 3C

BISHOP, D. F.
Toxics in Municipal and Industrial Wastewaters,
W82-00712 5A

BISWAS, A. K.
Long Distance Mass Transfer of Water,
W82-00858 6D

BITONDO, M.
Cold Weather Waste Treatment,
W82-00636 5D

BLACK, A. L.
Dryland Cropping Strategies for Efficient Water-Use to Control Saline Seeps in the Northern Great Plains, U.S.A.,
W82-01023 3F

BLACK, J. H.
Determination of Hydrogeological Parameters Using Sinusoidal Pressure Tests: A Theoretical Appraisal,
W82-00603 7B

BLAIR, J. F.
2,500 Acres of Wastewater Irrigation,
W82-00769 3C

BLENCH, T.
Graphed Equilibrium Parameters of Channels Formed in Sediment,
W82-00881 2J

BLEVINS, R. D.
Heavy Metal Concentrations in the Holston River Basin (Tennessee),
W82-00959 5A

BLIGHT, G. E.
Settlement of a Compacted Unsaturated Earth Embankment,
W82-00678 8D

BLINN, D. W.
A Portable Pump Sampler for Lotic Periphyton,
W82-00826 7B

BLOCK, J. C.
Simultaneous Concentration of Salmonella and Enterovirus From Surface Water by Using Micro-Fiber Glass Filters,
W82-00573 5A

BLOMQVIST, S.
A Review on Sediment Traps in Aquatic Environments,
W82-01020 7B

BLOYD, R. M.
Approximate Ground-Water-Level Contours, April 1981, for the Soquel-Aptos Area, Santa Cruz County, California,
W82-00734 7C

BLUM, A.
The Manifestation of Dehydration Avoidance in Wheat Breeding Germplasm,
W82-00958 2I

BOESEL, M. W.
Insect Community Structure as an Index of Heavy-Metal Pollution in Lotic Ecosystems,
W82-00596 5C

BOGARDI, I.
Reliability of Underground Flood Control System,
W82-00556 8A

BONNET, L.
Isolation and Identification of Pathogenic Microorganisms at Wastewater-Irrigated Fields: Ratios in Air and Wastewater,
W82-00579 5A

BOONE, D. R.
Formulating Alternatives for Environmental Studies,
W82-00997 6G

BOORMAN, L. A.
The Changing Status of Reedswamp in the Norfolk Broads,
W82-00691 5C

BORENZSTAJN-ROTEM, Y.
Isolation and Identification of Pathogenic Microorganisms at Wastewater-Irrigated Fields: Ratios in Air and Wastewater,
W82-00579 5A

BORGMANN, U.
Effect of Metals on the Biomass Production Kinetics of Freshwater Copepods,
W82-00593 5C

BOTHWELL, M. L.
Aluminum Shadowing-Direct Projection Photomicroscopy of Diatom Frustules,
W82-00884 5A

BOTTCHER, A. B.
Subsurface Drainage and Sediment Transport Model,
W82-00894 2G

BOURQUE, H.
Absorption of Fenitrothion by Plankton and Benthic Algae,
W82-00874 5B

BOWEN, R.
Direct Filtration Studies at Traverse City Water Treatment Plant,
W82-00945 5F

BOWER, R. F.
Potentiometric-Surface Map for the Cretaceous Aquifer, Virginia Coastal Plain, 1978,
W82-00727 7C

BOWERS, S. A.
Operational Evaluation of Village Level Irrigation Conveyance Systems,
W82-00696 3F

BOWERSOX, V. C.
Analysis of Precipitation Chemistry at a Central Pennsylvania Site,
W82-00980 2K

BOWMAN, C. F.
A New Look at Design of Raw Water Piping,
W82-01029 8A

BOYD, C. E.
Effects of Ion-Pairing on Calculations of Ionic Activities of Major Ions in Freshwater,
W82-00823 2K

BOYLE, M. V.
Effect of Leachate Flow Rate on Metal Migration Through Soil,
W82-00565 5E

BOYLE, V. J.
Bacterial DNA Repair Assay of Selected Compounds in Pulp and Paper Mill Effluents,
W82-00687 5C

BOYLE, W. H.
Sludge Blanket in Activated Final Clarifiers,
W82-00951 5D

BOYLEN, C. W.
Influence of Seasonal Temperature on the Temperature Optima of Bacteria in Sediments of Lake George, New York,
W82-00606 2H

BRAND, J. G.
The Cape Flats Sewage Treatment Works,
W82-00957 5D

BRAULT, J.
New Waterborne Bacteriophages Active on Yersinia Enterocolitica,
W82-00662 5A

BRAY, E. A.
Clonal Variations in the Water Relations of Red Osier Dogwood During Cold Acclimation,
W82-00839 2I

BREEN, C. M.
The Pongolo Floodplain: A Unique Ecosystem Threatened,
W82-00684 6G

BRENNIMAN, G. R.
Home Water Softeners, Water Softness and Possible Health Implications,
W82-01045 5F

BRESLER, E.
Transport of Salts in Soils and Subsoils,
W82-00930 5B

BRISBIN, T. D.
Metal Speciation. Effects on Aquatic Toxicity,
W82-00610 5A

BROADHEAD, R.
The Development of Methods for Determining Aquifer Characteristics,
W82-00827 2F

BROWN, L. H.
Organochlorine Residues in Kenya's Rift Valley Lakes,
W82-00690 5A

BROWN, P. L.
Dryland Cropping Strategies for Efficient Water-Use to Control Saline Seeps in the Northern Great Plains, U.S.A.,
W82-01023 3F

Saline Seep Development and Control in the North American Great Plains - Hydrogeological Aspects,
W82-01022 5B

BRUGAM, R. B.
Chemistry of Lake Water and Groundwater in Areas of Contrasting Glacial Drifts in Eastern Minnesota,
W82-00821 2K

BRUSH, G. S.
Spatial Distributions of Pollen in Surface Sediments of the Potomac Estuary,
W82-00757 2L

BUBENZER, G. D.
Aerial Photography as an Aid to Cropland Erosion Analysis,
W82-00902 2J

BUCHANAN, D. W.
Water Stress and Cold Hardiness in Field-Grown Citrus,
W82-00864 2I

BUCHANAN, T. J.
The U.S. Geological Survey Federal-State Cooperative Water Resources Program,
W82-00735 6B

BUNKER, T. J.
Better Dewatering Improves Sludge Recycling and Gives Significant Energy Savings,
W82-00526 5E

BURKE, J. C.
Anthropogenic Trace Elements and Polycyclic Aromatic Hydrocarbon Levels in Sediment Cores From Two Lakes in the Adirondack Acid Lake Region,
W82-00501 5B

BURNS, G. D.
Identification of Organic Compounds,
W82-00635 5A

BURNS, S.
The Effects of Sodium and Organic Matter In Sewage Effluent on Water Retention Properties of Soils,
W82-00663 3C

BURRINI, D.
Effect of Ozonation and Chlorination on the Mutagenic Potential of Drinking Water,
W82-00649 5A

BUSCH, C. D.
Water Movement for Water Quality in Catfish Production,
W82-00866 5G

BUTTERY, B. R.
Transpiration, Stomatal Conductance, and Photosynthesis of Tomato Plants With Various Proportions of Root System Supplied With Water,
W82-00504 2I

BUTTY, M.
Light Penetration and the Interrelationships Between Optical Parameters in a Turbid Subtropical Impoundment,
W82-00667 2H

CAIRNS, J. JR.
Industrial Effluent Monitoring Incorporating a Recent Automated Fish Biomonitoring System,
W82-00530 5A

Preference-Avoidance Reactions of Crayfish to Sublethal Concentrations of Cadmium,
W82-00916 5A

CAIRNS JR, J.
Does Improved Waste Treatment Have Demonstrable Biological Benefits,
W82-00779 5C

CALABRESE, E. J.
Health Effects of Monochloramines in Drinking Water,
W82-01091 5C

CALOMIRIS, J. J.
Antibiotic-Resistant Bacteria in Drinking Water,
W82-00645 5F

CALVO, C.
New Waterborne Bacteriophages Active on Yersinia Enterocolitica,
W82-00662 5A

CALZONETTI, F. J.
Bentonite Liners for Power Plant Lagoons,
W82-00617 5E

CAMERON, A. J.
Adsorption as a Control of Metal Concentrations in Sediment Extracts,
W82-00614 5A

CANTERAS, J. C.
The Organic Pollution of River Cubillas (Granada, South Spain),
W82-00674 5B

CANTON, R. B.
Sources and Control of Organic Air Pollutants,
W82-00711 5B

CAREY, G. F.
Moisture Transport in a Soil-Plant System: A Mathematical Model and Finite Element Analysis,
W82-00648 2I

CAREY, V. P.
Buoyancy Force Reversals in Vertical Natural Convection Flows in Cold Water,
W82-00981 1A

CARLE, F. L.
Accurate and Efficient Estimation of Benthic Populations: A Comparison Between Removal Estimation and Conventional Sampling Techniques,
W82-00633 5A

CARNEY, J. H.
A Comparison of Sensitivity Analysis and Error Analysis Based on a Stream Ecosystem Model,
W82-00991 7A

CARPENTER, R. A.
Using Ecological Knowledge for Development Planning,
W82-00671 6A

CARREIRA, L. A.
New Liquid Chromatographic Detection System for Environmental Pollutants,
W82-00740 5A

CARRONDO, M. J. T.
Sedimentation of Zeolite Type A in Water and Waste Water,
W82-00848 5D

CARSWELL, W. J. JR.
Floods in Kansas City, Missouri and Kansas, September 12-13,
W82-00724 2E

CARTER, M. J.
Leach Characteristics of Coal-Gasification Char,
W82-01025 5B

CECH, I.
Relationships Between Environmental Factors, Bacterial Indicators, and the Occurrence of Enteric Viruses in Estuarine Sediments,
W82-00574 5A

CHANDLER, D. S.
Persistence and Distribution of Erysipelothrix Rhusiopathiae and Bacterial Indicator Organisms on Land Used for Disposal of Piggery Effluent,
W82-00686 5B

CHANG, H-M.
Fungal Decolorization of Kraft Bleach Plant Effluents,
W82-00689 5D

CHARBENEAU, R. J.
Groundwater Contaminant Transport with Adsorption and Ion Exchange Chemistry: Method of Characteristics for the Case Without Dispersion,
W82-00551 5B

CHATT, A.
Determination of Molybdenum in Sea and Estuarine Water with Beta-Naphthoin Oxime and Neutron Activation,
W82-01098 5A

CHATTOPADHYAY, G. N.
Inorganic Transformation of Applied Phosphorus in Brackish Water Fish Pond Soil Under Different Water Salinity Levels,
W82-00920 2H

CHAU, Y. K.
Occurrence of Tetraalkylead Compounds in the Aquatic Environment,
W82-00878 5A

CHENEY, M. C.
Water Hardness Determination by the Catalytic Polarographic Wave of Magnesium Ion,
W82-01083 5A

CHIN, E. H.
Floods in Kansas City, Missouri and Kansas, September 12-13,
W82-00724 2E

CHRISTIANSEN, C.
The Kyholm Corer--A Diver-Operated Sediment Corer,
W82-00793 7B

CHRZANOWSKI, T. H.
The Assay of Adenosine 5'Triphosphate Extracted from Salt-Marsh Microbiota,
W82-00838 2L

Estimation of Material Fluxes in an Estuarine Cross Section: A Critical Analysis of Spatial Measurement Density and Errors,
W82-00816 7A

CHU, R. L.
Cation Transport in Packed Bed Reactor of Soil,
W82-00970 5D

CLAPP, C. E.
Effects of Municipal Waste Water Effluent on Performance and Feed Quality of Maize Vs. Reed Canarygrass,
W82-00564 3C

CLARK, C. W.
Towards a Predictive Model for the Economic Regulation of Commercial Fisheries,
W82-00549 6A

CLARK, R. M.
Removing Trihalomethanes from Drinking Water,
W82-00953 5F

CLARKE, R. T.
Adaptive Hydrological Forecasting - A Review,
W82-00984 2A

CLEMMENS, A. J.
Depths of Flow in Level Basins,
W82-00900 3F

COBET, A. B.
Methylation of Trimethyltin Compounds by Estuarine Sediments,
W82-00801 5B

CODY, H. M.
New Secondary Treatment System Brought On-Line at Georgia-Pacific,
W82-01009 5D

COGLEY, D. R.
Preliminary Pollutant Limit Values for Human Health Effects,
W82-00628 5G

COLEMAN, W. M. III.
Methylation of Trimethyltin Compounds by Estuarine Sediments,
W82-00801 5B

COLLETT, L. C.
Effect of Otter Prawn Trawling on the Macrobenthos of a Sandy Substratum in a New South Wales Estuary,
W82-00677 5C

COLLINS, A. J.
Effect of Otter Prawn Trawling on the Macrobenthos of a Sandy Substratum in a New South Wales Estuary,
W82-00677 5C

CONTRERAS, S.
Purification of Wastewater by Electrolysis,
W82-00847 5D

COOPER, C.
A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
W82-00532 5A

CORAPCIOGLU, M. Y.
A Mathematical Model for Consolidation in a Thermoelastic Aquifer Due to Hot Water Injection or Pumping,
W82-00602 2F

COREY, J. E.
Trace Element Accumulation, Movement, and Distribution in the Soil Profile From Massive Applications of Sewage Sludge,
W82-00640 5E

CORNELISSE, A.
Transpiration, Stomatal Conductance, and Photosynthesis of Tomato Plants With Various Proportions of Root System Supplied With Water,
W82-00504 2I

COSBY, R.
Sampling Ground Water for Organic Contaminants,
W82-00820 5A

COUBROUGH, P.
Evaluation of Standard and Modified M-FC, Macconkey, and Teepol Media for Membrane Filtration Counting of Fecal Coliforms in Water,
W82-00644 5A

COVE, R.
Effect of Metals on the Biomass Production Kinetics of Freshwater Copepods,
W82-00593 5C

CRAMER, D.
Dispersal of Salmonella from a Polluted Stream to Neighboring Terrestrial Habitats,
W82-01043 5A

CRAUN, G. F.
Asbestos Cement Pipe and Cancer in Connecticut 1955-1974,
W82-01094 5C

CRAVEN, J. A.
Persistence and Distribution of Erysipelothrix Rhusiopathiae and Bacterial Indicator Organ-

iams on Land Used for Disposal of Piggery Effluent,
W82-00686 5B

CROSBY, J. W. III.
Uranium Concentration in the Ground Waters of the Pullman-Moscow Basin, Whitman County, Washington, and Latah County, Idaho,
W82-00809 5B

CROWE, A. S.
Simulation of Lake-Watershed Systems, I. Description and Sensitivity Analysis of the Model,
W82-00926 2A

Simulation of Lake-Watershed Systems, II. Application to Baptiste Lake, Alberta, Canada,
W82-00927 2A

CROZIER, M. J.
Effects of Tropical Cyclone Wally in Southeast Viti Levu, Fiji, Easter 1980,
W82-00670 2A

CRUZ, R. B.
Occurrence of Tetraalkylead Compounds in the Aquatic Environment,
W82-00878 5A

CSANADY, G. T.
Mean Summer Circulation in Lake Ontario Within the Coastal Zone,
W82-00967 2H

CSIZINSZKY, A. A.
Yield and Water Use of Vegetable Crops with Seepage and Drip Irrigation Systems,
W82-00544 3F

CURRAN, D. J.
Water Hardness Determination by the Catalytic Polarographic Wave of Magnesium Ion,
W82-01083 5A

CUSICK, W.
A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
W82-00532 5A

DACRE, J. C.
Preliminary Pollutant Limit Values for Human Health Effects,
W82-00628 5G

DAKSHANAMURTHY, V.
A Mathematical Model for Predicting Moisture Flow in an Unsaturated Soil Under Hydraulic and Temperature Gradients,
W82-00605 2G

DAN, J.
The Use of Na/Cl Ratios to Trace Solute Sources in a Semiarid Zone,
W82-00601 7B

DANIEL, R. R.
A Note on the Fate of El Tor Cholera and Other Vibrios in Percolating Filters,
W82-00566 5D

DANIEL, T. C.
Sample Intake Position and Loading Rates from Nonpoint Source Pollution,
W82-00778 5A

DARVILLE, R. G.
Macrobenthos of Pine Island Bayou in the Big Thicket National Preserve, Texas,
W82-00924 5C

DARZI, M.
Sulfur and Associated Elements and Acidity in Continental and Marine Rain from North Florida,
W82-00965 2B

DAVE, M.
Trace Element Concentrations Over Midlake Michigan as a Function of Meteorology and Source Region,
W82-00550 5B

DAVIES, E.
Sediments as a Source of Phosphate: A Study of 38 Impoundments,
W82-00653 2H

DAVIES, F. S.
Water Stress and Cold Hardiness in Field-Grown Citrus,
W82-00864 2I

DAVIES, W. D.
Gonad Development, Fecundity, and Spawning Season of Largemouth Bass in Newly Impounded West Point Reservoir, Alabama-Georgia,
W82-01080 2H

DAVIS, C. B.
The Impact of a Natural Drawdown on the Growth of Four Emergent Species in a Prairie Glacial Marsh,
W82-01096 2H

DAVIS, J.
The Use of Algal Assays and Chlorophyll Concentrations to Determine Fertility of Water in Small Impoundments in West Virginia,
W82-00919 2H

DAWSON, V. K.
Residues of Isobornyl Thiocyanoacetate (Thanite) and a Metabolite in Fish and Treated Ponds,
W82-00570 5B

DAY JR, J. W.
Modeling Hydrology and Eutrophication in a Louisiana Swamp Forest Ecosystem,
W82-00890 4A

DE LAUNE, R. D.
Effect of pH and Redox Potential on Concentration of Dissolved Nutrients in an Estuarine Sediment,
W82-00795 2L

DE PENA, R. G.
Analysis of Precipitation Chemistry at a Central Pennsylvania Site,
W82-00980 2K

DECOSTA, J.
The Use of Algal Assays and Chlorophyll Concentrations to Determine Fertility of Water in Small Impoundments in West Virginia,
W82-00919 2H

DEFRIES, R. S.
Spatial Distributions of Pollen in Surface Sediments of the Potomac Estuary,
W82-00757 2L

DELAUNE, R. D.
Degradation of Hydrocarbons in Oxidized and Reduced Sediments,
W82-00907 5B

DENICH, K.
A Rapid Simple Long-Term Toxicity Assay for Aquatic Contaminants Using the Nematode Panagrellus Redivivus,
W82-01017 5A

DERENZO, D. R.
Apparatus for the Simulation of Rain in the Laboratory,
W82-00807 2B

DESAULNIERS, J. A. H.
Comparison of Methods for the Determination of Trace Elements in Seawater,
W82-01086 5A

DEVENDER REDDY, M.
Consumptive Use and Daily Evapotranspiration of Corn Under Different Levels of Nitrogen and Moisture Regimes,
W82-00660 2D

DEVINNY, J. S.
Effects of Thermal Effluents on Communities of Benthic Marine Macroalgae,
W82-00870 5C

DEXTER, F.
Modification of the Standard Most-Probable-Number Procedure for Fecal Coliform Bacteria in Seawater and Shellfish,
W82-00646 5A

DI PERNA, J.
System for Oil and Water Separation,
W82-00611 5D

DIACHENKO, G. W.
Waterborne Methylene Bis(2-Chloroaniline) and 2-Chloroaniline Contamination Around Adrian, Michigan,
W82-00873 5B

DICKEY, E. C.
Vegetative Filter Treatment of Livestock Feedlot Runoff,
W82-00794 5D

DICKSON, G. W.
The Effect of Season and Location on Phosphoadenylate Concentrations and Adenylate Energy Charge in Two Species of Freshwater Clams,
W82-00810 2H

DIJULIO, D. H.
Sea Urchin Sperm Bioassay for Sewage and Chlorinated Seawater and Its Relation to Fish Bioassays,
W82-00988 5A

DINNEL, P. A.
Sea Urchin Sperm Bioassay for Sewage and Chlorinated Seawater and Its Relation to Fish Bioassays,
W82-00988 5A

DOLARA, P.
Effect of Ozonation and Chlorination on the Mutagenic Potential of Drinking Water,
W82-00649 5A

DOLSKE, D.
Trace Element Concentrations Over Midlake Michigan as a Function of Meteorology and Source Region,
W82-00550 5B

DONOVAN, J. J.
Saline Seep Development and Control in the North American Great Plains - Hydrogeological Aspects,
W82-01022 5B

DORING, E. J.
Watertable Management Saves Water and Energy,
W82-00943 3F

DRAKE, C. M.
A Comparative Study of Four Dredges Used for Sampling Benthic Macroinvertebrates in Rivers,
W82-00833 7B

DRAKE, J. J.
The Effects of Surface Dust on Snowmelt Rates,
W82-00845 2C

DUCKSTEIN, L.
Reliability of Underground Flood Control System,
W82-00556 8A

DUNCAN, S. W.
A Portable Pump Sampler for Lotic Periphyton,
W82-00826 7B

DUNLAP, W. J.
Sampling Ground Water for Organic Contaminants,
W82-00820 5A

DURHAM, J. L.
Influence of Gaseous Nitric Acid on Sulfate Production and Acidity in Rain,
W82-00642 5B

DURKIN, P.
Human Health Hazards Associated With Chemical Contamination of Aquatic Environment,
W82-00632 5C

DUSSART, G.
Relationships Between Water Chemistry and Respiration Rate in Several Populations of Lymnaea Peregra Muller (Gastropoda:Mollusca),
W82-00854 2K

DUTKA, B. J.
Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay, Canada. I: Bacteriological Aspects,
W82-00921 2L

DUVAL, R. L.
Effects of a Cattleskin Tannery of Stream Quality and Benthic Macroinvertebrates in Central Maine,
W82-00872 5C

DYE, C. W.
Diel Variations of Selected Physico-Chemical Parameters in Lake Kissimmee, Florida,
W82-00535 2H

DYER, T. G. J.
On August Mean Temperature and the Succeeding Season's Rainfall Over South Africa,
W82-00692 2B

EASTBURN, R. P.
Potential for Land Disposal of Two Nonbiodegradable Wastes,
W82-00939 5D

EATON, D.
Fungal Decolorization of Kraft Bleach Plant Effluents,
W82-00689 5D

EATOUGH, D. J.
Determination of Alkaline Earth and Divalent Transition Metal Cations by Ion Chromatography with Sulfate-Suppressed Barium and Lead Eluents,
W82-01082 5A

EBERZ, P. G.
Ferric Chloride Takes Over,
W82-00954 5F

ECHERT, J. M.
A Reduction-Spectrophotometric Method for the Determination of Sulphate in Waters,
W82-00850 5A

ECKHOFF, P. A.
Numerical Simulation of the Effects of Cooling Tower Complexes on Clouds and Severe Storms,
W82-00995 2B

EDMONDSON, W. T.
The Effect of Changes in the Nutrient Income on the Condition of Lake Washington,
W82-00987 2H

EICKMEIER, W. G.
Photosynthetic Recovery of Resurrection Spikemosses from Different Hydration Regimes,
W82-01010 2I

EISENREICH, J. J.
Assessment of Airborne Organic Contaminants in the Great Lakes Ecosystem,
W82-00709 5B

EL-NENNAH, M.
Effect of Irrigating Loamy Sand Soil by Liquid Sewage Sludge on its Content of some Micronutrients,
W82-00661 5E

EL-SHINAWY, R. M. K.
Retention of Radionuclides by Some Aquatic Fresh Water Plants,
W82-00853 5B

ELKINS, J. W.
Transformations of Nitrogen in a Polluted Estuary: Nonlinearities in the Demand for Oxygen at Low Flow,
W82-00777 5B

ELLIOT, G. E.
R Factors in Coliform-Fecal Coliform Sewage Flora of the Prairies and Northwest Territories of Canada,
W82-00508 5A

ELLIOTT, J. M.
A Comparative Study of Four Dredges Used for Sampling Benthic Macroinvertebrates in Rivers,
W82-00833 7B

ELORANTA, P.
Annual Succession of Phytoplankton in One Heated Pond in Central Finland,
W82-00673 5C

ENGLISH, M. J.
The Uncertainty of Crop Models in Irrigation Optimization,
W82-00940 3F

ENTZ, R. C.
Waterborne Methylene Bis(2-Chloroaniline) and 2-Chloroaniline Contamination Around Adrian, Michigan,
W82-00873 5B

EPP, D. J.
Land Treatment of Municipal Wastewater in Small Communities,
W82-00588 5D

EREMENKO, E. V.
Modeling the Transformation of Nitrogen Compounds for Water-Quality Management in Streams,
W82-00598 6A

ERSKINE, W. D.
Effects of Recent Increases in Rainfall on Floods and Runoff in the Upper Hunter Valley,
W82-00668 2E

EVANS, D. W.
Trace Element Inputs From a Coal Burning Power Plant to Adjacent Terrestrial and Aquatic Environments,
W82-00557 5B

EVANS, T. M.
Effect of Turbidity on Chlorination Efficiency and Bacterial Persistence in Drinking Water,
W82-00865 5A

EWERT, D. L.
Enumeration of Bacteriophages and Host Bacteria in Sewage and the Activated-Sludge Treatment Process,
W82-00584 5A

FAN, C-Y.
Recycling Urban Stormwater for Profit,
W82-00524 3C

FARLEY, D.
The Relationship of Environmental Epidemiology to Water and Wastewater Plant Operators,
W82-00789 5C

FARMER, D. M.
Circulation and Energetics of a Deep, Strongly Stratified Inlet,
W82-00547 2L

FARMER, J. G.
Evidence of the Unsuitability of Gravity Coring for Collecting Sediment in Pollution and Sedimentation Rate Studies,
W82-00840 7B

FARNUM, P.
Moisture Transport in a Soil-Plant System: A Mathematical Model and Finite Element Analysis,
W82-00648 2I

FARQUHAR, G. J.
Simulation Modeling of Primary Clarifiers,
W82-01027 6A

FARRELL, M. P.
Insect Community Structure as an Index of Heavy-Metal Pollution in Lotic Ecosystems,
W82-00596 5C

FAUSEY, N. R.
Backfill Alteration Effects on Pipe Drainage of a Clay Soil,
W82-00763 4A

FELSOT, A.
Bioconcentration of Pesticides by Egg Masses of the Caddisfly, Triaenodes Tardus Milne,
W82-00982 5B

FERRIS, C. R.
Effects of a Cattleskin Tannery of Stream Quality and Benthic Macroinvertebrates in Central Maine,
W82-00872 5C

FERRONSKII, V. I.
Possibility of Using Tritium for Studying Global Circulation of Atmospheric Moisture,
W82-00863 2A

FETTER, C. W. JR.
Interstate Conflict Over Ground Water: Wisconsin-Illinois,
W82-00818 6E

FIELD, R.
Recycling Urban Stormwater for Profit,
W82-00524 3C

FINK, L. K.
Effects of a Cattleskin Tannery of Stream Quality and Benthic Macroinvertebrates in Central Maine,
W82-00872 5C

FINLEY, R. J.
Interpretation of Surface-Water Circulation, Aransas Pass, Texas, Using Landsat Imagery,
W82-00904 7B

FINN, J. T.
Flow Analysis of Models of the Hubbard Brook Ecosystem,
W82-01038 1A

FISHER, A.
The Toxic Waste Dump Problem and a Suggested Insurance Program,
W82-00591 5E

FISK, M. J.
Sedimentological and Biological Changes in the Windsor Mudflat, an Area of Induced Siltation,
W82-00548 5C

FITZGERALD, W. F.
Trace Metal Fluxes to Nearshore Long Island Sound Sediments,
W82-01040 5B

FLEMING, G. H.
Water Quality Management in River Basins: US National Experience,
W82-00800 6E

FLETCHER, K.S. III.
Water Hardness Determination by the Catalytic Polarographic Wave of Magnesium Ion,
W82-01083 5A

FLOOD, C. A. JR.
Water Movement for Water Quality in Catfish Production,
W82-00866 5G

FLORA, C. J.
Determination of Nickel by Differential Pulse Polarography at a Dropping Mercury Electrode,
W82-01100 5A

FLYNN, M. S.
Variations in Precipitation Parameters Between Drought and Non-Drought Periods in Texas and Some Implications for Cloud Seeding,
W82-01006 2B

FORTES, M.
A Non-Equilibrium Thermodynamics Approach to Transport Phenomena in Capillary Porous Media,
W82-00697 2F

FRANKOS, N. H.
Trenching of Digested Sludge,
W82-00974 5E

FREDLUND, D. G.
A Mathematical Model for Predicting Moisture Flow in an Unsaturated Soil Under Hydraulic and Temperature Gradients,
W82-00605 2G

FREELAND, H. J.
Circulation and Energetics of a Deep, Strongly Stratified Inlet,
W82-00547 2L

FREIBERG, J. E.
Mass-Transport Limitation to the Rate of Reaction of Gases in Liquid Droplets: Application to Oxidation of SO2 in Aqueous Solutions,
W82-00994 2K

FRENCH, R. H.
Effectiveness of River Models,
W82-00961 6A

FRETWELL, J. D.
Resistivity Study of a Coastal Karst Terrain, Florida,
W82-00817 2F

FRITZ, J. S.
Cation Chromatography With a Conductivity Detector,
W82-00582 5A

FROST, F.
Giardia Prevalence in Commercially Trapped Mammals,
W82-01046 5A

FUJIOKA, R. S.
Survival of Human Enteroviruses in the Hawaiian Ocean Environment: Evidence for Virus-Inactivating Microorganisms,
W82-00587 5C

FUKSMAN, YA. L.
Modeling of Processes of Decomposition of Organic Matter in Bottom Sediments,
W82-00553 5B

FULLER, R. M.
The Changing Status of Reedswamp in the Norfolk Broads,
W82-00691 5C

FULLER, W. H.
Effect of Leachate Flow Rate on Metal Migration Through Soil,
W82-00565 5E

FULTON, J. M.
Ratio Between Evapotranspiration of Irrigated Crops from Floating Lysimeters and Class A Pan Evaporation,
W82-01050 2D

FURUTANI, A.
Dynamics of Selenium in Mercury-Contaminated Experimental Freshwater Ecosystems,
W82-00595 5B

GALE, W. F.
Monitoring River Periphyton With Artificial Benthic Substrates,
W82-00581 5A

GALLOWAY, J. N.
Acid Precipitation: The Importance of Nitric Acid,
W82-00643 2K

GARBADE, J. M.
Generalized Thickness of the Floridan Aquifer, Southwest Florida Water Management District,
W82-00729 7C

GARDNER, R. H.
A Comparison of Sensitivity Analysis and Error Analysis Based on a Stream Ecosystem Model,
W82-00991 7A

GARVINE, R. W.
Frontal Jump Conditions for Models of Shallow, Buoyant Surface Layer Hydrodynamics,
W82-00804 8B

GASCHO, G. J.
Water Requirement for Sugarcane Production,
W82-00899 3F

GATZ, D. F.
Associations and Mesoscale Spatial Relationships Among Rainwater Constituents,
W82-00964 2B

GEARING, J. N.
Partitioning of No. 2 Fuel Oil in Controlled Estuarine Ecosystems. Sediments and Suspended Particulate Matter,
W82-00541 2L

GEARING, P. J.
Partitioning of No. 2 Fuel Oil in Controlled Estuarine Ecosystems. Sediments and Suspended Particulate Matter,
W82-00541 2L

GEBHART, B.
Buoyancy Force Reversals in Vertical Natural Convection Flows in Cold Water,
W82-00981 1A

GELDREICH, E. E.
Removing Trihalomethanes from Drinking Water,
W82-00953 5F

GELLER, G. N.
Leaf and Environmental Parameters Influencing Transpiration: Theory and Field Measurements,
W82-00979 2D

GEMMELL, R. S.
Water Quality Evaluation of Regional Wastewater Management,
W82-00977 5D

GERARDI, M. B.
What Caused the Bad Odor in the Drinking Water,
W82-00527 5F

GERARDI, M. H.
What Caused the Bad Odor in the Drinking Water,
W82-00527 5F

GERBA, C. P.
Evaluation of Various Soil Water Samplers for Virological Sampling,
W82-00572 5A

Movement of Endotoxin Through Soil Columns,
W82-00586 5B

Relationships Between Environmental Factors, Bacterial Indicators, and the Occurrence of Enteric Viruses in Estuarine Sediments,
W82-00574 5A

GERNERT, J. L.
Diel Variations of Selected Physico-Chemical Parameters in Lake Kissimmee, Florida,
W82-00535 2H

GESSER, H. D.
Monitoring Trace Amounts of Cadmium in Natural Waters,
W82-00516 5A

GHORBANZADEH, A.
Impact of Water Resource Development on Salinization of Semi-Arid Lands,
W82-01024 5B

GHOSH, M. M.
Vacuum Filtration of Metal Hydroxide Sludges,
W82-00976 5D

GHOSH, R. K.
Estimation of Soil-Moisture Characteristics from Mechanical Properties of Soils,
W82-00785 2G

GIANESSI, L. P.
The Distribution of the Costs of Federal Water Pollution Control Policy,
W82-00537 6B

GIBBS, K. E.
Effects of a Cattleskin Tannery of Stream Quality and Benthic Macroinvertebrates in Central Maine,
W82-00872 5C

GIBBS, P. J.
Effect of Otter Prawn Trawling on the Macrobenthos of a Sandy Substratum in a New South Wales Estuary,
W82-00677 5C

GIBSON, J.
Experimental Manipulation of Algal Bloom Composition by Nitrogen Addition,
W82-00998 5C

GIBSON, N. A.
A Reduction-Spectrophotometric Method for the Determination of Sulphate in Waters,
W82-00850 5A

GICHURU, M.
Effects of Water Quality on Forage Production,
W82-01002 3C

GIESY, J. P.
The Effect of Season and Location on Phosphoadenylate Concentrations and Adenylate Energy Charge in Two Species of Freshwater Clams,
W82-00810 2H

GILBERT, B. K.
The U.S. Geological Survey Federal-State Cooperative Water Resources Program,
W82-00735 6B

GILES, A. H.
Ground Water Problems Virginia Portion Ohio River Basin,
W82-01059 4B

GILES, M.
Chemical Treatment Solves Tannery Waste Problems,
W82-00638 5D

GILMOUR, C. M.
A Simulation Model for Sludge Decomposition in Soil,
W82-01001 5E

GILMOUR, J. T.
A Simulation Model for Sludge Decomposition in Soil,
W82-01001 5E

GJERDE, D. T.
Cation Chromatography With a Conductivity Detector,
W82-00582 5A

GLASGOW, D.
Pressure Sewer Systems,
W82-00528 5D

GLEDHILL, W. E.
An Environmental Safety Assessment of Butyl Benzyl Phthalate,
W82-00615 5A

GODDEN, G. F.
Environmental Aspects of Rural Development with Particular Reference to the Keiskamma River Basin Study,
W82-00685 6D

GOLTERMAN, H. L.
Phosphate Models, a Gap to Bridge,
W82-00929 2H

GOODIN, J. R.
Effects of Water Quality on Forage Production,
W82-01002 3C

GOSLING, L. M.
Acidity Fluctuations at a Broadland Site in Norfolk,
W82-00656 2K

GOSS, D. W.
Management of Recharge Basins on the Southern High Plains,
W82-00938 4B

GOSS, J.
Low Turbidity Water from Fast Processes,
W82-00946 5F

GOSZ, J. R.
Nutrient Budget Studies for Forests Along an Elevational Gradient in New Mexico,
W82-01036 2K

GOWDA, N. M. MADE
Chloramine-T as A Potential Scrubbing Agent: Removal of Odorous Sulfur-Containing Environmental Pollutants,
W82-00871 5D

GOYAL, S. M.
Movement of Endotoxin Through Soil Columns,
W82-00586 5B

Relationships Between Environmental Factors, Bacterial Indicators, and the Occurrence of Enteric Viruses in Estuarine Sediments,
W82-00574 5A

GOZLAN, G.
The Manifestation of Dehydration Avoidance in Wheat Breeding Germplasm,
W82-00958 2I

GRABOW, W. O. K.
Evaluation of Standard and Modified M-FC, Macconkey, and Teepol Media for Membrane Filtration Counting of Fecal Coliforms in Water,
W82-00644 5A

GRANDELL, J.
A Numerical Comparison Between Lagrangian and Eulerian Rainfall Statistics,
W82-00803 2B

GRANT, I. J.
Effects of Tropical Cyclone Wally in Southeast Viti Levu, Fiji, Easter 1980,
W82-00670 2A

GRAY, M. J.
Manganese Dioxide as an Adsorbant for Heavy Metals,
W82-00775 5F

GREENE, D. J.
An Alternative Wastewater Disinfectant,
W82-00950 5D

GREENE, L. A.
Removal of Nitrate from Public Water Supply Abstractions,
W82-00774 5F

GREER, J. D.
Effect of Slope Length on Erosion from Low Slopes,
W82-00896 2J

GREGORY, R. W.
Relation Between Trophic Position and Mercury Accumulation Among Fishes from the Tongue River Reservoir, Montana,
W82-01041 5A

GRIFFINI, O.
Effect of Ozonation and Chlorination on the Mutagenic Potential of Drinking Water,
W82-00649 5A

GRIFFITH, C. G.
Satellite Rain Estimation in the U.S. High Plains,
W82-00808 2B

GRIFFITHS, J. F.
Variations in Precipitation Parameters Between Drought and Non-Drought Periods in Texas and Some Implications for Cloud Seeding,
W82-01006 2B

GRIGG, N. S.
Water Quality Management in River Basins: US National Experience,
W82-00800 6E

GRIZZLE, J. M.
Effects of Hypolimnetic Discharge on Fish Health Below a Reservoir,
W82-00805 5C

GROBLER, D.
Light Penetration and the Interrelationships Between Optical Parameters in a Turbid Subtropical Impoundment,
W82-00667 2H

GROBLER, D. C.
Sediments as a Source of Phosphate: A Study of 38 Impoundments,
W82-00653 2H

GRODY, N. C.
Atmospheric Water Content Over the Tropical Pacific Derived from the Nimbus-6 Scanning Microwave Spectrometer,
W82-01004 7B

GROVER, K.
Good Looks, Low Maintenance Guide Water Tank Choice,
W82-00868 5A

GRUBER, A.
Atmospheric Water Content Over the Tropical Pacific Derived from the Nimbus-6 Scanning Microwave Spectrometer,
W82-01004 7B

GRUBER, D.
Industrial Effluent Monitoring Incorporating a Recent Automated Fish Biomonitoring System,
W82-00530 5A

GUARD, H. E.
Methylation of Trimethyltin Compounds by Estuarine Sediments,
W82-00801 5B

GUDE, H.
Occurrence of Cytophagas in Sewage Plants,
W82-00682 5A

GUEVREMONT, R.
Organic Matrix Modifiers for Direct Graphite Furnace Atomic Absorption Determination of Cadmium in Seawater,
W82-01085 5A

GUPTA, V. K.
A Geomorphologic Synthesis of Nonlinearity in Surface Runoff,
W82-00604 2A

GURTZ, M. E.
Seston Dynamics in Southern Appalachian Streams: Effects of Clear-Cutting,
W82-00543 4C

GUTER, K. J.
Ferric Chloride Takes Over,
W82-00954 5F

HAAN, C. T.
Evaluation of Stripmine Sediment Detention Basins in Kentucky,
W82-00893 5G

HABICHT, M. H.
Potential Eutrophication of the Rideau River by an Urban Drainage Waterway,
W82-00834 5C

HAGAN, R. E.
Sizing Rice Irrigation Canals,
W82-00895 3F

HAGGAR, R. J.
The Effect of Height of Water Table on the Growth of Holcus Lanatus With Reference to Lolium Perenne,
W82-00654 2I

HAKANSON, L.
On Lake Bottom Dynamics--The Energy-Topography Factor,
W82-00837 2H

A Review on Sediment Traps in Aquatic Environments,
W82-01020 7B

HAKE, K. A.
State Water Use and Socioeconomic Data Related to the Second National Water Assessment,
W82-00739 6D

HALL, R. H.
Metal Speciation. Effects on Aquatic Toxicity,
W82-00610 5A

HALLEY, M. A.
Assessment of Airborne Inorganic Contaminants in the Great Lakes,
W82-00710 5B

HALVORSON, A. D.
Dryland Cropping Strategies for Efficient Water-Use to Control Saline Seeps in the Northern Great Plains, U.S.A.,
W82-01023 3F

HAMALA, J. A.
A Portable Pump Sampler for Lotic Periphyton,
W82-00826 7B

HAMBRICK, G. A. III
Degradation of Hydrocarbons in Oxidized and Reduced Sediments,
W82-00907 5B

HAMMEL, H. T.
Superseparation: Soret Effect Reversed,
W82-00791 3A

HAMMERTON, D.
The Design and Interpretation of Marine Pollution Surveys,
W82-00700 6E

HAMRUD, M.
A Numerical Comparison Between Lagrangian and Eulerian Rainfall Statistics,
W82-00803 2B

HANLON JR, E. A.
Quality of Irrigation Water and Effects of Sulfuric Acid and Gypsum on Soil Properties and Sundangrass Yields,
W82-00767 3C

HANSEN, L. D.
Determination of Alkaline Earth and Divalent Transition Metal Cations by Ion Chromatography with Sulfate-Suppressed Barium and Lead Eluents,
W82-01082 5A

HANSEN, P. D.
Uptake and Transfer of the Chlorinated Hydrocarbon Lindane (Gamma-BHC) in a Laboratory Freshwater Food Chain,
W82-01033 5C

HANSHAW, B. B.
Chemical Mass-Wasting of the Northern Yucatan Peninsula by Groundwater Dissolution,
W82-01015 2K

HANYA, T.
Chemical Composition of Labile Fractions in DOM,
W82-00917 2H

Vertical Distribution of Monosaccharides in Lake Water,
W82-00665 2H

HARDING, J. P. C.
Aquatic Mosses as Monitors of Heavy Metal Contamination in the River Etherow, Great Britain,
W82-00787 5A

HARLO, E. H.
Large Rubble-Mound Breakwater Failures,
W82-00862 8D

HARMON, W. C.
Sediment Sizes Eroded from Crop Row Sideslopes,
W82-00903 2J

HARREL, R. C.
Macrobenthos of Pine Island Bayou in the Big Thicket National Preserve, Texas,
W82-00924 5C

HARRIS, G. P.
Temporal and Spatial Scales in Phytoplankton Ecology. Mechanisms, Methods, Models and Management,
W82-00594 5G

HARSH, J. F.
Potentiometric-Surface Map for the Cretaceous Aquifer, Virginia Coastal Plain, 1978,
W82-00727 7C

HARTMETZ, G.
Detection of Volatile Nitrosamines in Waste Water from Chemical Plants by Combined Capillary Gas Chromatography-Mass Spectrometry,
W82-00856 5A

HASTINGS, D.
Enrichment of the Agricultural Herbicide Atrazine in the Microsurface Water of an Estuary,
W82-00877 5B

HAUTH, L. D.
Floods in Kansas City, Missouri and Kansas, September 12-13,
W82-00724 2E

HAYES, M. O.
General Morphology and Sediment Patterns in Tidal Inlets,
W82-00792 2L

HEBBERT, R. H. B.
A Comparison of Rainfall-Runoff Models,
W82-00911 2A

HEEG, J.
The Pongolo Floodplain: A Unique Ecosystem Threatened,
W82-00684 6G

HEEKMANN, W.
Waste Heat Balance in Aquifers Calculated by a Computer Programme,
W82-00830 7B

HEGARTY, T. W.
Investigations of Control Mechanisms of Germination Under Water Stress,
W82-00912 2I

HEIT, M.
Anthropogenic Trace Elements and Polycyclic Aromatic Hydrocarbon Levels in Sediment Cores From Two Lakes in the Adirondack Acid Lake Region,
W82-00501 5B

HEJKAL, T. W.
Water-To-Air Fractionation of Bacteria,
W82-00575 5B

HEMOND, H. F.
Biogeochemistry of Thoreau's Bog, Concord, Massachusetts,
W82-00887 2K

HEMSLEY, J.
Automation of Norwich Sewage-Treatment Works: Early Cost Considerations,
W82-00955 5D

HENDRICKS, A. C.
Does Improved Waste Treatment Have Demonstrable Biological Benefits,
W82-00779 5C

HENRIKSEN, K.
Measurement of in situ Rates of Nitrification in Sediment,
W82-00798 5A

HERON, R.
Occurrence of Ice Layers at the Base of High Arctic Snowpacks,
W82-00844 2C

HERSHAFT, A.
The Nonfuel Minerals Industry: Regulatory Impacts,
W82-00612 5B

HERSHFIELD, D. M.
The Magnitude of the Hydrological Frequency Factor in Maximum Rainfall Estimation,
W82-00983 2B

HESTON, J. F.
Asbestos Cement Pipe and Cancer in Connecticut 1955-1974,
W82-01094 5C

HICKS, O.
An Environmental Safety Assessment of Butyl Benzyl Phthalate,
W82-00615 5A

HIJNEN, W. A. M.
Growth of Aeromonas Hydrophila at Low Concentrations of Substrates Added to Tap Water,
W82-00578 5A

HIKUMA, M.
Ammonia Electrode with Immobilized Nitrifying Bacteria,
W82-01099 5A

HILL, G.
Classification of Central Amazon Lakes on the Basis of their Microbiological and Physico-Chemical Characteristics,
W82-00666 2H

HILL, G. E.
Seeding-Opportunity Recognition in Winter Orographic Clouds,
W82-01005 3B

HILNER, C. A.
Evaluation of Standard and Modified M-FC, Macconkey, and Teepol Media for Membrane Filtration Counting of Fecal Coliforms in Water,
W82-00644 5A

HINCKLEY, T. M.
Water Relations, Soil Fertility, and Plant Nutrient Composition of a Pygmy Oak Ecosystem,
W82-01034 2I

HINDLE, R.
Residues of Nonylphenol in Spruce Foliage, Forest Soil, Stream Water and Sediment After its Aerial Application,
W82-00559 5B

HINES, A. L.
Groundwater Leaching of Organic Pollutants From in Situ Retorted Oil Shale. A Mass Transfer Analysis,
W82-00626 5B

HINTERLEITNER, S.
Serum Enzymes in Rainbow Trout as Tools in the Diagnosis of Water Quality,
W82-00857 5A

HIRSCH, J. H.
Numerical Simulation of the Effects of Cooling Tower Complexes on Clouds and Severe Storms,
W82-00995 2B

HIRTLE, R. W. M.
Sedimentological and Biological Changes in the Windsor Mudflat, an Area of Induced Siltation,
W82-00548 5C

HITES, R. A.
Aromatic Amines in and Near the Buffalo River,
W82-00622 5B

HOBBS, E. H.
Response of Fababean Yield, Protein Production and Water Use to Irrigation,
W82-01089 2I

HODGES, E.
The Control of Bacterial Pollution Caused by Sea Discharges of Sewage,
W82-00699 5D

HODGSON, M. E.
State Water Use and Socioeconomic Data Related to the Second National Water Assessment,
W82-00739 6D

HOFFMAN, M. R.
Trace Metal Catalysis in Aquatic Environments,
W82-00629 5B

HOLMES, B. H.
Federal Participation in Land Use Decision-Making at the Water's Edge--Floodplains and Wetlands,
W82-00799 6E

HOLMES, J. W.
The Influence of Plant Communities Upon the Hydrology of Catchments,
W82-00931 2D

HOOD, M. A.
Effects of Temperature, pH, Salinity, and Inorganic Nitrogen on the Rate of Ammonium Oxidation by Nitrifiers Isolated from Wetland Environments,
W82-00910 2L

HOPCRAFT, J.
Organochlorine Residues in Kenya's Rift Valley Lakes,
W82-00690 5A

HOPKINS, H. T.
Potentiometric-Surface Map for the Cretaceous Aquifer, Virginia Coastal Plain, 1978,
W82-00727 7C

HOPKINSON JR, C. S.
Modeling Hydrology and Eutrophication in a Louisiana Swamp Forest Ecosystem,
W82-00890 4A

HORNBECK, J. W.
Acid Rain: Facts and Fallacies,
W82-00518 5C

HORTON, J. H.
Trace Element Inputs From a Coal Burning Power Plant to Adjacent Terrestrial and Aquatic Environments,
W82-00557 5B

HOWORTH, R.
Effects of Tropical Cyclone Wally in Southeast Viti Levu, Fiji, Easter 1980,
W82-00670 2A

HSU, C. T.
Multivariate Hydrologic Time Series Analysis,
W82-00647 2A

HUANG, P. M.
The Nature of Selected Prairie Lake and Stream Sediments,
W82-00815 2J

HUBER, J.
Application of Immobilized Hydrogenase for the Detritiation of Water,
W82-00768 5D

HUGGETT, R. J.
Kepone in the James River,
W82-00631 5B

HUGGINS, L. F.
Answers: A Model for Watershed Planning,
W82-00898 6A

Subsurface Drainage and Sediment Transport Model,
W82-00894 2G

HUNDAL, S. S.
Backfill Alteration Effects on Pipe Drainage of a Clay Soil,
W82-00763 4A

HUNSINGER, R. B.
Chrysotile Asbestos Fiber Removal During Potable Water Treatment. Pilot Plant Studies,
W82-00613 5F

HUNTER, E. J.
Traveling Sprinkler System and Method,
W82-00561 3F

HUTKA, J.
Movement of Loose, Sandy Detritus by Shallow Water Flows: An Experimental Study,
W82-00776 2J

HUTTON, D. G.
Removal of Priority Pollutants,
W82-00639 5D

ICHIMURA, V. T.
Uranium Concentration in the Ground Waters of the Pullman-Moscow Basin, Whitman County, Washington, and Latah County, Idaho,
W82-00809 5B

IDELOVITCH, E.
Environmental Effects of Water Reuse Scheme,
W82-00973 3C

IMHOFF, K. R.
The Fate of Heavy Metals in the Ruhr System and Their Influence on Drinking Water Quality,
W82-00962 5B

INGRAM, R.
Factors Controlling Phytoplankton Primary Productivity in Byram Lake, Mt. Kisco, N.Y., Summer, 1977,
W82-00915 2H

ISRAEL, D. H.
Western Coal Mining in the 1980s: A Study in Federal/State Conflicts,
W82-00972 6E

ITO, T.
Multielement Preconcentration of Trace Heavy Metals in Water by Coprecipitation and Flotation with Indium Hydroxide for Inductively Coupled Plasma-Atomic Emission Spectrometry,
W82-01097 5A

IVANOVA, L. YU.
Possibility of Using Tritium for Studying Global Circulation of Atmospheric Moisture,
W82-00863 2A

IWUGO, K. O.
Pilot Plant Performances in Municipal Wastewater Treatment by Activated Carbon Adsorption,
W82-00851 5D

JACK, W.
Evidence of the Unsuitability of Gravity Coring for Collecting Sediment in Pollution and Sedimentation Rate Studies,
W82-00840 7B

JACKSON, R.
Managing Oil and Gas Activities in Coastal Environments: Refuge Manual,
W82-01081 5G

JACKSON, T.
A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
W82-00532 5A

JACOB, J. T.
Detoxification of Residual Quaternaries,
W82-00562 5G

JANARDAN, K. G.
Grab Versus Composite Sampling: A Primer for the Manager and Engineer,
W82-00891 5A

JENKINS, T. F.
Removal of Volatile Trace Organics from Wastewater by Overland Flow Land Treatment,
W82-01042 5D

JOBSON, H. E.
Temperature and Solute-Transport Simulation in Streamflow Using a Lagrangian Reference Frame,
W82-00726 2E

JOHNSON, M. G.
Great Lakes Environmental Protection Policies from a Fisheries Perspective,
W82-00978 6G

JOHNSTON, R. A.
Evaluation of Winter Application of Liquid Sludge to Farmland,
W82-00952 5B

JONES, D. A.
Diel Variations of Selected Physico-Chemical Parameters in Lake Kissimmee, Florida,
W82-00535 2H

JONES, J. D.
Heavy Metal Contents in Some Macrophytes from Saginaw Bay (Lake Huron, U.S.A.),
W82-01000 5B

JONES, J. H.
Dairy Liquid Waste Distribution in an Overland Flow Vegetative-Soil Filter System,
W82-00897 5D

JONES, O. R.
Effect of Soil Water Content and a Growing Season Straw Mulch on Grain Sorghum,
W82-00765 3F

Land Forming Effects on Dryland Sorghum Production in the Southern Great Plains,
W82-00764 3F

Management of Recharge Basins on the Southern High Plains,
W82-00938 4B

JONES, R. D.
Effects of Temperature, pH, Salinity, and Inorganic Nitrogen on the Rate of Ammonium Oxidation by Nitrifiers Isolated from Wetland Environments,
W82-00910 2L

JORDAN, Y.
A Rapid Simple Long-Term Toxicity Assay for Aquatic Contaminants Using the Nematode Panagrellus Redivivus,
W82-01017 5A

JOSEPH, I.
Development of Makeup-Line Safe-Operating Criteria,
W82-01095 8B

JOSEPHSON, J.
Groundwater Strategies,
W82-00620 5G

JOSSELYN, M. N.
Seasonal Influx and Decomposition of Autochthonous Macrophyte Litter in a North Temperate Estuary,
W82-00918 2L

JURY, W. A.
Estimation of the Salt Burden of Irrigation Drainage Waters,
W82-00563 5B

KACZYNSKI, V. W.
Receiving Stream Fisheries Studies Relative to Secondary Treated Pulp and Paper Mill Effluents,
W82-00688 5C

KAISER, D. L.
Coordinated Effort Stems Sediment and Erosion,
W82-00766 4D

KAJAK, Z.
Influence of Phosphorus Loads and of Some Limnological Processes on the Purity of Lake Water,
W82-00923 2H

KALEY, R. G.
An Environmental Safety Assessment of Butyl Benzyl Phthalate,
W82-00615 5A

KALINSKE, A. A.
Extracting Heavy Metals and Toxic Organics from Sludge,
W82-00947 5D

KANE, D. L.
Physical Mechanics of Aufeis Growth,
W82-00836 2C

KARUBE, I.
Ammonia Electrode with Immobilized Nitrifying Bacteria,
W82-01099 5A

KATZENELSON, E.
Isolation and Identification of Pathogenic Microorganisms at Wastewater-Irrigated Fields: Ratios in Air and Wastewater,
W82-00579 5A

KAUFMAN, P. B.
Heavy Metal Contents in Some Macrophytes from Saginaw Bay (Lake Huron, U.S.A.),
W82-01000 5B

KAWAGUCHI, H.
Multielement Preconcentration of Trace Heavy Metals in Water by Coprecipitation and Flotation with Indium Hydroxide for Inductively Coupled Plasma-Atomic Emission Spectrometry,
W82-01097 5A

KAY, C.
Enteric Viruses in Renovated Water in Manitoba,
W82-01090 5A

KAY, R.
Relationships Between Water Chemistry and Respiration Rate in Several Populations of Lymnaea Peregra Muller (Gastropoda:Mollusca),
W82-00854 2K

KEDMI, S.
Isolation and Identification of Pathogenic Microorganisms at Wastewater-Irrigated Fields: Ratios in Air and Wastewater,
W82-00579 5A

KEELEY, J. W.
Sampling Ground Water for Organic Contaminants,
W82-00820 5A

KELLO, D.
Human Health Hazards Associated With Chemical Contamination of Aquatic Environment,
W82-00632 5C

KERSTER, H. W.
Grab Versus Composite Sampling: A Primer for the Manager and Engineer,
W82-00891 5A

KESLER, D. H.
Grazing Rate Determination of Corynoneura Scutellata Winnertz (Chironomidae:Diptera),
W82-00822 2H

KETCHESON, J. W.
Evaluation of Winter Application of Liquid Sludge to Farmland,
W82-00952 5B

KHALEEL, R.
Behavior and Transport of Microbial Pathogens and Indicator Organisms in Soils Treated with Organic Wastes,
W82-00797 5B

KICHENS, W. M.
Estimation of Material Fluxes in an Estuarine Cross Section: A Critical Analysis of Spatial Measurement Density and Errors,
W82-00816 7A

KIEFER, J. E.
Electrical Aspects of Adsorbing Colloid Flotation. XI. Surfactant Adsorption Isotherms, Particle Displacement, and Differential Capacitance,
W82-00788 1B

KIEFER, R. W.
Aerial Photography as an Aid to Cropland Erosion Analysis,
W82-00902 2J

KIKICHEV, KH. A.
Possibility of Using Tritium for Studying Global Circulation of Atmospheric Moisture,
W82-00863 2A

KING, G. A.
Methane Formation in the Acid Peats of Okefenokee Swamp, Georgia,
W82-00936 2H

KINGSOLVER, J.
The Effect of Environmental Uncertainty on Morphological Design and Fluid Balance in Sarracenia Purpurea L.,
W82-00811 2I

KIPP, K. L. JR.
Determination of Hydrogeological Parameters Using Sinusoidal Pressure Tests: A Theoretical Appraisal,
W82-00603 7B

KIRK, T. K.
Fungal Decolorization of Kraft Bleach Plant Effluents,
W82-00689 5D

KIRKLAND, D. W.
Dissolution of Salt Deposits by Brine Density Flow,
W82-01016 2F

KJERFVE, B.
Estimation of Material Fluxes in an Estuarine Cross Section: A Critical Analysis of Spatial Measurement Density and Errors,
W82-00816 7A

KLASSEN, M. J.
Hydraulic Design for the Two-Stage Stilling Basin,
W82-00849 8B

KLEEN, H.
Floc/Float System Cleans Desalter Effluent,
W82-00906 5D

KLEI, H. E.
Metal Leaching from Sewage Sludge Ash,
W82-00770 5B

KLEMAS, V.
Quantitative Assessment of Tidal Wetlands Using Remote Sensing,
W82-00781 7B

KLEPPEL, G. S.
Factors Controlling Phytoplankton Primary Productivity in Byram Lake, Mt. Kisco, N.Y., Summer, 1977,
W82-00915 2H

KLEY, W.
Waste Heat Balance in Aquifers Calculated by a Computer Programme,
W82-00830 7B

KLIBANOV, A. M.
Application of Immobilized Hydrogenase for the Detritiation of Water,
W82-00768 5D

KLING, H.
Experimental Manipulation of Algal Bloom Composition by Nitrogen Addition,
W82-00998 5C

KLUSEK, C.
Anthropogenic Trace Elements and Polycyclic Aromatic Hydrocarbon Levels in Sediment Cores From Two Lakes in the Adirondack Acid Lake Region,
W82-00501 5B

KNOCKE, W. R.
Vacuum Filtration of Metal Hydroxide Sludges,
W82-00976 5D

KNOERR, K. R.
Seasonal Patterns of Leaf Water Relations in Four Co-Occurring Forest Tree Species: Parameters from Pressure-Volume Curves,
W82-01011 2I

KNOWLES, G.
The Removal of Organic Matter from Demineralised Water,
W82-00888 5F

KOGIKU, K. C.
Game Theory Analyses Applied to Water Resource Problems,
W82-00802 6A

KOJOLA, W. H.
Home Water Softeners, Water Softness and Possible Health Implications,
W82-01045 5F

KOMAROV, V. D.
Study of the Factors and Regularities of River Runoff on the Basis of Data of Observations on Representative Basins,
W82-00652 2A

KONIKOW, L. F.
Role of Solute-Transport Models in the Analysis of Groundwater Salinity Problems in Agricultural Areas,
W82-00993 5B

KOPP, F. J.
Numerical Simulation of the Effects of Cooling Tower Complexes on Clouds and Severe Storms,
W82-00995 2B

KOPPE, P.
The Fate of Heavy Metals in the Ruhr System and Their Influence on Drinking Water Quality,
W82-00962 5B

KOYUMDJISKY, H.
The Use of Na/Cl Ratios to Trace Solute Sources in a Semiarid Zone,
W82-00601 7B

KRAMAR, O.
Occurrence of Tetraalkylead Compounds in the Aquatic Environment,
W82-00878 5A

KRENKEL, P. A.
Effectiveness of River Models,
W82-00961 6A

KRISHNA MURTHY, I.
Consumptive Use and Daily Evapotranspiration of Corn Under Different Levels of Nitrogen and Moisture Regimes,
W82-00660 2D

KROGMAN, K. K.
Response of Fababean Yield, Protein Production and Water Use to Irrigation,
W82-01089 2I

KROTHE, N. C.
The Relationship Between Fracture Traces and Joints in a Tertiary Basin, Southwest Montana,
W82-00829 7B

KRUGER, D.
An Assessment of the Trophic Status of Deer, Loon, and Diamond Lakes,
W82-01072 2H

KRUGER, D. M.
An Industrial and Hazardous Waste Inventory of Washington's Manufacturing Industries (1980),
W82-01065 5B

KRUIZE, R. R.
Flocculation of Clay Particles with a Synthetic Anionic Polymer,
W82-00773 5F

KRUSE, E. G.
Lateral Sizes for Efficient Level-Basin Irrigation,
W82-00942 3F

KUBO, T.
Ammonia Electrode with Immobilized Nitrifying Bacteria,
W82-01099 5A

KUCHMA, S. R.
Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay II. Mycological Aspects,
W82-00922 2L

KULATHILAKE, A. I.
Determination of Molybdenum in Sea and Estuarine Water with Beta-Naphthoin Oxime and Neutron Activation,
W82-01098 5A

KURANZ, J. H.
Distribution System Liability,
W82-01028 5F

KUZNETSOVA, L. P.
Possibility of Using Tritium for Studying Global Circulation of Atmospheric Moisture,
W82-00863 2A

KWAN, K. K.
Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay, Canada. I: Bacteriological Aspects,
W82-00921 2L

LAAK, R.
Mutlichamber Septic Tanks,
W82-00969 5D

LABAUGH, J. W.
Water Chemistry Changes During Artificial Aeration of Spruce Knob Lake, West Virginia,
W82-01049 5G

LABELLE, R. L.
Relationships Between Environmental Factors, Bacterial Indicators, and the Occurrence of Enteric Viruses in Estuarine Sediments,
W82-00574 5A

LACHER, M.
A Method for the Evaluation of Conditions in a Fish Pond Sediment,
W82-01019 2H

LACY, W.
The Nonfuel Minerals Industry: Regulatory Impacts,
W82-00612 5B

LAIRD, M. G.
Debris Flow Deposits of Early Miocene Age, Deadman Stream, Marlborough, New Zealand,
W82-00694 2J

LAKSHMINARAYANA, J. S. S.
Absorption of Fenitrothion by Plankton and Benthic Algae,
W82-00874 5B

LAMB, D. S.
Acute and Chronic Effects of Alum to Midge Larva (Diptera: Chironomidae),
W82-00650 5F

LAMB, J. D.
Determination of Alkaline Earth and Divalent Transition Metal Cations by Ion Chromatography with Sulfate-Suppressed Barium and Lead Eluents,
W82-01082 5A

LAMBERT, L.
Enrichment of the Agricultural Herbicide Atrazine in the Microsurface Water of an Estuary,
W82-00877 5B

LANCE, J. C.
Evaluation of Various Soil Water Samplers for Virological Sampling,
W82-00572 5A

Movement of Endotoxin Through Soil Columns,
W82-00586 5B

LANG, G. E.
Vegetational Analysis of Big Run Bog, A Nonglaciated Sphagnum Bog in West Virginia,
W82-00992 2I

LANGWORTHY, V. W.
Management Training is the Key to Good Operator Performance,
W82-00623 5D

LAROCK, P. A.
Water-To-Air Fractionation of Bacteria,
W82-00575 5B

LARSEN, C. E.
Freedom from the Navigation Servitude Through Private Investment,
W82-01030 6E

LARSON, G. L.
Interpreting Dynamics of Aquatic Resources: A Perspective for Resource Managers,
W82-00539 6A

LARSON, W. E.
Effects of Municipal Waste Water Effluent on Performance and Feed Quality of Maize Vs. Reed Canarygrass,
W82-00564 3C

LATTEN, A.
Automation of Norwich Sewage-Treatment Works: Early Cost Considerations,
W82-00955 5D

LAU, L. S.
Survival of Human Enteroviruses in the Hawaiian Ocean Environment: Evidence for Virus-Inactivating Microorganisms,
W82-00587 5C

LAUENROTH, W. K.
Water Status of Soil and Vegetation in a Shortgrass Steppe,
W82-00761 2I

LAWRENCE, J.
Chrysotile Asbestos Fiber Removal During Potable Water Treatment. Pilot Plant Studies,
W82-00613 5F

LEATHERLAND, T. M.
The Design and Interpretation of Marine Pollution Surveys,
W82-00700 6E

LEBEL, G. L.
Determination of Low NG/L Levels of Polychlorinated Biphenyls in Drinking Water by Extraction with Macroreticular Resin and Analysis Using a Capillary Column,
W82-00875 5A

Gas Chromatographic Determination of Trialkyl/Aryl Phosphates in Drinking Water, Following Isolation Using Macroreticular Resin,
W82-00502 5A

LEBEL, J.
Measurement of PH in the Estuarine Environment on the NBS Scale. (LA Mesure Du PH En Milieu Estuarien Sur L'Echelle NBS),
W82-00521 7B

LECHEVALLIER, M. W.
Effect of Turbidity on Chlorination Efficiency and Bacterial Persistence in Drinking Water,
W82-00865 5A

LEE, E. G-H.
Conversion of Abienol into Tetrahydroepimanool by Anaerobic Processes in Woodroom Debarking Effluent,
W82-00860 5C

LEE, G. B.
Aerial Photography as an Aid to Cropland Erosion Analysis,
W82-00902 2J

LEGGE, G. H. H.
Settlement of a Compacted Unsaturated Earth Embankment,
W82-00678 8D

LEGGETT, D. C.
Removal of Volatile Trace Organics from Wastewater by Overland Flow Land Treatment,
W82-01042 5D

LEHMAN, J. T.
The Effect of Changes in the Nutrient Income on the Condition of Lake Washington,
W82-00987 2H

LENHART, T. E.
Relation Between Trophic Position and Mercury Accumulation Among Fishes from the Tongue River Reservoir, Montana,
W82-01041 5A

LESLIE, J. K.
Measurement of Particulates Extrained in Some Great Lakes Power Plant Cooling Water: An Exercise in Futility,
W82-00782 6G

LESTER, J. N.
Sedimentation of Zeolite Type A in Water and Waste Water,
W82-00848 5D

LETTERMAN, R. D.
Economic Analysis of Granular-Bed Filtration,
W82-00975 5F

LEUNG, T-S.
Toxicities of Paraquat and Diquat Herbicides to Freshwater Copepods (Diaptomus Sp. and Eucyclops Sp.),
W82-00589 5C

LEWIS, D. W.
Debris Flow Deposits of Early Miocene Age, Deadman Stream, Marlborough, New Zealand,
W82-00694 2J

LIAW, W. K.
The Nature of Selected Prairie Lake and Stream Sediments,
W82-00815 2J

LIECHTY, B.
Giardia Prevalence in Commercially Trapped Mammals,
W82-01046 5A

LIJKLEMA, L.
Interaction of Orthophosphate with Iron (III) and Aluminum Hydroxides,
W82-00783 2H

LIKENS, G. E.
Acid Precipitation: The Importance of Nitric Acid,
W82-00643 2K

Phosphorus, Nirogen, and Organic Carbon Flux in a Headwater Stream,
W82-01021 2K

LINCER, J. L.
Organochlorine Residues in Kenya's Rift Valley Lakes,
W82-00690 5A

LINDHOLM, G. F.
Plan of Study for the Regional Aquifer-System Analysis of the Snake River Plain, Idaho and Eastern Oregon,
W82-00730 6A

LINNIK, P. N.
Methods of Investigating the State of Metal Ions in Natural Waters,
W82-00859 5A

LINTHURST, R. A.
Dieback of Salt-Water Cordgrass (Spartina Alterniflora Loisel.) in the Lower Cape Fear Estuary of North Carolina: An Experimental Approach to Re-Establishment,
W82-00889 2L

LIPPMAN, M. J.
Ground-Water Use for Cooling: Associated Aquifer Temperature Changes,
W82-01014 3E

LLOYD, B. J.
A Note on the Fate of El Tor Cholera and Other Vibrios in Percolating Filters,
W82-00566 5D

LOEB, S. L.
An In Situ Method for Measuring the Primary Productivity and Standing Crop of the Epilithic Periphyton Community in Lentic Systems,
W82-00756 7B

LOH, P. C.
Survival of Human Enteroviruses in the Hawaiian Ocean Environment: Evidence for Virus-Inactivating Microorganisms,
W82-00587 5C

LOMBARDO, P.
Waterborne Methylene Bis(2-Chloroaniline) and 2-Chloroaniline Contamination Around Adrian, Michigan,
W82-00873 5B

LONG, J. M.
Interim Method for Determining Asbestos in Water,
W82-00741 5A

LONGLEY, W. L.
Managing Oil and Gas Activities in Coastal Environments: Refuge Manual,
W82-01081 5G

LOONEY, B. B.
Assessment of Airborne Organic Contaminants in the Great Lakes Ecosystem,
W82-00709 5B

LOVE, O. T. JR.
Removing Trihalomethanes from Drinking Water,
W82-00953 5F

LOVERIDGE, C.
Effect of Metals on the Biomass Production Kinetics of Freshwater Copepods,
W82-00593 5C

LOWE, R. L.
Monitoring River Periphyton With Artificial Benthic Substrates,
W82-00581 5A

LUDINGTON, D. C.
The Breakdown of Poultry Manure Aggregates by Rainfall Impact,
W82-00513 5B

LUDWIG, K. L.
Foam Control in Aeration Tanks,
W82-00525 5D

LUND, D. E.
Empire Controlled by Computer,
W82-00529 5D

LUTHY, R.
Leach Characteristics of Coal-Gasification Char,
W82-01025 5B

LUTHY, R. G.
Biological Treatment of Synthetic Fuel Wastewater,
W82-00971 5D

LYONS, W. B.
Trace Metal Fluxes to Nearshore Long Island Sound Sediments,
W82-01040 5B

MACCHI, G.
Voltammetric Characterization and Chemical Behavior of Inorganic Tin in Natural Waters,
W82-00627 5A

MACIOROWSKI, A. F.
Preference-Avoidance Reactions of Crayfish to Sublethal Concentrations of Cadmium,
W82-00916 5A

MACK, S.
Hydrogeology of the Sierra Nevada Foothill Lineament Near Oakhurst, California,
W82-00831 2F

MACRAE, W. R.
R Factors in Coliform-Fecal Coliform Sewage Flora of the Prairies and Northwest Territories of Canada,
W82-00508 5A

MACTAVISH, D.
Residues of Nonylphenol in Spruce Foliage, Forest Soil, Stream Water and Sediment After its Aerial Application,
W82-00559 5B

MADDY, K. T.
A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
W82-00532 5A

MADSEN, B. C.
Acid Rain at Kennedy Space Center, Florida: Recent Observations,
W82-00533 5B

MAGGERT, J. E.
Superseparation: Soret Effect Reversed,
W82-00791 3A

MAH, R. A.
Thin Layer Chromatographic and Atomic Absorption Spectrophotometric Determination of Methyl Mercury,
W82-00503 5A

MALINA, J. F. JR.
Chemicals Disinfect Sludge,
W82-01003 5D

MANDAL, L. N.
Inorganic Transformation of Applied Phosphorus in Brackish Water Fish Pond Soil Under Different Water Salinity Levels,
W82-00920 2H

MANKIN, J. B.
A Comparison of Sensitivity Analysis and Error Analysis Based on a Stream Ecosystem Model,
W82-00991 7A

MANN, R.
Growth of the Bay Scallop, Argopecten Irradians, in a Waste Recycling Aquaculture System,
W82-00842 3C

MARGARITZ, M.
The Use of Na/Cl Ratios to Trace Solute Sources in a Semiarid Zone,
W82-00601 7B

MARGLER, L. W.
Thin Layer Chromatographic and Atomic Absorption Spectrophotometric Determination of Methyl Mercury,
W82-00503 5A

MARINI, R. C.
Potential Political Influences Affecting the Water Industry,
W82-00861 6C

MARSON, H.
Floc/Float System Cleans Desalter Effluent,
W82-00906 5D

MARTEL, C. J.
Removal of Volatile Trace Organics from Wastewater by Overland Flow Land Treatment,
W82-01042 5D

MARTEN, G. C.
Effects of Municipal Waste Water Effluent on Performance and Feed Quality of Maize Vs. Reed Canarygrass,
W82-00564 3C

MARTI, YU. YU.
The Azov Sea Problem,
W82-00651 6G

MARTIN, B. B.
Potential Management of Florida Red Tide Through Selective Photodynamic Action,
W82-00515 5G

MARTIN, C. S.
Receiving Stream Fisheries Studies Relative to Secondary Treated Pulp and Paper Mill Effluents,
W82-00688 5C

MARTIN, D. F.
Potential Management of Florida Red Tide Through Selective Photodynamic Action,
W82-00515 5G

MARTIN, R. J.
Pilot Plant Performances in Municipal Wastewater Treatment by Activated Carbon Adsorption,
W82-00851 5D

MARTIN, W. W.
Hydraulic Model Study for the Design of the Wreck Cove Control Gates,
W82-00880 8B

MATHIAS, J. A.
Relationship Between Thermal Stability and Summer Oxygen Depletion in a Prairie Pothole Lake,
W82-00545 2H

MATHIESON, A. C.
Seasonal Influx and Decomposition of Autochthonous Macrophyte Litter in a North Temperate Estuary,
W82-00918 2L

MATHUR, D.
Assessment of Thermal Discharges on Zooplankton in Conowingo Pond, Pennsylvania,
W82-00592 5C

MATOUSEK, J. P.
Determination of Chromium Speciation in Natural Waters by Electrodeposition on Graphite Tubes for Electrothermal Atomization,
W82-01084 5A

MATTHEWS, S. B.
Factors Affecting Puget Sound Coho Salmon (Oncorhynchus Kisutch) Runs,
W82-00883 8I

MATUSHANSKII, M. V.
The Azov Sea Problem,
W82-00651 6G

MAUCK, W. L.
Toxicity of Five Forest Insecticides to Cutthroat Trout and Two Species of Aquatic Invertebrates,
W82-00590 5C

MAUGHAN, O. E.
Accurate and Efficient Estimation of Benthic Populations: A Comparison Between Removal Estimation and Conventional Sampling Techniques,
W82-00633 5A

MAYER, J.
The Manifestation of Dehydration Avoidance in Wheat Breeding Germplasm,
W82-00958 2I

MCBEAN, E. A.
Simulation Modeling of Primary Clarifiers,
W82-01027 6A

MCCARL, B. A.
Risk and the Demand for Supplemental Irrigation: A Case Study in the Corn Belt,
W82-00522 6A

MCCARTHY, R. L.
Control Systems for Return and Waste Sludge,
W82-00949 5D

MCCARTY, P. L.
Utilization of Dichloromethane by Suspended and Fixed-Film Bacteria,
W82-00577 5B

MCCLURE, J. R.
Aquatic Weed Cutting Apparatus,
W82-00624 4A

MCCORMICK, A. M.
Vegetational Analysis of Big Run Bog, A Nonglaciated Sphagnum Bog in West Virginia,
W82-00992 2I

MCCOY, G. C.
Dairy Liquid Waste Distribution in an Overland Flow Vegetative-Soil Filter System,
W82-00897 5D

MCCOY, P.
Trace Element Concentrations Over Midlake Michigan as a Function of Meteorology and Source Region,
W82-00550 5B

MCDIFFETT, W. F.
Limnological Characteristics of Several Lakes on the Lake Wales Ridge, South-Central Florida,
W82-00914 2H

MCDOWELL, L. L.
Sediment Sizes Eroded from Crop Row Sideslopes,
W82-00903 2J

MCELROY, M. B.
Transformations of Nitrogen in a Polluted Estuary: Nonlinearities in the Demand for Oxygen at Low Flow,
W82-00777 5B

MCGEE, A. B.
Photosynthesis and Growth in Populations of Populus Deltoides from Constrating Habitats,
W82-00935 2I

MCGEE, M.
Health Effects of Monochloramines in Drinking Water,
W82-01091 5C

MCGUIRE, P. E.
Sample Intake Position and Loading Rates from Nonpoint Source Pollution,
W82-00778 5A

MCINTOSH, A. W.
The Effects of Heavy Metals on Microbial Biomass in Sediments of Palestine Lake,
W82-00925 5C

MCKAGUE, A. B.
Conversion of Abienol into Tetrahydroepimanool by Anaerobic Processes in Woodroom Debarking Effluent,
W82-00860 5C

MCKENZIE, R. C.
Response of Fababean Yield, Protein Production and Water Use to Irrigation,
W82-01089 2I

MCKINLEY, I. G.
Evidence of the Unsuitability of Gravity Coring for Collecting Sediment in Pollution and Sedimentation Rate Studies,
W82-00840 7B

MCLAREN, J. W.
Comparison of Methods for the Determination of Trace Elements in Seawater,
W82-01086 5A

MCLELLAN, B.
Evaluating Irrigation Systems,
W82-00772 6B

MCMAHON, B. R.
Cation Transport in Packed Bed Reactor of Soil,
W82-00970 5D

MCMILLAN, M.
Evaluation of the Oldman River Basin Irrigation Proposals: Implications for Interbasin Transfers,
W82-00519 6B

MCNAUGHTON, D. J.
Relationships Between Sulfate and Nitrate Ion Concentrations and Rainfall PH for Use in Modeling Applications,
W82-00507 5B

MCPHERSON, M. B.
Evaluation of Areal Versus Point Rainfall with Sparse Data,
W82-00835 2B

MCWILLIAM, J. R.
Research and Development to Service a Sustainable Agriculture,
W82-00669 3F

MEDLAR, S.
Design and Construction of the Danvers, Massachusetts Water Processing Plant,
W82-01088 5F

MEIGS, J. W.
Asbestos Cement Pipe and Cancer in Connecticut 1955-1974,
W82-01094 5C

MEIS, J. F. G. M.
Comparison of a Few Systems for the Determination of Saprobic and Trophic Degree on the Basis of Plankton Data,
W82-00664 2H

MELNICK, J. L.
Relationships Between Environmental Factors, Bacterial Indicators, and the Occurrence of Enteric Viruses in Estuarine Sediments,
W82-00574 5A

MEYER, J. L.
Phosphorus, Nirogen, and Organic Carbon Flux in a Headwater Stream,
W82-01021 2K

MEYER, L. D.
Sediment Sizes Eroded from Crop Row Sideslopes,
W82-00903 2J

MICHAEL, P. R.
An Environmental Safety Assessment of Butyl Benzyl Phthalate,
W82-00615 5A

MIDDLETON, A. C.
Potential Eutrophication of the Rideau River by an Urban Drainage Waterway,
W82-00834 5C

MIEURE, J. P.
Determining Volatile Organics in Water,
W82-00630 5A

MILLER, M. R.
Saline Seep Development and Control in the North American Great Plains - Hydrogeological Aspects,
W82-01022 5B

MILLER, P. C.
Comparative Field Water Relations of Four Co-Occuring Chaparral Shrub Species,
W82-00762 2I

Soil Moisture Relations in the Southern California Chaparral,
W82-01035 2D

Some Aspects of Plant Water Relations in Alaskan Arctic Tundra Species,
W82-00846 2I

MILLER, S.
Adsorption on Carbon: Solvent Effects on Adsorption,
W82-00619 5F

Environmental Health Hazards,
W82-00625 5F

Water-Treatment Chemicals,
W82-00618 5F

MILLER, T. D.
Effects of Water Quality on Forage Production,
W82-01002 3C

MILLER, W. L.
Risk and the Demand for Supplemental Irrigation: A Case Study in the Corn Belt,
W82-00522 6A

MILLETTE, J. R.
The Activity of Environmental Samples in a Cell Culture Test for Asbestos Toxicity,
W82-01031 5C

Asbestos Cement Pipe and Cancer in Connecticut 1955-1974,
W82-01094 5C

MILLS, J. L.
Ferric Chloride Takes Over,
W82-00954 5F

MINCKLEY, W. L.
Factors Influencing Fish Distribution in Two Desert Reservoirs, Central Arizona,
W82-00814 2H

MIRAIDE, M.
Multielement Preconcentration of Trace Heavy Metals in Water by Coprecipitation and Flotation with Indium Hydroxide for Inductively Coupled Plasma-Atomic Emission Spectrometry,
W82-01097 5A

MITCHELL, C. P.
Control of Water Weeds by Grass Carp in Two Small Lakes,
W82-00609 3B

MITTERMEYER, F. C.
Dispersal of Salmonella from a Polluted Stream to Neighboring Terrestrial Habitats,
W82-01043 5A

MIZUIKE, A.
Multielement Preconcentration of Trace Heavy Metals in Water by Coprecipitation and Flotation with Indium Hydroxide for Inductively Coupled Plasma-Atomic Emission Spectrometry,
W82-01097 5A

MOLLARET, H. H.
New Waterborne Bacteriophages Active on Yersinia Enterocolitica,
W82-00662 5A

MOLLENDORF, J. C.
Buoyancy Force Reversals in Vertical Natural Convection Flows in Cold Water,
W82-00981 1A

MOLODTSOV, V. A.
Irrigation and Drainage Waters of a New Irrigation Zone in the Hungry Steppe and Possibilities of their Use,
W82-00658 3C

MONKE, E. J.
Answers: A Model for Watershed Planning,
W82-00898 6A

Subsurface Drainage and Sediment Transport Model,
W82-00894 2G

MOORE, G. S.
Health Effects of Monochloramines in Drinking Water,
W82-01091 5C

MOORE, J. E.
Measurement of Particulates Extrained in Some Great Lakes Power Plant Cooling Water: An Exercise in Futility,
W82-00782 6G

MOORE, J. S.
Illinois Groundwater Problems and Needs,
W82-01052 4B

MOORE, L. L.
An Intangible Benefit of Water Pollution Control Programs,
W82-01092 6B

MORGADE, C.
Determination of Polyhalogenated Phenolic Compounds in Drinking Water, Human Blood Serum and Adipose Tissue,
W82-00879 5A

MORGAN, K. M.
Aerial Photography as an Aid to Cropland Erosion Analysis,
W82-00902 2J

MORRIS, C. E.
Low-Cost Wastewater Treatment,
W82-00841 5D

MORRIS, D. R.
Aerial Photography as an Aid to Cropland Erosion Analysis,
W82-00902 2J

MORRIS, R.
Environmental Virology and its Problems,
W82-00505 5A

MOSEY, F. E.
Anaerobic Biological Treatment of Food Industry Wastewaters,
W82-00698 5D

MOSS, A. J.
Movement of Loose, Sandy Detritus by Shallow Water Flows: An Experimental Study,
W82-00776 2J

MOTZ, L. H.
Well-Field Drawdowns Using Coupled Aquifer Model,
W82-00990 2F

MUCK, R. E.
The Breakdown of Poultry Manure Aggregates by Rainfall Impact,
W82-00513 5B

MUIR, D. C. G.
Determination of Terbutryn and its Degradation Products in Water, Sediments, Aquatic Plants, and Fish,
W82-00567 5A

MUNOZ, E. F.
Microbial Mobilization of Calcium and Magnesium in Waterlogged Soils,
W82-00560 2G

MURPHREE, C. E.
Sediment Yield from a Flatland Watershed,
W82-00941 2J

MURPHY, T. P.
Ammonia and Nitrate Uptake in the Lower Great Lakes,
W82-00882 2H

MURRAY, C. M.
Trenching of Digested Sludge,
W82-00974 5E

MUTCHLER, C. K.
Effect of Slope Length on Erosion from Low Slopes,
W82-00896 2J

Sediment Yield from a Flatland Watershed,
W82-00941 2J

MUZYLEV, S. V.
Probability-Theoretical Analysis of Fluctuations in the Level of a Closed Water Body,
W82-00571 2H

MYKYTIUK, A. P.
Comparison of Methods for the Determination of Trace Elements in Seawater,
W82-01086 5A

Simultaneous Determination of Iron, Cadmium, Zinc, Copper, Nickel, Lead, and Uranium in Seawater by Stable Isotope Dilution Spark Source Mass Spectrometry,
W82-00786 5A

NABIVANETS, B. I.
Methods of Investigating the State of Metal Ions in Natural Waters,
W82-00859 5A

NADLER, A.
The Use of Na/Cl Ratios to Trace Solute Sources in a Semiarid Zone,
W82-00601 7B

NAKAJIMA, T.
Chemical Composition of Labile Fractions in DOM,
W82-00917 2H

NAQVI, N. Z.
Toxicities of Paraquat and Diquat Herbicides to Freshwater Copepods (Diaptomus Sp. and Eucyclops Sp.),
W82-00589 5C

NAQVI, S. M.
Toxicities of Paraquat and Diquat Herbicides to Freshwater Copepods (Diaptomus Sp. and Eucyclops Sp.),
W82-00589 5C

NASH, R. G.
Distribution of Silvex, 2,4-D, and TCDD Applied to Turf in Chambers and Field Plots,
W82-00568 5B

NEGRI, A. J.
Relation of Satellite-Based Thunderstorm Intensity to Radar-Estimated Rainfall,
W82-00806 2B

NEISSER, M. P.
Potential for Land Disposal of Two Nonbiodegradable Wastes,
W82-00939 5D

NELSON, C. R.
Aromatic Amines in and Near the Buffalo River,
W82-00622 5B

NELSON, D. W.
The Effects of Heavy Metals on Microbial Biomass in Sediments of Palestine Lake,
W82-00925 5C

NELSON, P. F.
Groundwater Problems in North Carolina,
W82-01056 4B

NELSON, S. G.
Kinetics of Nitrate and Ammonium Uptake by the Tropical Freshwater Macrophyte Pistia Stratiotes L.,
W82-00937 5D

NEWPORT, R.
Factors Influencing the Occurrence of Bursts in Iron Water Mains,
W82-00960 8A

NEWTON, A. J.
The Design and Interpretation of Marine Pollution Surveys,
W82-00700 6E

NG, E.
Soil Moisture Relations in the Southern California Chaparral,
W82-01035 2D

NGUYEN, V-T-V.
Evaluation of Areal Versus Point Rainfall with Sparse Data,
W82-00835 2B

NICOL, S. M.
Environmental Aspects of Rural Development with Particular Reference to the Keiskamma River Basin Study,
W82-00685 6D

NIEBOER, E.
Determination of Nickel by Differential Pulse Polarography at a Dropping Mercury Electrode,
W82-01100 5A

NIKOLAEV, I. I.
Theory of Ecological Prediction of Limnetic Ecosystems,
W82-00597 6G

NOBEL, P. S.
Water Vapor Conductance and CO2 Uptake for Leaves of a C4 Desert Grass, Hilaria Rigida,
W82-01039 2I

NORDMEYE, F. R.
Determination of Alkaline Earth and Divalent Transition Metal Cations by Ion Chromatography with Sulfate-Suppressed Barium and Lead Eluents,
W82-01082 5A

NORNBERG, P.
The Kyholm Corer--A Diver-Operated Sediment Corer,
W82-00793 7B

NORTHEIMER, J.
Ground Water Problems in West Virginia,
W82-01060 4B

NORTON, D.
Assessment of Water Quality Conditions in Skamokawa Creek, Washington,
W82-01066 5C

NOVAK, J. T.
Vacuum Filtration of Metal Hydroxide Sludges,
W82-00976 5D

NUGENT, C. E.
The Effects of Heavy Metals on Microbial Biomass in Sediments of Palestine Lake,
W82-00925 5C

O'CONNELL, P. E.
Adaptive Hydrological Forecasting - A Review,
W82-00984 2A

O'CONNORS, H. B. JR.
Uptake of Polychlorinated Biphenyls by Natural Phytoplankton Assemblages: Field and Laboratory Determination of C14-PCB Particle-Water Index of Sorption,
W82-01032 5B

O'GRADY, S. M.
Description of a New Submersible Filter-Pump Apparatus for Sampling Plankton,
W82-01012 7B

O'MELIA, C. R.
Aquasols: The Behavior of Small Particles in Aquatic Systems,
W82-00540 1B

O'NEILL, R. V.
A Comparison of Sensitivity Analysis and Error Analysis Based on a Stream Ecosystem Model,
W82-00991 7A

OBERAUER, S.
Some Aspects of Plant Water Relations in Alaskan Arctic Tundra Species,
W82-00846 2I

OBEYSEKERA, J. T. B.
Identification of Streamflow Stochastic Models,
W82-00555 2A

OCHIAI, M.
Chemical Composition of Labile Fractions in DOM,
W82-00917 2H

Vertical Distribution of Monosaccharides in Lake Water,
W82-00665 2H

OCHS, J. D.
Composting Is Working in Camden,
W82-00948 5E

OKOS, M. R.
A Non-Equilibrium Thermodynamics Approach to Transport Phenomena in Capillary Porous Media,
W82-00697 2F

OLOFFS, P. C.
Residues in Cutthroat Trout (Salmo Clarki) and California Newts (Tarichia Torosa) From a Lake Treated With Technical Chlordane,
W82-00558 5C

OLSEN, F. J.
Dairy Liquid Waste Distribution in an Overland Flow Vegetative-Soil Filter System,
W82-00897 5D

OLSON, F. W.
Factors Affecting Puget Sound Coho Salmon (Oncorhynchus Kisutch) Runs,
W82-00883 8I

ORLOB, G. T.
Impact of Water Resource Development on Salinization of Semi-Arid Lands,
W82-01024 5B

ORVILLE, H. D.
Numerical Simulation of the Effects of Cooling Tower Complexes on Clouds and Severe Storms,
W82-00995 2B

OSBORNE, P. L.
Prediction of Phosphorus and Nitrogen Concentrations in Lakes from Both Internal and External Loading Rates,
W82-00928 2H

OSCARSON, D. W.
The Nature of Selected Prairie Lake and Stream Sediments,
W82-00815 2J

OTSON, R.
Assessment of Some Aqueous Residual Chlorine Measurements,
W82-00867 5F

OVERCASH, M. R.
Behavior and Transport of Microbial Pathogens and Indicator Organisms in Soils Treated with Organic Wastes,
W82-00797 5B

OVERMAN, A. R.
Cation Transport in Packed Bed Reactor of Soil,
W82-00970 5D

OVERTON, J. H.
Influence of Gaseous Nitric Acid on Sulfate Production and Acidity in Rain,
W82-00642 5B

OWEN, R. B.
Effects of a Cattleskin Tannery of Stream Quality and Benthic Macroinvertebrates in Central Maine,
W82-00872 5C

OWENS, L. B.
Effects of Nitrapyrin on Nitrate Movement in Soil Columns,
W82-01048 5G

PANE, G.
Distribution and Biological Availability of Reactive High Molecular Weight Phosphorus in Natural Waters in New Zealand,
W82-00659 2H

PAPST, M. H.
Relationship Between Thermal Stability and Summer Oxygen Depletion in a Prairie Pothole Lake,
W82-00545 2H

PARIS, D. F.
Correlation of Microbial Degradation Rates With Chemical Structure,
W82-00621 2K

PARIZEK, R. R.
Numerical Simulation of Potentiometric Surface Changes Caused by a Proposed Open-Pit Anthracite Mine,
W82-00819 6A

PARRIS, G. E.
Waterborne Methylene Bis(2-Chloroaniline) and 2-Chloroaniline Contamination Around Adrian, Michigan,
W82-00873 5B

PARSONS, L. R.
Clonal Variations in the Water Relations of Red Osier Dogwood During Cold Acclimation,
W82-00839 2I

PARTON, W. J.
Water Status of Soil and Vegetation in a Shortgrass Steppe,
W82-00761 2I

PATERSON, J. J.
Dairy Liquid Waste Distribution in an Overland Flow Vegetative-Soil Filter System,
W82-00897 5D

PATRICK, W. H. JR.
Degradation of Hydrocarbons in Oxidized and Reduced Sediments,
W82-00907 5B

Effect of pH and Redox Potential on Concentration of Dissolved Nutrients in an Estuarine Sediment,
W82-00795 2L

PAYNTER, M. J. B.
Enumeration of Bacteriophages and Host Bacteria in Sewage and the Activated-Sludge Treatment Process,
W82-00584 5A

PEAK, J. E.
Numerical Simulation of the Effects of Cooling Tower Complexes on Clouds and Severe Storms,
W82-00995 2B

PEEBLES, R. W.
A Leaky Reservoir Model for Ephemeral Flow Recession,
W82-00600 2E

PELLETIER, E.
Measurement of PH in the Estuarine Environment on the NBS Scale. (LA Mesure Du PH En Milieu Estuarien Sur L'Echelle NBS),
W82-00521 7B

PEOPLES, S. A.
A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
W82-00532 5A

PERRY, R.
Sedimentation of Zeolite Type A in Water and Waste Water,
W82-00848 5D

PESKIN, H. M.
The Distribution of the Costs of Federal Water Pollution Control Policy,
W82-00537 6B

PETERS, H. G. SR.
Mixing Technology Reduces Energy Use,
W82-00634 5D

PETERSON, A. W.
Graphed Equilibrium Parameters of Channels Formed in Sediment,
W82-00881 2J

PETERSON, M. E.
Soil Percolation Tests,
W82-01044 2G

PETTINE, M.
Voltammetric Characterization and Chemical Behavior of Inorganic Tin in Natural Waters,
W82-00627 5A

PETTS, G. E.
Morphological Changes of River Channels Consequent Upon Headwater Impoundment,
W82-01087 6G

PETTYJOHN, W. A.
Sampling Ground Water for Organic Contaminants,
W82-00820 5A

PFAFFENBERGER, C. D.
Determination of Polyhalogenated Phenolic Compounds in Drinking Water, Human Blood Serum and Adipose Tissue,
W82-00879 5A

PHILLIPS, G. R.
Relation Between Trophic Position and Mercury Accumulation Among Fishes from the Tongue River Reservoir, Montana,
W82-01041 5A

PHILLIPS, W.
Evaluation of the Oldman River Basin Irrigation Proposals: Implications for Interbasin Transfers,
W82-00519 6B

PIEBER, M.
Purification of Wastewater by Electrolysis,
W82-00847 5D

PITMAN, R. M.
Seasonal Changes in Leaf Area, Stomatal and Canopy Conductances and Transpiration From Bracken Below a Forest Canopy,
W82-00655 2D

PLAN, B.
Giardia Prevalence in Commercially Trapped Mammals,
W82-01046 5A

PONCE, V. M.
Modeling Gradual Dam Breaches,
W82-00554 8D

POPE, D. H.
Effect of Temperature on Mineralization by Heterotrophic Bacteria,
W82-00583 5C

Influence of Seasonal Temperature on the Temperature Optima of Bacteria in Sediments of Lake George, New York,
W82-00606 2H

POPPITI, J. A.
Waterborne Methylene Bis(2-Chloroaniline) and 2-Chloroaniline Contamination Around Adrian, Michigan,
W82-00873 5B

POWELL, R. D.
Debris Flow Deposits of Early Miocene Age, Deadman Stream, Marlborough, New Zealand,
W82-00694 2J

POWERS, C. D.
Uptake of Polychlorinated Biphenyls by Natural Phytoplankton Assemblages: Field and Laboratory Determination of C14-PCB Particle-Water Index of Sorption,
W82-01032 5B

PRATT, P. F.
Estimation of the Salt Burden of Irrigation Drainage Waters,
W82-00563 5B

PRICE, D.
Summary Appraisal of Water Resources in the Redmond Quadrangle, Sanpete and Sevier Counties, Utah,
W82-00725 7C

PRICKETT, T. A.
Mathematical Modeling Techniques for Groundwater Management,
W82-01062 4B

PRIVAL'SKII, V. E.
The Azov Sea Problem,
W82-00651 6G

PROEHL, J. A.
Estimation of Material Fluxes in an Estuarine Cross Section: A Critical Analysis of Spatial Measurement Density and Errors,
W82-00816 7A

PRUELL, R. J.
Partitioning of No. 2 Fuel Oil in Controlled Estuarine Ecosystems. Sediments and Suspended Particulate Matter,
W82-00541 2L

PUKITE, A. H.
Trace Element Accumulation, Movement, and Distribution in the Soil Profile From Massive Applications of Sewage Sludge,
W82-00640 5E

PURDY, E. J. JR.
Assessment of Thermal Discharges on Zooplankton in Conowingo Pond, Pennsylvania,
W82-00592 5C

PYMAR, C. F.
Seasonal Changes in Leaf Area, Stomatal and Canopy Conductances and Transpiration From Bracken Below a Forest Canopy,
W82-00655 2D

QUACKENBUSH, D. W.
Aluminum Shadowing-Direct Projection Photomicroscopy of Diatom Frustules,
W82-00884 5A

QUESENBERRY, K. H.
Growth and Nitrogen Fixation of Aeschynomene Under Water Stressed Conditions,
W82-00758 2I

QUINN, J. G.
Partitioning of No. 2 Fuel Oil in Controlled Estuarine Ecosystems. Sediments and Suspended Particulate Matter,
W82-00541 2L

RAATS, P. A. C.
Residence Times of Water and Solutes Within and Below the Root Zone,
W82-00932 2G

RAI, H.
Classification of Central Amazon Lakes on the Basis of their Microbiological and Physico-Chemical Characteristics,
W82-00666 2H

RAMANUJAM, V. M. SADAGOPA
Chloramine-T as A Potential Scrubbing Agent: Removal of Odorous Sulfur-Containing Environmental Pollutants,
W82-00871 5D

RAMIREZ, A.
Chemicals Disinfect Sludge,
W82-01003 5D

RANSFORD, R.
Dispersal of Salmonella from a Polluted Stream to Neighboring Terrestrial Habitats,
W82-01043 5A

RATKOVICH, D. YA.
The Azov Sea Problem,
W82-00651 6G

The Caspian Sea Problem,
W82-00657 4A

RAVEH, A.
A Method for the Evaluation of Conditions in a Fish Pond Sediment,
W82-01019 2H

RAWITZ, E.
The Effects of Sodium and Organic Matter In Sewage Effluent on Water Retention Properties of Soils,
W82-00663 3C

REBUCK, E. C.
Ground Water in the Ohio River Basin Portion of Maryland: Problems and Needs,
W82-01054 4B

RECKHOW, K. H.
A Procedure Using Modeling and Error Analysis for the Prediction of Lake Phosphorus Concentration from Land Use Information,
W82-00546 5G

REDDY, C. N.
Effect of pH and Redox Potential on Concentration of Dissolved Nutrients in an Estuarine Sediment,
W82-00795 2L

REDDY, K. R.
Behavior and Transport of Microbial Pathogens and Indicator Organisms in Soils Treated with Organic Wastes,
W82-00797 5B

REED, P.
Acute Toxicity of Zinc to Some Fishes in High Alkalinity Water,
W82-00713 5C

REICE, S. R.
The Role of Substratum in Benthic Macroinvertebrate Microdistribution and Litter Decomposition in a Woodland Stream,
W82-01037 2E

REICH, P. B.
Water Relations, Soil Fertility, and Plant Nutrient Composition of a Pygmy Oak Ecosystem,
W82-01034 2I

REICHMAN, G. A.
Watertable Management Saves Water and Energy,
W82-00943 3F

REID, R. C.
Toxic Dinoflagellates and Tidal Power Generation in the Bay of Fundy, Canada,
W82-00908 6G

REISS, B.
The Activity of Environmental Samples in a Cell Culture Test for Asbestos Toxicity,
W82-01031 5C

REMIZOVA, S. S.
The Azov Sea Problem,
W82-00651 6G

RENDELL, P. S.
Adsorption as a Control of Metal Concentrations in Sediment Extracts,
W82-00614 5A

RICCI, V.
Effect of Ozonation and Chlorination on the Mutagenic Potential of Drinking Water,
W82-00649 5A

RICHARDSON, W. H.
Experience Gained with the U.S. Pollution Control Policies,
W82-00996 6E

RICHEY, D.
Acute Toxicity of Zinc to Some Fishes in High Alkalinity Water,
W82-00713 5C

RIGGLE, F. R.
Effects of Joule Heating on Thermocouple Psychrometer Water Potential Determinations,
W82-00892 7B

RIGGLEMAN, J. D.
Search for Linuron Residues in Tributaries of the Chesapeake Bay,
W82-00569 5A

RINNE, J. N.
Factors Influencing Fish Distribution in Two Desert Reservoirs, Central Arizona,
W82-00814 2H

RITCHIE, J. T.
Water Dynamics in the Soil-Plant-Atmosphere System,
W82-00759 2I

RITTER, W. F.
Potential for Land Disposal of Two Nonbiodegradable Wastes,
W82-00939 5D

RITTMANN, B. E.
Utilization of Dichloromethane by Suspended and Fixed-Film Bacteria,
W82-00577 5B

ROBBINS, T. W.
Assessment of Thermal Discharges on Zooplankton in Conowingo Pond, Pennsylvania,
W82-00592 5C

ROBERTS, J.
Glen Canyon Dam Is Killing the Grand Canyon and Your Tax Dollars Are Paying for It.
W82-00813 6G

Seasonal Changes in Leaf Area, Stomatal and Canopy Conductances and Transpiration From Bracken Below a Forest Canopy,
W82-00655 2D

ROBERTS, K. J.
Chrysotile Asbestos Fiber Removal During Potable Water Treatment. Pilot Plant Studies,
W82-00613 5F

ROBERTS, S. W.
Comparative Field Water Relations of Four Co-Occuring Chaparral Shrub Species,
W82-00762 2I

Seasonal Patterns of Leaf Water Relations in Four Co-Occurring Forest Tree Species: Parameters from Pressure-Volume Curves,
W82-01011 2I

ROBSON, S. G.
Hydrogeochemistry and Simulated Solute Transport, Piceance Basin, Northwestern Colorado,
W82-00723 5B

RODHE, A.
Spring Flood: Meltwater or Groundwater,
W82-00531 7B

RODHE, H.
A Numerical Comparison Between Lagrangian and Eulerian Rainfall Statistics,
W82-00803 2B

ROGERS, J. S.
The Nature of Selected Prairie Lake and Stream Sediments,
W82-00815 2J

ROGERS, K. H.
The Pongolo Floodplain: A Unique Ecosystem Threatened,
W82-00684 6G

ROGERS, L. B.
New Liquid Chromatographic Detection System for Environmental Pollutants,
W82-00740 5A

ROGERSON, A.
Effect of Crude Oil and Petroleum-Degrading Microorganisms on the Growth of Freshwater and Soil Protozoa,
W82-00517 5C

ROGOWSKI, A. S.
Modeling Water Flux on Strip-Mined Land,
W82-00944 2G

ROHDE, W.
Reviving Acidified Lakes,
W82-00933 2H

ROLLAND, D.
Simultaneous Concentration of Salmonella and Enterovirus From Surface Water by Using Micro-Fiber Glass Filters,
W82-00573 5A

ROLLINS, D. K.
Determination of Alkaline Earth and Divalent Transition Metal Cations by Ion Chromatography with Sulfate-Suppressed Barium and Lead Eluents,
W82-01082 5A

ROMANOV, V. V.
Possibility of Using Tritium for Studying Global Circulation of Atmospheric Moisture,
W82-00863 2A

ROSEBOOM, D.
Acute Toxicity of Zinc to Some Fishes in High Alkalinity Water,
W82-00713 5C

ROSENBERG, D. M.
Sampling Emerging Chironomidae (Diptera) With Submerged Funnel Traps in a New Northern Canadian Reservoir, Southern Indian Lake, Manitoba,
W82-00520 2H

ROSENBLATT, D. H.
Preliminary Pollutant Limit Values for Human Health Effects,
W82-00628 5G

ROSS, H. A.
Investigations of Control Mechanisms of Germination Under Water Stress,
W82-00912 2I

ROSS, L. T.
Diel Variations of Selected Physico-Chemical Parameters in Lake Kissimmee, Florida,
W82-00535 2H

ROUSSELLE, J.
Evaluation of Areal Versus Point Rainfall with Sparse Data,
W82-00835 2B

ROWLAND, R. G.
Uptake of Polychlorinated Biphenyls by Natural Phytoplankton Assemblages: Field and Laboratory Determination of C14-PCB Particle-Water Index of Sorption,
W82-01032 5B

ROY, P. S.
Holocene Sequences on an Embayed High-Energy Coast: An Evolutionary Model,
W82-00695 2J

RUDD, J. W. M.
Dynamics of Selenium in Mercury-Contaminated Experimental Freshwater Ecosystems,
W82-00595 5B

RUSSELL, D. S.
Simultaneous Determination of Iron, Cadmium, Zinc, Copper, Nickel, Lead, and Uranium in Seawater by Stable Isotope Dilution Spark Source Mass Spectrometry,
W82-00786 5A

RUTHERFORD, M. C.
Annual Plant Production-Precipitation Relations in Arid and Semi-Arid Regions,
W82-00693 2I

RYALS, G. N.
Potentiometric Surface of the Wilcox-Carrizo Aquifer; Bienville, Red River, Northern Natchitoches, and Southern Webster Parishes, Louisana,
W82-00728 7C

SADASIVAN, S.
Trace Constituents in Cloud Water, Rainwater and Aerosol Samples Collected near the West Coast of India During the Southwest Monsoon,
W82-00676 2B

SAEGER, V. W.
Biodegradability of Halogen-Substituted Diphenylmethanes,
W82-00599 5B

SALA, O. E.
Water Status of Soil and Vegetation in a Shortgrass Steppe,
W82-00761 2I

SALAS, J. D.
Identification of Streamflow Stochastic Models,
W82-00555 2A

SALTZMAN, S.
Dye-Sensitized Photooxidation of Bromacil in Water,
W82-00514 5B

SAMOILOFF, M. R.
A Rapid Simple Long-Term Toxicity Assay for Aquatic Contaminants Using the Nematode Panagrellus Redivivus,
W82-01017 5A

SAMUELS, W. B.
Factors Controlling Phytoplankton Primary Productivity in Byram Lake, Mt. Kisco, N.Y., Summer, 1977,
W82-00915 2H

SASTRI, V. S.
Separation of Selenium from Sulfide Leach Liquors,
W82-00905 5D

SAULNIER JR, G. J.
Hydrogeochemistry and Simulated Solute Transport, Piceance Basin, Northwestern Colorado,
W82-00723 5B

SAUNDERS, C. L.
The Control of Bacterial Pollution Caused by Sea Discharges of Sewage,
W82-00699 5D

SAY, P. J.
Aquatic Mosses as Monitors of Heavy Metal Contamination in the River Etherow, Great Britain,
W82-00787 5A

SCHAEFFER, D. J.
Grab Versus Composite Sampling: A Primer for the Manager and Engineer,
W82-00891 5A

SCHMIDT, K. D.
Hydrogeology of the Sierra Nevada Foothill Lineament Near Oakhurst, California,
W82-00831 2F

SCHMIERBACH, M. R.
Photosynthesis and Growth in Populations of Populus Deltoides from Constrating Habitats,
W82-00935 2I

SCHNEIDER, A. D.
Management of Recharge Basins on the Southern High Plains,
W82-00938 4B

SCHUBERT, G.
Gravitational Stability of Water Over Steam in Vapor-Dominated Geothermal Systems,
W82-00963 1A

SCHULZ, S.
A Rapid Simple Long-Term Toxicity Assay for Aquatic Contaminants Using the Nematode Panagrellus Redivivus,
W82-01017 5A

SCHWAB, G. O.
Backfill Alteration Effects on Pipe Drainage of a Clay Soil,
W82-00763 4A

SCHWARTZ, F. W.
Simulation of Lake-Watershed Systems, I. Description and Sensitivity Analysis of the Model,
W82-00926 2A

Simulation of Lake-Watershed Systems, II. Application to Baptiste Lake, Alberta, Canada,
W82-00927 2A

SCHWARTZ, S. E.
Mass-Transport Limitation to the Rate of Reaction of Gases in Liquid Droplets: Application to Oxidation of SO2 in Aqueous Solutions,
W82-00994 2K

SCOTT, J. T.
Mean Summer Circulation in Lake Ontario Within the Coastal Zone,
W82-00967 2H

SEAGLE JR, H. H.
Does Improved Waste Treatment Have Demonstrable Biological Benefits,
W82-00779 5C

SEIDLER, R. J.
Antibiotic-Resistant Bacteria in Drinking Water,
W82-00645 5F

Effect of Turbidity on Chlorination Efficiency and Bacterial Persistence in Drinking Water,
W82-00865 5A

SEKEL, D. J.
Biological Treatment of Synthetic Fuel Wastewater,
W82-00971 5D

SEKLA, L.
Enteric Viruses in Renovated Water in Manitoba,
W82-01090 5A

SELLECK, R. E.
Groundwater Leaching of Organic Pollutants From in Situ Retorted Oil Shale. A Mass Transfer Analysis,
W82-00626 5B

SENECA, E. D.
Dieback of Salt-Water Cordgrass (Spartina Alterniflora Loisel.) in the Lower Cape Fear Estuary of North Carolina: An Experimental Approach to Re-Establishment,
W82-00889 2L

SHEEHAN, M.
Game Theory Analyses Applied to Water Resource Problems,
W82-00802 6A

SHELTON, W. L.
Gonad Development, Fecundity, and Spawning Season of Largemouth Bass in Newly Impounded West Point Reservoir, Alabama-Georgia,
W82-01080 2H

SHEN, W. C.
Atmospheric Water Content Over the Tropical Pacific Derived from the Nimbus-6 Scanning Microwave Spectrometer,
W82-01004 7B

SHEPHERD, A. D.
State Water Use and Socioeconomic Data Related to the Second National Water Assessment,
W82-00739 6D

SHERRY, J. P.
Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay II. Mycological Aspects,
W82-00922 2L

SHIGENO, D. S.
Antibiotic-Resistant Bacteria in Drinking Water,
W82-00645 5F

SHIH, S. F.
Water Requirement for Sugarcane Production,
W82-00899 3F

SHORT, R. A.
Leaf Litter Processing in a Regulated Rocky Mountain Stream,
W82-00542 6G

SIDDOWAY, F. H.
Dryland Cropping Strategies for Efficient Water-Use to Control Saline Seeps in the Northern Great Plains, U.S.A.,
W82-01023 3F

SIEVERING, H.
Trace Element Concentrations Over Midlake Michigan as a Function of Meteorology and Source Region,
W82-00550 5B

SIKORA, L. J.
Trenching of Digested Sludge,
W82-00974 5E

SIKORA, V. A.
Health Aspects of Urban Water Conservation,
W82-01047 3C

SILLS, J. B.
Residues of Isobornyl Thiocyanoacetate (Thanite) and a Metabolite in Fish and Treated Ponds,
W82-00570 5B

SILVERMAN, M. P.
Microbial Mobilization of Calcium and Magnesium in Waterlogged Soils,
W82-00560 2G

SIMPSON, C. A.
Bacterial DNA Repair Assay of Selected Compounds in Pulp and Paper Mill Effluents,
W82-00687 5C

SIMPSON, G. D.
Facts Fix Fund Finding,
W82-00885 9A

SIMPSON, J. T.
A Procedure Using Modeling and Error Analysis for the Prediction of Lake Phosphorus Concentration from Land Use Information,
W82-00546 5G

SINGH, V. P.
Overland Flow on a Diverging Surface,
W82-00986 2A

SINGLETON, L.
An Assessment of the Trophic Status of Deer, Loon, and Diamond Lakes,
W82-01072 2H

SLACK, D. C.
Effects of Joule Heating on Thermocouple Psychrometer Water Potential Determinations,
W82-00892 7B

SLEMROVA, J.
Detection of Volatile Nitrosamines in Waste Water from Chemical Plants by Combined Capillary Gas Chromatography-Mass Spectrometry,
W82-00856 5A

SLOANE, J.
Phosphorus, Nirogen, and Organic Carbon Flux in a Headwater Stream,
W82-01021 2K

SMART, R. M.
Sediment-Based Nutrition of Submersed Macrophytes,
W82-00843 2H

SMEETS, J.
European Communities Directive Relating to the Quality of Water Intended for Human Consumption,
W82-00506 6D

SMITH, B. D.
Kinetics of Nitrate and Ammonium Uptake by the Tropical Freshwater Macrophyte Pistia Stratiotes L.,
W82-00937 5D

SMITH, C. D.
Hydraulic Design for the Two-Stage Stilling Basin,
W82-00849 8B

SMITH, C. L.
Management Provoked Conflict in Fisheries,
W82-00780 6A

SMITH, K. E.
Scott Brings Unique $25-Million Waste Treatment Facilities On-Line,
W82-01007 5D

SMITH, P. J.
A Method for Estimating Recharge and Boundary Flux from Groundwater Level Observations,
W82-00985 2F

SMITH, R. A.
Identification of Streamflow Stochastic Models,
W82-00555 2A

SMITH, R. E.
A Leaky Reservoir Model for Ephemeral Flow Recession,
W82-00600 2E

SMITH, R. J.
The Waterway That Cannot be Stopped,
W82-00510 6E

SMITH, W. K.
Leaf and Environmental Parameters Influencing Transpiration: Theory and Field Measurements,
W82-00979 2D

Temperature and Water Relation Patterns in Subalpine Understory Plants,
W82-00760 2I

SNYDER, B.
Managing Oil and Gas Activities in Coastal Environments: Refuge Manual,
W82-01081 5G

SOEDER, C. J.
Massive Cultivation of Microalgae: Results and Prospects,
W82-00913 5D

SOKOL, R. L.
Control Systems for Return and Waste Sludge,
W82-00949 5D

SONDEREGGER, J. L.
Saline Seep Development and Control in the North American Great Plains - Hydrogeological Aspects,
W82-01022 5B

SOON, Y. K.
Evaluation of Winter Application of Liquid Sludge to Farmland,
W82-00952 5B

SOPHOCLEOUS, M.
The Declining Ground-Water Resources of Alluvial Valleys: A Case Study,
W82-00832 4B

SPARE, D. P.
Sizing Rice Irrigation Canals,
W82-00895 3F

SPEYER, M. R.
Mercury and Selenium Concentrations in Fish, Sediments, and Water of Two Northwestern Quebec Lakes,
W82-00876 5B

SPRAKER, P.
Foam Control and Degradation of Nonionic Detergents,
W82-00637 5D

SPYRIDAKIS, D. E.
Nitrogen and Phosphorus Recycling in Lake Sammamish, A Temperate Mesotrophic Lake,
W82-00824 2H

SRIKAMESWARAN, K.
Monitoring Trace Amounts of Cadmium in Natural Waters,
W82-00516 5A

STACKIW, W.
Enteric Viruses in Renovated Water in Manitoba,
W82-01090 5A

STANLEY, R. F.
Water Quality Conditions in the Bellingham Bay Area 1979-1980,
W82-01068 5B

STARA, J. F.
Human Health Hazards Associated With Chemical Contamination of Aquatic Environment,
W82-00632 5C

STATHIS, T. C.
Fluidized Bed for Biological Wastewater Treatment,
W82-00968 5D

STEEN, W. C.
Correlation of Microbial Degradation Rates With Chemical Structure,
W82-00621 2K

STEIN, R. B.
Ohio's Ground Water Resources and Problem Areas,
W82-01057 4B

STEKETEE, C. H.
Why EPA's I/I Control Program Fails,
W82-00790 8A

STEVENS, A. A.
Removing Trihalomethanes from Drinking Water,
W82-00953 5F

STEVENSON, L. H.
The Assay of Adenosine 5'Triphosphate Extracted from Salt-Marsh Microbiota,
W82-00838 2L

Estimation of Material Fluxes in an Estuarine Cross Section: A Critical Analysis of Spatial Measurement Density and Errors,
W82-00816 7A

STEWART, J.
State Water Use and Socioeconomic Data Related to the Second National Water Assessment,
W82-00739 6D

STEWART, M. T.
Predictive Depositional Model for Glacial Aquifers,
W82-00828 2F

Resistivity Study of a Coastal Karst Terrain, Florida,
W82-00817 2F

STOBER, Q. J.
Sea Urchin Sperm Bioassay for Sewage and Chlorinated Seawater and Its Relation to Fish Bioassays,
W82-00988 5A

STOFFEL, D.
Sample Intake Position and Loading Rates from Nonpoint Source Pollution,
W82-00778 5A

STOLTENBERG, D. H.
Midwestern Wastewater Characteristics,
W82-00534 5D

STRAIN, B. R.
Seasonal Patterns of Leaf Water Relations in Four Co-Occurring Forest Tree Species: Parameters from Pressure-Volume Curves,
W82-01011 2I

STRAIN, P. M.
The Distribution of Sea Ice Meltwater in the Eastern Canadian Arctic,
W82-00966 2C

STRAUS, J. M.
Gravitational Stability of Water Over Steam in Vapor-Dominated Geothermal Systems,
W82-00963 1A

STROEHLEIN, J. L.
Quality of Irrigation Water and Effects of Sulfuric Acid and Gypsum on Soil Properties and Sundangrass Yields,
W82-00767 3C

STURGEON, R. E.
Comparison of Methods for the Determination of Trace Elements in Seawater,
W82-01086 5A

Simultaneous Determination of Iron, Cadmium, Zinc, Copper, Nickel, Lead, and Uranium in Seawater by Stable Isotope Dilution Spark Source Mass Spectrometry,
W82-00786 5A

SU, P. K.
Development of Makeup-Line Safe-Operating Criteria,
W82-01095 8B

SUBRAMANIAN, K. S.
Separation of Selenium from Sulfide Leach Liquors,
W82-00905 5D

SUNDARAM, K. M. S.
Residues of Nonylphenol in Spruce Foliage, Forest Soil, Stream Water and Sediment After its Aerial Application,
W82-00559 5B

SUNDSTROM, D.
Metal Leaching from Sewage Sludge Ash,
W82-00770 5B

SUZUKI, S.
Ammonia Electrode with Immobilized Nitrifying Bacteria,
W82-01099 5A

SWAN, D. S.
Evidence of the Unsuitability of Gravity Coring for Collecting Sediment in Pollution and Sedimentation Rate Studies,
W82-00840 7B

SWEENEY, C.
Metal Leaching from Sewage Sludge Ash,
W82-00770 5B

SWICK, A.
Dynamics of Selenium in Mercury-Contaminated Experimental Freshwater Ecosystems,
W82-00595 5B

SYMONS, J. M.
Removing Trihalomethanes from Drinking Water,
W82-00953 5F

SZETO, S.
Residues of Nonylphenol in Spruce Foliage, Forest Soil, Stream Water and Sediment After its Aerial Application,
W82-00559 5B

SZETO, S. Y.
Residues in Cutthroat Trout (Salmo Clarki) and California Newts (Tarichia Torosa) From a Lake Treated With Technical Chlordane,
W82-00558 5C

SZIDAROVSZKY, F.
Reliability of Underground Flood Control System,
W82-00556 8A

TALLON, J. T.
Biological Treatment of Synthetic Fuel Wastewater,
W82-00971 5D

TAN, C. S.
Ratio Between Evapotranspiration of Irrigated Crops from Floating Lysimeters and Class A Pan Evaporation,
W82-01050 2D

Transpiration, Stomatal Conductance, and Photosynthesis of Tomato Plants With Various Proportions of Root System Supplied With Water,
W82-00504 2I

TAN, F. C.
The Distribution of Sea Ice Meltwater in the Eastern Canadian Arctic,
W82-00966 2C

TAN, Y.
Anthropogenic Trace Elements and Polycyclic Aromatic Hydrocarbon Levels in Sediment Cores From Two Lakes in the Adirondack Acid Lake Region,
W82-00501 5B

TANAKA, S.
Sulfur and Associated Elements and Acidity in Continental and Marine Rain from North Florida,
W82-00965 2B

TAYLOR, G. S.
Backfill Alteration Effects on Pipe Drainage of a Clay Soil,
W82-00763 4A

TAYLOR, J. A.
The Effect of Temperature on Salt Uptake by Tomato Plants With Diurnal and Nocturnal Waterlogging of Salinized Rootzones,
W82-00608 2I

TAYLOR, R. E. JR.
Growth of the Bay Scallop, Argopecten Irradians, in a Waste Recycling Aquaculture System,
W82-00842 3C

TEDROW, A. C.
Groundwater Problems and Needs in New York,
W82-01055 4B

TELEPCHAK, M.
Foam Control and Degradation of Nonionic Detergents,
W82-00637 5D

TELTSCH, B.
Isolation and Identification of Pathogenic Microorganisms at Wastewater-Irrigated Fields: Ratios in Air and Wastewater,
W82-00579 5A

TEMPLE, D. M.
Tractive Force Design of Vegetated Channels,
W82-00901 4D

THIEL, D. A.
Receiving Stream Fisheries Studies Relative to Secondary Treated Pulp and Paper Mill Effluents,
W82-00688 5C

THIELEN, J.
An Assessment of the Trophic Status of Deer, Loon, and Diamond Lakes,
W82-01072 2H

THOM, B. G.
Holocene Sequences on an Embayed High-Energy Coast: An Evolutionary Model,
W82-00695 2J

THOMAS, J. F.
Groundwater Leaching of Organic Pollutants From in Situ Retorted Oil Shale. A Mass Transfer Analysis,
W82-00626 5B

THOMPSON, Q. E.
Biodegradability of Halogen-Substituted Diphenylmethanes,
W82-00599 5B

THORNTON, J. C.
Groundwater Pollution in Kentucky: A Status Report,
W82-01053 4B

THORNTON, J. D.
Assessment of Airborne Organic Contaminants in the Great Lakes Ecosystem,
W82-00709 5B

TIMMONS, J. F.
Costs of Alternative Policies for Controlling Agricultural Soil Loss and Associated Stream Sedimentation,
W82-00869 4D

TIMMONS, T. J.
Gonad Development, Fecundity, and Spawning Season of Largemouth Bass in Newly Impounded West Point Reservoir, Alabama-Georgia,
W82-01080 2H

TISON, D. L.
Effect of Temperature on Mineralization by Heterotrophic Bacteria,
W82-00583 5C

Influence of Seasonal Temperature on the Temperature Optima of Bacteria in Sediments of Lake George, New York,
W82-00606 2H

TITTLE, K.
The Removal of Organic Matter from Demineralised Water,
W82-00888 5F

TOHA, J.
Purification of Wastewater by Electrolysis,
W82-00847 5D

TOMS, R. G.
The Control of Bacterial Pollution Caused by Sea Discharges of Sewage,
W82-00699 5D

TOWNSEND, B. E.
Dynamics of Selenium in Mercury-Contaminated Experimental Freshwater Ecosystems,
W82-00595 5B

TRIEFF, N. M.
Chloramine-T as A Potential Scrubbing Agent: Removal of Odorous Sulfur-Containing Environmental Pollutants,
W82-00871 5D

TRLICA, M. J.
Water Status of Soil and Vegetation in a Shortgrass Steppe,
W82-00761 2I

TROUT, T. J.
Operational Evaluation of Village Level Irrigation Conveyance Systems,
W82-00696 3F

TSANG, C. F.
Ground-Water Use for Cooling: Associated Aquifer Temperature Changes,
W82-01014 3E

TSIVOGLOU, A. J.
Modeling Gradual Dam Breaches,
W82-00554 8D

TURK, T. R.
Sedimentological and Biological Changes in the Windsor Mudflat, an Area of Induced Siltation,
W82-00548 5C

TURNER JR, F.
Quality of Irrigation Water and Effects of Sulfuric Acid and Gypsum on Soil Properties and Sundangrass Yields,
W82-00767 3C

TURNER, M. A.
Dynamics of Selenium in Mercury-Contaminated Experimental Freshwater Ecosystems,
W82-00595 5B

TURNER, N. C.
Plant-Water Relations and Adaptation to Stress,
W82-00812 2I

UNGER, P. W.
Effect of Soil Water Content and a Growing Season Straw Mulch on Grain Sorghum,
W82-00765 3F

VAATANEN, P.
Effects of Environmental Factors on Microbial Populations in Brackish Waters off the Southern Coast of Finland,
W82-00683 2L

Factor Analysis of the Impact of the Environment on Microbial Communities in the Tvarminne Area, Southern Coast of Finland,
W82-00672 5C

VALAMANESH, A.
Comparative Field Water Relations of Four Co-Occuring Chaparral Shrub Species,
W82-00762 2I

VALLEJO, L. E.
Mechanics of Mudflow Mobilization in Low-Angled Clay Slopes,
W82-00989 2J

VAN DER KOOIJ, D.
Growth of Aeromonas Hydrophila at Low Concentrations of Substrates Added to Tap Water,
W82-00578 5A

VAN DER PIEPEN, H.
Light Penetration and the Interrelationships Between Optical Parameters in a Turbid Subtropical Impoundment,
W82-00667 2H

VAN DER VALK, A. G.
The Impact of a Natural Drawdown on the Growth of Four Emergent Species in a Prairie Glacial Marsh,
W82-01096 2H

VAN HOOF, F.
Evaluation of an Automatic System for Detection of Toxic Substances in Surface Water Using Trout,
W82-00855 5A

VAN NULAND, G. J.
Comparison of a Few Systems for the Determination of Saprobic and Trophic Degree on the Basis of Plankton Data,
W82-00664 2H

VAN OSS, C. J.
Mechanism of Charged Membrane Ultrafiltration of Salt Solutions,
W82-00641 5D

VAN OVERMEEREN, R. A.
A Combination of Electrical Resistivity, Seismic Refraction, and Gravity Measurements for Groundwater Exploration in Sudan,
W82-00852 2F

VAN ROBBROECK, T. P. C.
Sediment Surveys in the Department of Water Affairs,
W82-00680 7B

VAN SCHILFGAARDE, J.
Dryland Management for Salinity Control,
W82-01018 2G

VANBUCKENHOUT, L.
Enteric Viruses in Renovated Water in Manitoba,
W82-01090 5A

VANDERHOLM, D. H.
Vegetative Filter Treatment of Livestock Feedlot Runoff,
W82-00794 5D

VASIL'EV, O. F.
Modeling the Transformation of Nitrogen Compounds for Water-Quality Management in Streams,
W82-00598 6A

VASSILIOU, P.
Leach Characteristics of Coal-Gasification Char,
W82-01025 5B

VEEMAN, T.
Evaluation of the Oldman River Basin Irrigation Proposals: Implications for Interbasin Transfers,
W82-00519 6B

VENKATACHARI, A.
Consumptive Use and Daily Evapotranspiration of Corn Under Different Levels of Nitrogen and Moisture Regimes,
W82-00660 2D

VENKATESWARAN, M.
Monitoring Trace Amounts of Cadmium in Natural Waters,
W82-00516 5A

VENN, A. C.
Environmental Aspects of Rural Development with Particular Reference to the Keiskamma River Basin Study,
W82-00685 6D

VETTER, R. J.
The Impact of an Industrially Contaminated Lake on Heavy Metal Levels in it's Effluent Stream,
W82-00886 5B

VILJOEN, N.
Richards Bay: An Ecological Dilemma,
W82-00679 6A

VINYARD, L.
Point-of-Use Water Treatment...An Enlarging Reality,
W82-00784 10D

VISSER, A.
Growth of Aeromonas Hydrophila at Low Concentrations of Substrates Added to Tap Water,
W82-00578 5A

VLAMIS, J.
Trace Element Accumulation, Movement, and Distribution in the Soil Profile From Massive Applications of Sewage Sludge,
W82-00640 5E

VONNEGUT, B.
Apparatus for the Simulation of Rain in the Laboratory,
W82-00807 2B

WADE, T. L.
Partitioning of No. 2 Fuel Oil in Controlled Estuarine Ecosystems. Sediments and Suspended Particulate Matter,
W82-00541 2L

WAITE, S. W.
Description of a New Submersible Filter-Pump Apparatus for Sampling Plankton,
W82-01012 7B

WAITE, W. M.
Environmental Virology and its Problems,
W82-00505 5A

WALKER, D. J.
Costs of Alternative Policies for Controlling Agricultural Soil Loss and Associated Stream Sedimentation,
W82-00869 4D

WALKER, J. M.
Trenching of Digested Sludge,
W82-00974 5E

WALKER, P. H.
Movement of Loose, Sandy Detritus by Shallow Water Flows: An Experimental Study,
W82-00776 2J

WALKER, R. L.
Determination of Picogram Amounts of Technetium-99 by Resin Bead Mass Spectrometric Isotope Dilution,
W82-00999 5A

WALLACE, J. B.
Seston Dynamics in Southern Appalachian Streams: Effects of Clear-Cutting,
W82-00543 4C

WALLACE, J. S.
Seasonal Changes in Leaf Area, Stomatal and Canopy Conductances and Transpiration From Bracken Below a Forest Canopy,
W82-00655 2D

WALMSLEY, R. D.
Light Penetration and the Interrelationships Between Optical Parameters in a Turbid Subtropical Impoundment,
W82-00667 2H

WALTER, S. D.
Asbestos Cement Pipe and Cancer in Connecticut 1955-1974,
W82-01094 5C

WANG, C. T.
A Geomorphologic Synthesis of Nonlinearity in Surface Runoff,
W82-00604 2A

WANG, D-S.
Evaluation of Various Soil Water Samplers for Virological Sampling,
W82-00572 5A

WANG, F. C.
Cation Transport in Packed Bed Reactor of Soil,
W82-00970 5D

WANG, J-K.
Sizing Rice Irrigation Canals,
W82-00895 3F

WARD, A. D.
Evaluation of Stripmine Sediment Detention Basins in Kentucky,
W82-00893 5G

WARD, J. V.
Leaf Litter Processing in a Regulated Rocky Mountain Stream,
W82-00542 6G

WARD, R. L.
Effects of Wastewater Sludge and Its Detergents on the Stability of Rotavirus,
W82-00576 5A

WATT, T. A.
The Effect of Height of Water Table on the Growth of Holcus Lanatus With Reference to Lolium Perenne,
W82-00654 2I

WAYMIRE, E.
A Geomorphologic Synthesis of Nonlinearity in Surface Runoff,
W82-00604 2A

WEAVER, D. S.
Hydraulic Model Study for the Design of the Wreck Cove Control Gates,
W82-00880 8B

WEBSTER, J. R.
Seston Dynamics in Southern Appalachian Streams: Effects of Clear-Cutting,
W82-00543 4C

WEEKS, W. D.
A Comparison of Rainfall-Runoff Models,
W82-00911 2A

WEILAND, R. A.
Enforcement Under the Resource Conservation and Recovery Act of 1976,
W82-01013 6E

WEINBAUER, J. D.
Receiving Stream Fisheries Studies Relative to Secondary Treated Pulp and Paper Mill Effluents,
W82-00688 5C

WEINRICH, B. E.
Modeling Water Flux on Strip-Mined Land,
W82-00944 2G

WELLS, J. R.
Heavy Metal Contents in Some Macrophytes from Saginaw Bay (Lake Huron, U.S.A.),
W82-01000 5B

WEST, D. W.
The Effect of Temperature on Salt Uptake by Tomato Plants With Diurnal and Nocturnal Waterlogging of Salinized Rootzones,
W82-00608 2I

WESTON, R. T.
Pennsylvania Ground Water Problems and Needs,
W82-01058 4B

WHITE, E.
Distribution and Biological Availability of Reactive High Molecular Weight Phosphorus in Natural Waters in New Zealand,
W82-00659 2H

WHITTON, B. A.
Aquatic Mosses as Monitors of Heavy Metal Contamination in the River Etherow, Great Britain,
W82-00787 5A

WIEBE, W. J.
Methane Formation in the Acid Peats of Okefenokee Swamp, Georgia,
W82-00936 2H

WIEDER, R. K.
Vegetational Analysis of Big Run Bog, A Nonglaciated Sphagnum Bog in West Virginia,
W82-00992 2I

WIENER, J. G.
Trace Element Inputs From a Coal Burning Power Plant to Adjacent Terrestrial and Aquatic Environments,
W82-00557 5B

WIENS, A. P.
Sampling Emerging Chironomidae (Diptera) With Submerged Funnel Traps in a New Northern Canadian Reservoir, Southern Indian Lake, Manitoba,
W82-00520 2H

WIESER, W.
Serum Enzymes in Rainbow Trout as Tools in the Diagnosis of Water Quality,
W82-00857 5A

WIKRAMARATNA, R. S.
A Method for Estimating Recharge and Boundary Flux from Groundwater Level Observations,
W82-00985 2F

WILLER, D. C.
Small Hydro Installations Spur Unique Engineering Solutions,
W82-00538 6B

WILLIAMS, D. E.
Trace Element Accumulation, Movement, and Distribution in the Soil Profile From Massive Applications of Sewage Sludge,
W82-00640 5E

WILLIAMS, D. T.
Assessment of Some Aqueous Residual Chlorine Measurements,
W82-00867 5F

Determination of Low NG/L Levels of Polychlorinated Biphenyls in Drinking Water by Extraction with Macroreticular Resin and Analysis Using a Capillary Column,
W82-00875 5A

Gas Chromatographic Determination of Trialkyl/Aryl Phosphates in Drinking Water, Following Isolation Using Macroreticular Resin,
W82-00502 5A

WILLIAMS, G. M.
The Activity of Environmental Samples in a Cell Culture Test for Asbestos Toxicity,
W82-01031 5C

WILSON, C. A.
The Assay of Adenosine 5'Triphosphate Extracted from Salt-Marsh Microbiota,
W82-00838 2L

WILSON, D.
Electrical Aspects of Adsorbing Colloid Flotation. XI. Surfactant Adsorption Isotherms, Particle Displacement, and Differential Capacitance,
W82-00788 1B

WINCHESTER, J. W.
Sulfur and Associated Elements and Acidity in Continental and Marine Rain from North Florida,
W82-00965 2B

Water-To-Air Fractionation of Bacteria,
W82-00575 5B

WINNER, R. W.
Insect Community Structure as an Index of Heavy-Metal Pollution in Lotic Ecosystems,
W82-00596 5C

WOFSY, S. C.
Transformations of Nitrogen in a Polluted Estuary: Nonlinearities in the Demand for Oxygen at Low Flow,
W82-00777 5B

WOLANSKY, R. M.
Generalized Thickness of the Floridan Aquifer, Southwest Florida Water Management District,
W82-00729 7C

WOLFE, N. L.
Correlation of Microbial Degradation Rates With Chemical Structure,
W82-00621 2K

WOLFF, A. H.
Home Water Softeners, Water Softness and Possible Health Implications,
W82-01045 5F

WONG, P. T. S.
Occurrence of Tetraalkylead Compounds in the Aquatic Environment,
W82-00878 5A

WOO, M-K.
Occurrence of Ice Layers at the Base of High Arctic Snowpacks,
W82-00844 2C

WOODLEY, W. L.
Satellite Rain Estimation in the U.S. High Plains,
W82-00808 2B

WOODWARD, D. F.
Toxicity of Five Forest Insecticides to Cutthroat Trout and Two Species of Aquatic Invertebrates,
W82-00590 5C

WOOTON, F. T.
Dredging and Disposal of Toxic Material Using Japanese Technology Suggested for United States,
W82-01026 5E

WORONIECKA-STASIAK, A.
Chemical Composition of Interstitial Waters in Bottom Sediments of Some Polish Lakes of the Wigry Group (Northern Poland),
W82-00675 2H

WRIGHT, L. D.
Holocene Sequences on an Embayed High-Energy Coast: An Evolutionary Model,
W82-00695 2J

WRONSKI, E. B.
The Influence of Plant Communities Upon the Hydrology of Catchments,
W82-00931 2D

WU, T. L.
Enrichment of the Agricultural Herbicide Atrazine in the Microsurface Water of an Estuary,
W82-00877 5B

WURSTER, C. F.
Uptake of Polychlorinated Biphenyls by Natural Phytoplankton Assemblages: Field and Laboratory Determination of C14-PCB Particle-Water Index of Sorption,
W82-01032 5B

YAKE, W. E.
The Impact of Effluent from the Renton Wastewater Treatment Plant on the Dissolved Oxygen Regimen of the Lower Green/Duwamish River,
W82-01064 5D

YAKOWITZ, S. J.
A Leaky Reservoir Model for Ephemeral Flow Recession,
W82-00600 2E

YASUDA, T.
Ammonia Electrode with Immobilized Nitrifying Bacteria,
W82-01099 5A

YEO, R. K.
Sedimentological and Biological Changes in the Windsor Mudflat, an Area of Induced Siltation,
W82-00548 5C

YORDY, J. R.
Formation of N-Nitrosodiethanolamine from Diethanolamine in Lake Water and Sewage,
W82-00796 5A

Microbial Metabolism of N-Nitrosodiethanolamine in Lake Water and Sewage,
W82-00585 2H

YOUNG, C. E.
Land Treatment of Municipal Wastewater in Small Communities,
W82-00588 5D

YOUNG, G. J.
Heavy Metal Concentrations in the Holston River Basin (Tennessee),
W82-00959 5A

ZAHNOW, E. W.
Search for Linuron Residues in Tributaries of the Chesapeake Bay,
W82-00569 5A

ZALKIND, D.
Organochlorine Residues in Kenya's Rift Valley Lakes,
W82-00690 5A

ZARTMAN, R. E.
Effects of Water Quality on Forage Production,
W82-01002 3C

ZITRIDES, T. G.
Mutant Bacteria Control Filamentous Growth in Mill Wastewater Treatment,
W82-01008 5D

ZUR, O.
A Method for the Evaluation of Conditions in a Fish Pond Sediment,
W82-01019 2H

ORGANIZATIONAL INDEX

AARHUS UNIV. (DENMARK). INST. OF ECOLOGY AND GENETICS.
Measurement of in situ Rates of Nitrification in Sediment,
W82-00798 5A

AARHUS UNIV. (DENMARK), LAB. OF PHYSICAL GEOGRAPHY.
The Kyholm Corer--A Diver-Operated Sediment Corer,
W82-00793 7B

AEROSPACE CORP., LOS ANGELES, CA. SPACE SCIENCE LAB.
Gravitational Stability of Water Over Steam in Vapor-Dominated Geothermal Systems,
W82-00963 1A

AGRICULTURAL RESEARCH AND EDUCATION CENTER, BELLE GLADE, FL.
Water Requirement for Sugarcane Production,
W82-00899 3F

AGRICULTURAL RESEARCH AND EDUCATION CENTER, BRADENTON.
Yield and Water Use of Vegetable Crops with Seepage and Drip Irrigation Systems,
W82-00544 3F

AGRICULTURAL RESEARCH SERVICE, FORT COLLINS, CO.
Lateral Sizes for Efficient Level-Basin Irrigation,
W82-00942 3F

AIN SHAMS UNIV., CAIRO (EGYPT). DEPT. OF SOILS.
Effect of Irrigating Loamy Sand Soil by Liquid Sewage Sludge on its Content of some Micronutrients,
W82-00661 5E

AKADEMIA ROLNICZA, WARSAW (POLAND). ZAKLAD LIMNOLOGII I RYBACTWA.
Chemical Composition of Interstitial Waters in Bottom Sediments of Some Polish Lakes of the Wigry Group (Northern Poland),
W82-00675 2H

AKADEMIYA NAUK SSSR, MOSCOW. INST. OF LIMNOLOGY.
Model of the Seasonal Dynamics of an Ecosystem of a Shallow Lake,
W82-00552 2H

AKADEMIYA NAUK SSSR, MOSCOW. INST. VODNYKH PROBLEM.
Probability-Theoretical Analysis of Fluctuations in the Level of a Closed Water Body,
W82-00571 2H

Theory of Ecological Prediction of Limnetic Ecosystems,
W82-00597 6G

The Azov Sea Problem,
W82-00651 6G

The Caspian Sea Problem,
W82-00657 4A

Possibility of Using Tritium for Studying Global Circulation of Atmospheric Moisture,
W82-00863 2A

AKADEMIYA NAUK URSR, KIEV. INST. HIDROBIOLOGII.
Modeling of Processes of Decomposition of Organic Matter in Bottom Sediments,
W82-00553 5B

Methods of Investigating the State of Metal Ions in Natural Waters,
W82-00859 5A

AKINOMOTO CO., INC., KAWASAKI (JAPAN). CENTRAL RESEARCH LAB.
Ammonia Electrode with Immobilized Nitrifying Bacteria,
W82-01099 5A

ALABAMA AGRICULTURAL EXPERIMENT STATION, AUBURN.
Water Movement for Water Quality in Catfish Production,
W82-00866 5G

ALABAMA COOPERATIVE FISHERY RESEARCH UNIT, AUBURN.
Gonad Development, Fecundity, and Spawning Season of Largemouth Bass in Newly Impounded West Point Reservoir, Alabama-Georgia,
W82-01080 2H

ALASKA UNIV., FAIRBANKS. INST. OF WATER RESOURCES.
Physical Mechanics of Aufeis Growth,
W82-00836 2C

ALBERTA UNIV., EDMONTON. DEPT. OF CIVIL ENGINEERING.
Graphed Equilibrium Parameters of Channels Formed in Sediment,
W82-00881 2J

ALBERTA UNIV., EDMONTON. DEPT. OF GEOLOGY.
Simulation of Lake-Watershed Systems, I. Description and Sensitivity Analysis of the Model,
W82-00926 2A

Simulation of Lake-Watershed Systems, II. Application to Baptiste Lake, Alberta, Canada,
W82-00927 2A

ALVORD, BURDICK AND HOWSON, CHICAGO, IL.
Experience Gained with the U.S. Pollution Control Policies,
W82-00996 6E

AMES LAB., IA.
Cation Chromatography With a Conductivity Detector,
W82-00582 5A

AMSTERDAM PUBLIC WORKS (NETHERLANDS).
Flocculation of Clay Particles with a Synthetic Anionic Polymer,
W82-00773 5F

ANDHRA PRADESH AGRICULTURAL UNIV., HYDERABAD (INDIA). DEPT. OF AGRONOMY.
Consumptive Use and Daily Evapotranspiration of Corn Under Different Levels of Nitrogen and Moisture Regimes,
W82-00660 2D

ANGLIAN WATER AUTHORITY (ENGLAND).
Removal of Nitrate from Public Water Supply Abstractions,
W82-00774 5F

ANGLIAN WATER AUTHORITY, NORWICH (ENGLAND). NORWICH SEWAGE DIV.
Automation of Norwich Sewage-Treatment Works: Early Cost Considerations,
W82-00955 5D

ANNE ARUNDEL COUNTY DEPT. OF PUBLIC WORKS, ANNAPOLIS, MD.
Coordinated Effort Stems Sediment and Erosion,
W82-00766 4D

ANTWERPSE WATERWERKEN (BELGIUM).
Evaluation of an Automatic System for Detection of Toxic Substances in Surface Water Using Trout,
W82-00855 5A

ARIZONA STATE UNIV., TEMPE. FORESTRY SCIENCES LAB.
Factors Influencing Fish Distribution in Two Desert Reservoirs, Central Arizona,
W82-00814 2H

ARIZONA UNIV., TUCSON. DEPT. OF ECONOMICS.
Price Elasticities for Water: A Case of Increasing Block Rates,
W82-00536 6C

ARIZONA UNIV., TUCSON. DEPT. OF SOILS, WATER AND ENGINEERING.
Effect of Leachate Flow Rate on Metal Migration Through Soil,
W82-00565 5E

Quality of Irrigation Water and Effects of Sulfuric Acid and Gypsum on Soil Properties and Sundangrass Yields,
W82-00767 3C

ARIZONA UNIV., TUCSON. DEPT. OF SYSTEMS AND INDUSTRIAL ENGINEERING.
Reliability of Underground Flood Control System,
W82-00556 8A

ARKANSAS UNIV., FAYETTEVILLE. DEPT. OF AGRONOMY.
A Simulation Model for Sludge Decomposition in Soil,
W82-01001 5E

ARMY COLD REGIONS RESEARCH AND ENGINEERING LAB., HANOVER, NH.
Removal of Volatile Trace Organics from Wastewater by Overland Flow Land Treatment,
W82-01042 5D

ARMY MEDICAL BIOENGINEERING RESEARCH AND DEVELOPMENT LAB., FORT DETRICK, MD.
Preliminary Pollutant Limit Values for Human Health Effects,
W82-00628 5G

ARMY WATERWAYS EXPERIMENT STATION, VICKSBURG, MS.
Sediment-Based Nutrition of Submersed Macrophytes,
W82-00843 2H

ATOMIC ENERGY ESTABLISHMENT, CAIRO (EGYPT). RADIATION PROTECTION DEPT.
Retention of Radionuclides by Some Aquatic Fresh Water Plants,
W82-00853 5B

AUBURN UNIV., AL. DEPT. OF FISHERIES AND ALLIED AQUACULTURES.
Effects of Hypolimnetic Discharge on Fish Health Below a Reservoir,
W82-00805 5C

Effects of Ion-Pairing on Calculations of Ionic Activities of Major Ions in Freshwater,
W82-00823 2K

AUSTRALIAN ATOMIC ENERGY COMMISSION RESEARCH ESTABLISHMENT, LUCAS HEIGHTS.
Adsorption as a Control of Metal Concentrations in Sediment Extracts,
W82-00614 5A

Determination of Chromium Speciation in Natural Waters by Electrodeposition on Graphite Tubes for Electrothermal Atomization,
W82-01084 5A

BATTELLE PACIFIC NORTHWEST LAB., RICHLAND, WA. ATMOSPHERIC SCIENCES DEPT.
Relationships Between Sulfate and Nitrate Ion Concentrations and Rainfall PH for Use in Modeling Applications,
W82-00507 5B

BAYLOR COLL. OF MEDICINE, HOUSTON, TX. DEPT. OF VIROLOGY AND EPIDEMIOLOGY.
Evaluation of Various Soil Water Samplers for Virological Sampling,
W82-00572 5A

Relationships Between Environmental Factors, Bacterial Indicators, and the Occurrence of Enteric Viruses in Estuarine Sediments,
W82-00574 5A

Movement of Endotoxin Through Soil Columns,
W82-00586 5B

BECHTEL INC., NORWALK, CA.
Development of Makeup-Line Safe-Operating Criteria,
W82-01095 8B

BEDFORD INST. OF OCEANOGRAPHY, DARTMOUTH (NOVA SCOTIA). ATLANTIC OCEANOGRAPHIC LAB.
The Distribution of Sea Ice Meltwater in the Eastern Canadian Arctic,
W82-00966 2C

BHABHA ATOMIC RESEARCH CENTRE, BOMBAY (INDIA). AIR MONITORING SECTION.
Trace Constituents in Cloud Water, Rainwater and Aerosol Samples Collected near the West Coast of India During the Southwest Monsoon,
W82-00676 2B

BIDHAN CHANDRA KRISHI VISWA VIDYALAYA, KALYANI (INDIA). DEPT. OF AGRICULTURAL ENGINEERING.
Estimation of Soil-Moisture Characteristics from Mechanical Properties of Soils,
W82-00785 2G

BISWAS AND ASSOCIATES, OXFORD (ENGLAND).
Long Distance Mass Transfer of Water,
W82-00858 6D

BOTANICAL RESEARCH INST., PRETORIA (SOUTH AFRICA).
Annual Plant Production-Precipitation Relations in Arid and Semi-Arid Regions,
W82-00693 2I

BOWLING GREEN STATE UNIV., OH. DEPT. OF BIOLOGICAL SCIENCES.
Monitoring River Periphyton With Artificial Benthic Substrates,
W82-00581 5A

BRANDON UNIV. (MANITOBA). DEPT. OF CHEMISTRY.
Monitoring Trace Amounts of Cadmium in Natural Waters,
W82-00516 5A

BRIGHAM YOUNG UNIV., PROVO, UT. DEPT. OF CHEMISTRY.
Determination of Alkaline Earth and Divalent Transition Metal Cations by Ion Chromatography with Sulfate-Suppressed Barium and Lead Eluents,
W82-01082 5A

BRITISH COLUMBIA RESEARCH COUNCIL, VANCOUVER.
Conversion of Abienol into Tetrahydroepimanool by Anaerobic Processes in Woodroom Debarking Effluent,
W82-00860 5C

BRITISH COLUMBIA UNIV., VANCOUVER. DEPT. OF MATHEMATICS.
Towards a Predictive Model for the Economic Regulation of Commercial Fisheries,
W82-00549 6A

BROOKHAVEN NATIONAL LAB., UPTON, NY.
Mass-Transport Limitation to the Rate of Reaction of Gases in Liquid Droplets: Application to Oxidation of SO2 in Aqueous Solutions,
W82-00994 2K

BUCKNELL UNIV., LEWISBURG, PA. DEPT. OF BIOLOGY.
Limnological Characteristics of Several Lakes on the Lake Wales Ridge, South-Central Florida,
W82-00914 2H

BUREAU OF RECLAMATION, BOULDER CITY, NV.
Saline Water Use and Disposal Opportunities; Colorado River Water Quality Improvement Program,
W82-00717 3C

BURLINGTON WATER DEPT., VT.
Low Turbidity Water from Fast Processes,
W82-00946 5F

CADHAM PROVINCIAL LAB., WINNIPEG (MANITOBA).
Enteric Viruses in Renovated Water in Manitoba,
W82-01090 5A

CALIFORNIA DEPT. OF FOOD AND AGRICULTURE, SACRAMENTO.
A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
W82-00532 5A

CALIFORNIA INST. OF TECH., PASADENA. W. M. KECK LABS.
Trace Metal Catalysis in Aquatic Environments,
W82-00629 5B

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD, PALM DESERT. COLORADO RIVER BASIN REGION.
Proposed Water Quality Control Plan for Indio Subarea of the Whitewater Hydrologic Unit, West Colorado River Basin.
W82-00716 6F

CALIFORNIA STATE UNIV., FRESNO. DEPT. OF GEOLOGY.
Hydrogeology of the Sierra Nevada Foothill Lineament Near Oakhurst, California,
W82-00831 2F

CALIFORNIA UNIV., BERKELEY. DEPT. OF CIVIL ENGINEERING.
Groundwater Leaching of Organic Pollutants From in Situ Retorted Oil Shale. A Mass Transfer Analysis,
W82-00626 5B

CALIFORNIA UNIV., BERKELEY. DEPT. OF SOILS AND PLANT NUTRITION.
Trace Element Accumulation, Movement, and Distribution in the Soil Profile From Massive Applications of Sewage Sludge,
W82-00640 5E

CALIFORNIA UNIV., BERKELEY. LAWRENCE BERKELEY LAB.
Ground-Water Use for Cooling: Associated Aquifer Temperature Changes,
W82-01014 3E

CALIFORNIA UNIV., BERKELEY. NAVAL BIOSCIENCES LAB.
Methylation of Trimethyltin Compounds by Estuarine Sediments,
W82-00801 5B

CALIFORNIA UNIV., DAVIS. DIV. OF ENVIRONMENTAL STUDIES.
An In Situ Method for Measuring the Primary Productivity and Standing Crop of the Epilithic Periphyton Community in Lentic Systems,
W82-00756 7B

CALIFORNIA UNIV., DAVIS. SCHOOL OF CIVIL ENGINEERING.
Impact of Water Resource Development on Salinization of Semi-Arid Lands,
W82-01024 5B

CALIFORNIA UNIV., LOS ANGELES. LAB. OF NUCLEAR MEDICINE AND RADIATION BIOLOGY.
Water Vapor Conductance and CO2 Uptake for Leaves of a C4 Desert Grass, Hilaria Rigida,
W82-01039 2I

CALIFORNIA UNIV., LOS ANGELES. SCHOOL OF PUBLIC HEALTH.
Thin Layer Chromatographic and Atomic Absorption Spectrophotometric Determination of Methyl Mercury,
W82-00503 5A

CALIFORNIA UNIV., RIVERSIDE. DEPT. OF SOIL AND ENVIRONMENTAL SCIENCES.
Estimation of the Salt Burden of Irrigation Drainage Waters,
W82-00563 5B

CAMDEN COUNTY MUNICIPAL UTILITIES AUTHORITY, NJ.
Composting Is Working in Camden,
W82-00948 5E

CAMP, DRESSER AND MCKEE, INC., CLEARWATER, FL.
Tampa Bay Water Guarded by Computer,
W82-00934 4B

CANADA CENTER FOR INLAND WATERS, BURLINGTON (ONTARIO).
Effect of Metals on the Biomass Production Kinetics of Freshwater Copepods,
W82-00593 5C

CANADA CENTRE FOR INLAND WATERS, BURLINGTON (ONTARIO).
Measurement of Particulates Extrained in Some Great Lakes Power Plant Cooling Water: An Exercise in Futility,
W82-00782 6G

Occurrence of Tetraalkylead Compounds in the Aquatic Environment,
W82-00878 5A

Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay, Canada. I: Bacteriological Aspects,
W82-00921 2L

Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay II. Mycological Aspects,
W82-00922 2L

Great Lakes Environmental Protection Policies from a Fisheries Perspective,
W82-00978 6G

CANMET, OTTAWA (ONTARIO). MINERAL SCIENCES LAB.
Separation of Selenium from Sulfide Leach Liquors,
W82-00905 5D

CANTERBURY UNIV., CHRISTCHURCH (NEW ZEALAND). DEPT. OF GEOLOGY.
Debris Flow Deposits of Early Miocene Age, Deadman Stream, Marlborough, New Zealand,
W82-00694 2J

CARNEGIE-MELLON UNIV., PITTSBURGH, PA. DEPT. OF CIVIL ENGINEERING.
Biological Treatment of Synthetic Fuel Wastewater,
W82-00971 5D

Leach Characteristics of Coal-Gasification Char,
W82-01025 5B

CENTRAL ELECTRICITY GENERATING BOARD (ENGLAND). NORTHWESTERN REGION.
The Removal of Organic Matter from Demineralised Water,
W82-00888 5F

CENTRAL INLAND FISHERIES RESEARCH INST., BARRACKPORE (INDIA).
Inorganic Transformation of Applied Phosphorus in Brackish Water Fish Pond Soil Under Different Water Salinity Levels,
W82-00920 2H

CHEMED CORP., CINCINNATI, OH. (ASSIGNEE).
Detoxification of Residual Quaternaries,
W82-00562 5G

CHILE UNIV., SANTIAGO. DEPT. OF FISICA.
Purification of Wastewater by Electrolysis,
W82-00847 5D

CLEMSON UNIV., SC. DEPT. OF MICROBIOLOGY.
Enumeration of Bacteriophages and Host Bacteria in Sewage and the Activated-Sludge Treatment Process,
W82-00584 5A

CLYDE RIVER PURIFICATION BOARD (SCOTLAND).
The Design and Interpretation of Marine Pollution Surveys,
W82-00700 6E

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF AGRICULTURAL AND CHEMICAL ENGINEERING.
Operational Evaluation of Village Level Irrigation Conveyance Systems,
W82-00696 3F

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF CIVIL ENGINEERING.
Identification of Streamflow Stochastic Models,
W82-00555 2A

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF ZOOLOGY AND ENTOMOLOGY.
Leaf Litter Processing in a Regulated Rocky Mountain Stream,
W82-00542 6G

COLORADO STATE UNIV., FORT COLLINS. NATURAL RESOURCE ECOLOGY LAB.
Water Status of Soil and Vegetation in a Shortgrass Steppe,
W82-00761 2I

COLUMBIA NATIONAL FISHERIES RESEARCH LAB., MO.
Toxicity of Five Forest Insecticides to Cutthroat Trout and Two Species of Aquatic Invertebrates,
W82-00590 5C

COMMISSION OF THE EUROPEAN COMMUNITIES, BRUSSELS (BELGIUM).
European Communities Directive Relating to the Quality of Water Intended for Human Consumption,
W82-00506 6D

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CANBERRA (AUSTRALIA). DIV. OF PLANT INDUSTRY.
Plant-Water Relations and Adaptation to Stress,
W82-00812 2I

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CANBERRA (AUSTRALIA). DIV. OF SOILS.
Movement of Loose, Sandy Detritus by Shallow Water Flows: An Experimental Study,
W82-00776 2J

CONNECTICUT UNIV., STORRS. DEPT. OF CHEMICAL ENGINEERING.
Metal Leaching from Sewage Sludge Ash,
W82-00770 5B

CONNECTICUT UNIV., STORRS. SCHOOL OF ENGINEERING.
Mutlichamber Septic Tanks,
W82-00969 5D

CONSOLIDATED PAPERS, INC., WISCONSIN RAPIDS, WI.
Receiving Stream Fisheries Studies Relative to Secondary Treated Pulp and Paper Mill Effluents,
W82-00688 5C

CORNELL UNIV., ITHACA, NY. DEPT. OF AGRONOMY.
Formation of N-Nitrosodiethanolamine from Diethanolamine in Lake Water and Sewage,
W82-00796 5A

CORNELL UNIV., ITHACA, NY. SOIL MICROBIOLOGY LAB.
Microbial Metabolism of N-Nitrosodiethanolamine in Lake Water and Sewage,
W82-00585 2H

CRANBROOK INST. OF SCIENCE, BLOOMFIELD HILLS, MI.
Heavy Metal Contents in Some Macrophytes from Saginaw Bay (Lake Huron, U.S.A.),
W82-01000 5B

DALHOUSIE UNIVERSITY, HALIFAX (NOVA SCOTIA). DEPT. OF CHEMISTRY.
Determination of Molybdenum in Sea and Estuarine Water with Beta-Naphthoin Oxime and Neutron Activation,
W82-01098 5A

DECHERT, PRICE AND RHOADS, DENVER, CO.
Western Coal Mining in the 1980s: A Study in Federal/State Conflicts,
W82-00972 6E

DELAWARE UNIV., NEWARK. COLL. OF MARINE STUDIES.
Frontal Jump Conditions for Models of Shallow, Buoyant Surface Layer Hydrodynamics,
W82-00804 8B

DELAWARE UNIV., NEWARK. DEPT. OF AGRICULTURAL ENGINEERING.
Potential for Land Disposal of Two Nonbiodegradable Wastes,
W82-00939 5D

DEPARTMENT OF AGRICULTURE AND FISHERIES FOR SCOTLAND, EDINBURGH.
Investigations of Control Mechanisms of Germination Under Water Stress,
W82-00912 2I

DEPARTMENT OF AGRICULTURE, HARROW (ONTARIO).
Transpiration, Stomatal Conductance, and Photosynthesis of Tomato Plants With Various Proportions of Root System Supplied With Water,
W82-00504 2I

DEPARTMENT OF AGRICULTURE, HARROW (ONTARIO). RESEARCH STATION.
Ratio Between Evapotranspiration of Irrigated Crops from Floating Lysimeters and Class A Pan Evaporation,
W82-01050 2D

DEPARTMENT OF AGRICULTURE, LETHBRIDGE (ALBERTA). IRRIGATION DIV.
Evaluation of the Oldman River Basin Irrigation Proposals: Implications for Interbasin Transfers,
W82-00519 6B

DEPARTMENT OF AGRICULTURE, LETHBRIDGE (ALBERTA). RESEARCH STATION.
Response of Fababean Yield, Protein Production and Water Use to Irrigation,
W82-01089 2I

DEPARTMENT OF ENERGY, NY. ENVIRONMENTAL MEASUREMENTS LAB.
Anthropogenic Trace Elements and Polycyclic Aromatic Hydrocarbon Levels in Sediment Cores From Two Lakes in the Adirondack Acid Lake Region,
W82-00501 5B

DEPARTMENT OF ENVIRONMENTAL PLANNING AND ENERGY (SOUTH AFRICA).
Richards Bay: An Ecological Dilemma,
W82-00679 6A

DEPARTMENT OF FISHERIES AND OCEANS, WINNIPEG (MANITOBA).
Experimental Manipulation of Algal Bloom Composition by Nitrogen Addition,
W82-00998 5C

DEPARTMENT OF FISHERIES AND OCEANS, WINNIPEG (MANITOBA). FRESHWATER INST.
Sampling Emerging Chironomidae (Diptera) With Submerged Funnel Traps in a New Northern Canadian Reservoir, Southern Indian Lake, Manitoba,
W82-00520 2H

Relationship Between Thermal Stability and Summer Oxygen Depletion in a Prairie Pothole Lake,
W82-00545 2H

Determination of Terbutryn and its Degradation Products in Water, Sediments, Aquatic Plants, and Fish,
W82-00567 5A

Dynamics of Selenium in Mercury-Contaminated Experimental Freshwater Ecosystems,
W82-00595 5B

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, TAUPO (NEW ZEALAND). FRESHWATER SECTION.
Distribution and Biological Availability of Reactive High Molecular Weight Phosphorus in Natural Waters in New Zealand,
W82-00659 2H

DEPARTMENT OF WATER AFFAIRS, PRETORIA (SOUTH AFRICA).
Sediment Surveys in the Department of Water Affairs,
W82-00680 7B

DEPARTMENT OF WATER AFFAIRS, PRETORIA (SOUTH AFRICA). HYDROLOGICAL RESEARCH INST.
Sediments as a Source of Phosphate: A Study of 38 Impoundments,
W82-00653 2H

DU PONT DE NEMOURS (E. I.) AND CO., DEEPWATER, NJ.
Removal of Priority Pollutants,
W82-00639 5D

DU PONT DE NEMOURS (E. I.) AND CO., WILMINGTON, DE. DEPT. OF BIOCHEMICALS.
Search for Linuron Residues in Tributaries of the Chesapeake Bay,
W82-00569 5A

DUKE UNIV., DURHAM, NC. DEPT. OF BOTANY.

DUKE UNIV., DURHAM, NC. DEPT. OF BOTANY.
Seasonal Patterns of Leaf Water Relations in Four Co-Occurring Forest Tree Species: Parameters from Pressure-Volume Curves,
W82-01011 2I

DUPONT DE NEMOURS (E. I.) AND CO., AIKEN, SC. SAVANNAH RIVER LAB.
Determination of Picogram Amounts of Technetium-99 by Resin Bead Mass Spectrometric Isotope Dilution,
W82-00999 5A

DURHAM UNIV. (ENGLAND). DEPT. OF BOTANY.
Aquatic Mosses as Monitors of Heavy Metal Contamination in the River Etherow, Great Britain,
W82-00787 5A

EAST TENNESSEE STATE UNIV., JOHNSON CITY. DEPT. OF ENVIRONMENTAL HEALTH.
Health Aspects of Urban Water Conservation,
W82-01047 3C

EAST TENNESSEE STATE UNIV., KINGSPORT. DEPT. OF CHEMISTRY.
Heavy Metal Concentrations in the Holston River Basin (Tennessee),
W82-00959 5A

EAST-WEST ENVIRONMENT AND POLICY INST., HONOLULU, HAWAII.
Using Ecological Knowledge for Development Planning,
W82-00671 6A

EASTERN WASHINGTON UNIV., CHEMEY. DEPT. OF BIOLOGY.
The Effect of Continuous Advanced Wastewater Treatment by the City of Spokane on the Trophic Status of Long Lake, WA During 1979.
W82-01070 2H

ECOLE POLYTECHNIQUE, MONTREAL (QUEBEC). DEPT. OF CIVIL ENGINEERING.
Evaluation of Areal Versus Point Rainfall with Sparse Data,
W82-00835 2B

ECONOMIC RESEARCH SERVICE, WASHINGTON, DC. NATURAL RESOURCE ECONOMICS DIV.
Federal Participation in Land Use Decision-Making at the Water's Edge--Floodplains and Wetlands,
W82-00799 6E

ECONOMICS, STATISTICS, AND COOPERATIVES SERVICE, WASHINGTON, DC. NATURAL RESOURCES ECONOMICS DIV.
Land Treatment of Municipal Wastewater in Small Communities,
W82-00588 5D

ELMHURST COLL., IL. DEPT. OF BIOLOGY.
Dispersal of Salmonella from a Polluted Stream to Neighboring Terrestrial Habitats,
W82-01043 5A

ENVIREX, INC., MILWAUKEE, WI.
Sludge Blanket in Activated Final Clarifiers,
W82-00951 5D

ENVIRONMENTAL HEALTH DIRECTORATE, OTTAWA (ONTARIO).
Assessment of Some Aqueous Residual Chlorine Measurements,
W82-00867 5F

Determination of Low NG/L Levels of Polychlorinated Biphenyls in Drinking Water by Extraction with Macroreticular Resin and Analysis Using a Capillary Column,
W82-00875 5A

ENVIRONMENTAL PROTECTION AGENCY, CHICAGO, IL.
Midwestern Wastewater Characteristics,
W82-00534 5D

ENVIRONMENTAL PROTECTION AGENCY, CINCINNATI, OH.
Human Health Hazards Associated With Chemical Contamination of Aquatic Environment,
W82-00632 5C

Removing Trihalomethanes from Drinking Water,
W82-00953 5F

ENVIRONMENTAL PROTECTION AGENCY, CINCINNATI, OH. OFFICE OF RESEARCH AND DEVELOPMENT.
Destruction by Anaerobic Mesophilic and Thermophilic Digestion of Viruses and Indicator Bacteria Indigenous to Domestic Sludges,
W82-00580 5A

ENVIRONMENTAL PROTECTION AGENCY, EDISON, NJ.
Recycling Urban Stormwater for Profit,
W82-00524 3C

ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, DC. OFFICE OF RESEARCH AND DEVELOPMENT.
Treatability Manual; Volume I. Treatability Data.
W82-01073 5D

Treatability Manual: Volume II. Industrial Descriptions.
W82-01074 5D

Treatability Manual; Volume III. Technologies for Control/Removal of Pollutants.
W82-01075 5D

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W82-01076 5D

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W82-01077 5D

ENVIRONMENTAL PROTECTION SERVICE, EDMONTON (ALBERTA). MICROBIOLOGY LAB.
R Factors in Coliform-Fecal Coliform Sewage Flora of the Prairies and Northwest Territories of Canada,
W82-00508 5A

ENVIRONMENTAL RESEARCH LAB., ATHENS, GA.
Correlation of Microbial Degradation Rates With Chemical Structure,
W82-00621 2K

Interim Method for Determining Asbestos in Water,
W82-00741 5A

ENVIRONMENTAL SCIENCES RESEARCH LAB., RESEARCH TRIANGLE PARK, NC.
Influence of Gaseous Nitric Acid on Sulfate Production and Acidity in Rain,
W82-00642 5B

FEDERAL ENERGY REGULATORY COMMISSION, WASHINGTON, D.C. OFFICE OF ELECTRIC POWER REGULATION.
Water Resources Appraisal for Hydroelectric Licensing: Jordan River Basin, Utah.
W82-00736 6D

Final Environmental Impact Statement: North Fork Stanislaus River Project No. 2409 - California.
W82-00737 6G

FEDERAL ENERGY REGULATORY COMMISSION, WASHINGTON, DC. OFFICE OF ELECTRIC POWER REGULATION.
Final Environmental Impact Statement: Swan Lake Project No. 2911 - Alaska.
W82-00738 6G

FISHERIES AND WILDLIFE, COLUMBIA, MO.
Water Relations, Soil Fertility, and Plant Nutrient Composition of a Pygmy Oak Ecosystem,
W82-01034 2I

FLINDERS UNIV. OF SOUTH AUSTRALIA, BEDFORD PARK. SCHOOL OF EARTH SCIENCES.
The Influence of Plant Communities Upon the Hydrology of Catchments,
W82-00931 2D

FLORENCE UNIV. (ITALY). INST. OF PHARMACOLOGY.
Effect of Ozonation and Chlorination on the Mutagenic Potential of Drinking Water,
W82-00649 5A

FLORIDA DEPT. OF ENVIRONMENTAL REGULATION, TALLAHASSEE.
Diel Variations of Selected Physico-Chemical Parameters in Lake Kissimmee, Florida,
W82-00535 2H

FLORIDA INTERNATIONAL UNIV., MIAMI. SCHOOL OF TECHNOLOGY.
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W82-01093 5B

FLORIDA STATE UNIV., TALLAHASSEE. DEPT. OF OCEANOGRAPHY.
Sulfur and Associated Elements and Acidity in Continental and Marine Rain from North Florida,
W82-00965 2B

FLORIDA STATE UNIV., TALLAHASSEE. OCEANOGRAPHY DEPT.
Water-To-Air Fractionation of Bacteria,
W82-00575 5B

FLORIDA UNIV., GAINESVILLE. DEPT. OF AGRICULTURAL ENGINEERING.
Subsurface Drainage and Sediment Transport Model,
W82-00894 2G

FLORIDA UNIV., GAINESVILLE. DEPT. OF AGRONOMY.
Growth and Nitrogen Fixation of Aeschynomene Under Water Stressed Conditions,
W82-00758 2I

FLORIDA UNIV., GAINESVILLE. DEPT. OF FRUIT CROPS.
Water Stress and Cold Hardiness in Field-Grown Citrus,
W82-00864 2I

FLORIDA UNIV., STANFORD. INST. OF FOOD AND AGRICULTURAL SCIENCES.
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W82-00797 5B

FLORIDA UNIVERSITY, GAINESVILLE, AGRICULTURAL ENGINEERING DEPARTMENT.
Cation Transport in Packed Bed Reactor of Soil,
W82-00970 5D

FOOD AND DRUG ADMINISTRATION, DAVISVILLE, RI. CONSTRUCTION BATALLION CENTER.
Modification of the Standard Most-Probable-Number Procedure for Fecal Coliform Bacteria in Seawater and Shellfish,
W82-00646 5A

FOOD AND DRUG ADMINISTRATION, WASHINGTON, DC.
Waterborne Methylene Bis(2-Chloroaniline) and 2-Chloroaniline Contamination Around Adrian, Michigan,
W82-00873 5B

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W82-00915 2H

FOREST PEST MANAGEMENT INST., SAULT STE MARIE (ONTARIO).
Residues of Nonylphenol in Spruce Foliage, Forest Soil, Stream Water and Sediment After its Aerial Application,
W82-00559 5B

FOXBORO CO., MA.
Water Hardness Determination by the Catalytic Polarographic Wave of Magnesium Ion,
W82-01083 5A

FRANKLIN PIERCE CENTER, CONCORD, NH.
Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Virginia,
W82-00744 6E

FRANKLIN PIERCE LAW CENTER, CONCORD, NH.
Executive Summary; Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in the Seven Mid-Western States.
W82-00718 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in Illinois.
W82-00719 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Rhode Island.
W82-00720 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New Hampshire.
W82-00721 6E

Fundamental Economic Issues in the Development of Small Scale Hydro.
W82-00722 6C

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New Jersey.
W82-00742 6E

Summary of the Mid-Atlantic Conference on Small-Scale Hydro-Power in the Mid-Atlantic States: Resolution of the Barriers Impeding Its Development.
W82-00743 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Maryland.
W82-00745 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in Wisconsin.
W82-00746 6E

A Case Study Analysis of the Legal and Institutional Obstacles and Incentives to the Development of the Hydrolelectric Power of the Boardman River at Traverse City, Michigan.
W82-00747 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Indiana.
W82-00748 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Ohio.
W82-00749 6E

Analysis of Legal Obstacles and Incentives to the Development of Low-Head Hydroelectric Power in Maine.
W82-00750 6E

A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Development of the Hydroelectric Potential at Goose River, Maine.
W82-00751 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Pennsylvania.
W82-00752 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in West Virginia.
W82-00753 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New York.
W82-00754 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Delaware.
W82-00755 6E

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W82-01078 6E

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A Comparative Study of Four Dredges Used for Sampling Benthic Macroinvertebrates in Rivers,
W82-00833 7B

GENERAL MOTORS CORP., SAGINAW. STEERING GEAR DIV.
Mixing Technology Reduces Energy Use,
W82-00634 5D

GEOLOGICAL SURVEY, ALEXANDRIA, LA. WATER RESOURCES DIV.
Potentiometric Surface of the Wilcox-Carrizo Aquifer; Bienville, Red River, Northern Natchitoches, and Southern Webster Parishes, Louisana,
W82-00728 7C

GEOLOGICAL SURVEY, BOISE, ID. WATER RESOURCES DIV.
Plan of Study for the Regional Aquifer-System Analysis of the Snake River Plain, Idaho and Eastern Oregon,
W82-00730 6A

GEOLOGICAL SURVEY, LAKEWOOD, CO. WATER RESOURCES DIV.
Hydrogeochemistry and Simulated Solute Transport, Piceance Basin, Northwestern Colorado,
W82-00723 5B

GEOLOGICAL SURVEY, LAWRENCE, KS.
The Declining Ground-Water Resources of Alluvial Valleys: A Case Study,
W82-00832 4B

GEOLOGICAL SURVEY, MENLO PARK, CA. WATER RESOURCES DIV.
Approximate Ground-Water-Level Contours, April 1981, for the Soquel-Aptos Area, Santa Cruz County, California,
W82-00734 7C

GEOLOGICAL SURVEY, NSTL STATION, MS. WATER RESOURCES DIV.
Temperature and Solute-Transport Simulation in Streamflow Using a Lagrangian Reference Frame,
W82-00726 2E

GEOLOGICAL SURVEY OF NEW SOUTH WALES, SYDNEY (AUSTRALIA). DEPT. OF MINERAL RESOURCES AND DEVELOPMENT.
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W82-00695 2J

GEOLOGICAL SURVEY, RESTON, VA.
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W82-00993 5B

Chemical Mass-Wasting of the Northern Yucatan Peninsula by Groundwater Dissolution,
W82-01015 2K

GEOLOGICAL SURVEY, RESTON, VA. WATER RESOURCES DIV.
The U.S. Geological Survey Federal-State Cooperative Water Resources Program,
W82-00735 6B

GEOLOGICAL SURVEY, RICHMOND, VA. WATER RESOURCES DIV.
Potentiometric-Surface Map for the Cretaceous Aquifer, Virginia Coastal Plain, 1978,
W82-00727 7C

GEOLOGICAL SURVEY, ROLLA, MO. WATER RESOURCES DIV.
Floods in Kansas City, Missouri and Kansas, September 12-13,
W82-00724 2E

GEOLOGICAL SURVEY, SALT LAKE CITY, UT. WATER RESOURCES DIV.
Summary Appraisal of Water Resources in the Redmond Quadrangle, Sanpete and Sevier Counties, Utah,
W82-00725 7C

Water Resources Data for Utah, Water Year 1980.
W82-00733 7C

GEOLOGICAL SURVEY, TALLAHASSEE, FL. WATER RESOURCES DIV.
Generalized Thickness of the Floridan Aquifer, Southwest Florida Water Management District,
W82-00729 7C

GEOLOGICAL SURVEY, TAMPA, FL.
Resistivity Study of a Coastal Karst Terrain, Florida,
W82-00817 2F

GEOLOGICAL SURVEY, URBANA, IL. WATER RESOURCES DIV.
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W82-00731 7C

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W82-00732 7C

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W82-00830 7B

GEORGIA UNIV., ATHENS.
New Liquid Chromatographic Detection System for Environmental Pollutants,
W82-00740 5A

GEORGIA UNIV., ATHENS. DEPT. OF ZOOLOGY.
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W82-01021 2K

GESELLSCHAFT FUER BIOTECHNOLOGISCHE FORSCHUNG, M.B.H., STOCKHEIM (GERMANY, F.R.).
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W82-00682 5A

GLASGOW UNIVERSITY (SCOTLAND), DEPARTMENT OF CHEMISTRY.
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W82-00840 7B

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Trace Element Concentrations Over Midlake Michigan as a Function of Meteorology and Source Region,
W82-00550 5B

GRANADA UNIV. (SPAIN). DEPT. OF ECOLOGY.
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W82-00674 5B

GRANADA UNIV. (SPAIN). DEPT. OF MICROBIOLOGY.
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W82-00662 5A

GREAT SMOKY MOUNTAINS NATIONAL PARK, GATLINBURG, TN.
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W82-00539 6A

GROUNDWATER SURVEY TNO, DELFT (NETHERLANDS).
A Combination of Electrical Resistivity, Seismic Refraction, and Gravity Measurements for Groundwater Exploration in Sudan,
W82-00852 2F

GUAM UNIV., AGANA. MARINE LAB.
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W82-00937 5D

GUELPH UNIV. (ONTARIO). DEPT. OF LAND RESOURCE SCIENCE.
Evaluation of Winter Application of Liquid Sludge to Farmland,
W82-00952 5B

GUNNISON BROS. GIRARD, PA.
Chemical Treatment Solves Tannery Waste Problems,
W82-00638 5D

HAMBURG UNIV. (GERMANY, F.R.) INST. FUER HYDROBIOLOGIE UND FISCHEREIWISSENSCHAFT.
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W82-01033 5C

HARRIS (FREDERIC R.) INC., HOUSTON, TX.
Large Rubble-Mound Breakwater Failures,
W82-00862 8D

HARVARD UNIV., CAMBRIDGE, MA. CENTER FOR EARTH AND PLANETARY PHYSICS.
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W82-00777 5B

HAVENS AND EMERSON LTD., CLEVELAND, OH.
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W82-00885 9A

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W82-00587 5C

HEALTH AND WELFARE CANADA, OTTAWA (ONTARIO). MONITORING AND CRITERIA DIV.
Gas Chromatographic Determination of Trialkyl/Aryl Phosphates in Drinking Water, Following Isolation Using Macroreticular Resin,
W82-00502 5A

HEBREW UNIV., JERUSALEM (ISRAEL). ENVIRONMENTAL HEALTH LAB.
Isolation and Identification of Pathogenic Microorganisms at Wastewater-Irrigated Fields: Ratios in Air and Wastewater,
W82-00579 5A

HOOVER-NSK BEARING PLANT, ANN ARBOR, MI.
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W82-00636 5D

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W82-00652 2A

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W82-00607 2I

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W82-00869 4D

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY, SPRINGFIELD.
Grab Versus Composite Sampling: A Primer for the Manager and Engineer,
W82-00891 5A

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W82-01052 4B

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Assessment of Airborne Inorganic Contaminants in the Great Lakes,
W82-00710 5B

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W82-00982 5B

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W82-01012 7B

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W82-00713 5C

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Sedimentation of Zeolite Type A in Water and Waste Water,
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Report of the Aquatic Ecosystem Objectives Committee,
W82-00705 5G

1980 Annual Report, Committee on the Assessment of Human Health Effects of Great Lakes Water Quality,
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Control Systems for Return and Waste Sludge,
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W82-00892 7B

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W82-00839 2I

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An Environmental Safety Assessment of Butyl Benzyl Phthalate,
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Determining Volatile Organics in Water,
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W82-00560 2G

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W82-01004 7B

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W82-00570 5B

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Sample Intake Position and Loading Rates from Nonpoint Source Pollution,
W82-00778 5A

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Simultaneous Determination of Iron, Cadmium, Zinc, Copper, Nickel, Lead, and Uranium in Seawater by Stable Isotope Dilution Spark Source Mass Spectrometry,
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Comparison of Methods for the Determination of Trace Elements in Seawater,
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W82-00794 5D

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W82-00961 6A

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Fungal Decolorization of Kraft Bleach Plant Effluents,
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Identification of Organic Compounds,
W82-00635 5A

OAK RIDGE NATIONAL LAB. TN.
State Water Use and Socioeconomic Data Related to the Second National Water Assessment,
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W82-00991 7A

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A Leaky Reservoir Model for Ephemeral Flow Recession,
W82-00600 2E

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Backfill Alteration Effects on Pipe Drainage of a Clay Soil,
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The Uncertainty of Crop Models in Irrigation Optimization,
W82-00940 3F

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Management Provoked Conflict in Fisheries,
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Influence of Seasonal Temperature on the Temperature Optima of Bacteria in Sediments of Lake George, New York,
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Antibiotic-Resistant Bacteria in Drinking Water,
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Multivariate Hydrologic Time Series Analysis,
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The Effect of Height of Water Table on the Growth of Holcus Lanatus With Reference to Lolium Perenne,
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Simulation Modeling of Primary Clarifiers,
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Fluidized Bed for Biological Wastewater Treatment,
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Analysis of Precipitation Chemistry at a Central Pennsylvania Site,
W82-00980 2K

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Floc/Float System Cleans Desalter Effluent,
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Influence of Phosphorus Loads and of Some Limnological Processes on the Purity of Lake Water,
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Mutant Bacteria Control Filamentous Growth in Mill Wastewater Treatment,
W82-01008 5D

PRICKETT (THOMAS A.) AND ASSOCIATES, URBANA, IL.
Mathematical Modeling Techniques for Groundwater Management,
W82-01062 4B

PURDUE UNIV., LAFAYETTE, IN. DEPT. OF AGRICULTURAL ENGINEERING.
Answers: A Model for Watershed Planning,
W82-00898 6A

PURDUE UNIV., LAFAYETTE, IN. DEPT. OF BIONUCLEONICS.
The Impact of an Industrially Contaminated Lake on Heavy Metal Levels in it's Effluent Stream,
W82-00886 5B

The Effects of Heavy Metals on Microbial Biomass in Sediments of Palestine Lake,
W82-00925 5C

RACINE WASTEWATER UTILITY, WI.
Better Dewatering Improves Sludge Recycling and Gives Significant Energy Savings,
W82-00526 5E

RADIATION MANAGEMENT CORP., DRUMORE, PA. MUDDY RUN ECOLOGICAL LAB.
Assessment of Thermal Discharges on Zooplankton in Conowingo Pond, Pennsylvania,
W82-00592 5C

RENSSELAER POLYTECHNIC INST., TROY, NY. DEPT. OF BIOLOGY.
Effect of Temperature on Mineralization by Heterotrophic Bacteria,
W82-00583 5C

RESOURCES FOR THE FUTURE, WASHINGTON, DC.
The Distribution of the Costs of Federal Water Pollution Control Policy,
W82-00537 6B

RHODE ISLAND UNIV., KINGSTON. DEPT. OF ZOOLOGY.
Grazing Rate Determination of Corynoneura Scutellata Winnertz (Chironomidae:Diptera),
W82-00822 2H

RHODE ISLAND UNIV., KINGSTON. GRADUATE SCHOOL OF OCEANOGRAPHY.
Partitioning of No. 2 Fuel Oil in Controlled Estuarine Ecosystems. Sediments and Suspended Particulate Matter,
W82-00541 2L

ROCKWELL INTERNATIONAL, PITTSBURGH, PA.
An Intangible Benefit of Water Pollution Control Programs,
W82-01092 6B

RPC, INC., AUSTIN, TX.
Managing Oil and Gas Activities in Coastal Environments: Refuge Manual,
W82-01081 5G

RUHRVERBAND, ESSEN (GERMANY, F. R.).
The Fate of Heavy Metals in the Ruhr System and Their Influence on Drinking Water Quality,
W82-00962 5B

SAN DIEGO STATE UNIV., CA.
Comparative Field Water Relations of Four Co-Occuring Chaparral Shrub Species,
W82-00762 2I

Some Aspects of Plant Water Relations in Alaskan Arctic Tundra Species,
W82-00846 2I

SAN DIEGO STATE UNIV., CA. DEPT. OF BIOLOGY.
Soil Moisture Relations in the Southern California Chaparral,
W82-01035 2D

SAN DIEGO STATE UNIV., CA. DEPT. OF CIVIL ENGINEERING.
Modeling Gradual Dam Breaches,
W82-00554 8D

SANDIA LABS., ALBUQUERQUE, NM.
Effects of Wastewater Sludge and Its Detergents on the Stability of Rotavirus,
W82-00576 5A

SASKATCHEWAN UNIV., SASKATOON. DEPT. OF CIVIL ENGINEERING.
A Mathematical Model for Predicting Moisture Flow in an Unsaturated Soil Under Hydraulic and Temperature Gradients,
W82-00605 2G

Hydraulic Design for the Two-Stage Stilling Basin,
W82-00849 8B

SASKATCHEWAN UNIV., SASKATOON. DEPT. OF SOIL SCIENCE.
The Nature of Selected Prairie Lake and Stream Sediments,
W82-00815 2J

SAVANNAH RIVER ECOLOGY LAB., AIKEN, SC.
Trace Element Inputs From a Coal Burning Power Plant to Adjacent Terrestrial and Aquatic Environments,
W82-00557 5B

The Effect of Season and Location on Phosphoadenylate Concentrations and Adenylate Energy Charge in Two Species of Freshwater Clams,
W82-00810 2H

SCIENCE AND EDUCATION ADINISTRATION, OXFORD, MS. SEDIMENTATION LAB.
Sediment Yield from a Flatland Watershed,
W82-00941 2J

SCIENCE AND EDUCATION ADMINISTRATION, BELTSVILLE, MD.
Trenching of Digested Sludge,
W82-00974 5E

SCIENCE AND EDUCATION ADMINISTRATION, BELTSVILLE, MD. PESTICIDE DEGRADATION LAB.
Distribution of Silvex, 2,4-D, and TCDD Applied to Turf in Chambers and Field Plots,
W82-00568 5B

SCIENCE AND EDUCATION ADMINISTRATION, BUSHLAND, TX. CONSERVATION AND PRODUCTION RESEARCH LAB.
Land Forming Effects on Dryland Sorghum Production in the Southern Great Plains,
W82-00764 3F

Effect of Soil Water Content and a Growing Season Straw Mulch on Grain Sorghum,
W82-00765 3F

Management of Recharge Basins on the Southern High Plains,
W82-00938 4B

SCIENCE AND EDUCATION ADMINISTRATION, COSHOCTON, OH. NORTH APPALACHIAN EXPERIMENTAL WATERSHED.
Effects of Nitrapyrin on Nitrate Movement in Soil Columns,
W82-01048 5G

SCIENCE AND EDUCATION ADMINISTRATION, DURANT, OK. SOUTHERN PLAINS WATERSHED AND WATER QUALITY LAB.
A Method for the Evaluation of Conditions in a Fish Pond Sediment,
W82-01019 2H

SCIENCE AND EDUCATION ADMINISTRATION, ITHACA, NY.
The Breakdown of Poultry Manure Aggregates by Rainfall Impact,
W82-00513 5B

SCIENCE AND EDUCATION ADMINISTRATION, MANDAN, ND. NORTHERN GREAT PLAINS RESEARCH CENTER.
Watertable Management Saves Water and Energy,
W82-00943 3F

Dryland Cropping Strategies for Efficient Water-Use to Control Saline Seeps in the Northern Great Plains, U.S.A.,
W82-01023 3F

SCIENCE AND EDUCATION ADMINISTRATION, NORTHEAST WATERSHED RESEARCH CENTER, UNIVERSITY PARK, PA.
Modeling Water Flux on Strip-Mined Land,
W82-00944 2G

SCIENCE AND EDUCATION ADMINISTRATION, OXFORD, MS. SEDIMENTATION LAB.
Effect of Slope Length on Erosion from Low Slopes,
W82-00896 2J

Sediment Sizes Eroded from Crop Row Sideslopes,
W82-00903 2J

SCIENCE AND EDUCATION ADMINISTRATION, PHOENIX, AZ. WATER CONSERVATION LAB.
Depths of Flow in Level Basins,
W82-00900 3F

SCIENCE AND EDUCATION ADMINISTRATION, ST. PAUL, MN.
Effects of Municipal Waste Water Effluent on Performance and Feed Quality of Maize Vs. Reed Canarygrass,
W82-00564 3C

SCIENCE AND EDUCATION ADMINISTRATION, STILLWATER, OK. WATER CONSERVATION STRUCTURES LAB.
Tractive Force Design of Vegetated Channels,
W82-00901 4D

SCIENCE AND EDUCATION ADMINISTRATION, TEMPLE, TX. GRASSLAND, SOIL AND WATER RESEARCH LAB.
Water Dynamics in the Soil-Plant-Atmosphere System,
W82-00759 2I

SCIENCE AND EDUCATION, BELTSVILLE, MD. HYDROLOGY.
The Magnitude of the Hydrological Frequency Factor in Maximum Rainfall Estimation,
W82-00983 2B

SCRIPPS INSTITUTION OF OCEANOGRAPHY, LA JOLLA, CA. PHYSIOLOGICAL RESEARCH LAB.
Superseparation: Soret Effect Reversed,
W82-00791 3A

SECRETARY FOR AGRICULTURE AND FORESTRY, CISKEI (SOUTH AFRICA).
Environmental Aspects of Rural Development with Particular Reference to the Keiskamma River Basin Study,
W82-00685 6D

SEVERN-TRENT WATER AUTHORITY (ENGLAND).
Environmental Virology and its Problems,
W82-00505 5A

Factors Influencing the Occurrence of Bursts in Iron Water Mains,
W82-00960 8A

SEWAGE RECLAMATION DEPT., TEL AVIV (ISRAEL).
Environmental Effects of Water Reuse Scheme,
W82-00973 3C

SHORT-ELLIOTT-HENDRICKSON, INC., ST. PAUL, MN.
Empire Controlled by Computer,
W82-00529 5D

SIMON FRASER UNIVERSITY, BURNABY (BRITISH COLUMBIA). DEPT. OF BIOLOGICAL SCIENCES.
Residues in Cutthroat Trout (Salmo Clarki) and California Newts (Tarichia Torosa) From a Lake Treated With Technical Chlordane,
W82-00558 5C

SMITHSONIAN INSTITUTION, EDGEWATER, MD. CHESAPEAKE BAY CENTER FOR ENVIRONMENTAL STUDIES.
Enrichment of the Agricultural Herbicide Atrazine in the Microsurface Water of an Estuary,
W82-00877 5B

SNELL ENVIRONMENTAL GROUP, INC., LANSING, MI.
Ferric Chloride Takes Over,
W82-00954 5F

SOUTH CAROLINA UNIV., COLUMBIA. BELLE W. BARUCH INST. FOR MARINE BIOLOGY AND COASTAL RESEARCH.
Estimation of Material Fluxes in an Estuarine Cross Section: A Critical Analysis of Spatial Measurement Density and Errors,
W82-00816 7A

SOUTH CAROLINA UNIV., COLUMBIA. DEPT. OF BIOLOGY.
The Assay of Adenosine 5'Triphosphate Extracted from Salt-Marsh Microbiota,
W82-00838 2L

SOUTH CAROLINA UNIV., COLUMBIA. DEPT. OF GEOLOGY.
General Morphology and Sediment Patterns in Tidal Inlets,
W82-00792 2L

SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY, RAPID CITY.
Numerical Simulation of the Effects of Cooling Tower Complexes on Clouds and Severe Storms,
W82-00995 2B

SOUTHERN ILLINOIS UNIV. AT CARBONDALE. DEPT. OF AGRICULTURAL INDUSTRIES.
Dairy Liquid Waste Distribution in an Overland Flow Vegetative-Soil Filter System,
W82-00897 5D

SOUTHERN ILLINOIS UNIV. AT EDWARDSVILLE. DEPT. OF BIOLOGICAL SCIENCES.
Chemistry of Lake Water and Groundwater in Areas of Contrasting Glacial Drifts in Eastern Minnesota,
W82-00821 2K

SOUTHERN UNIV., BATON ROUGE, LA. DEPT. OF BIOLOGICAL SCIENCES.
Toxicities of Paraquat and Diquat Herbicides to Freshwater Copepods (Diaptomus Sp. and Eucyclops Sp.),
W82-00589 5C

STANFORD UNIV., CA. DEPT. OF BIOLOGICAL SCIENCES.
The Effect of Environmental Uncertainty on Morphological Design and Fluid Balance in Sarracenia Purpurea L.,
W82-00811 2I

STANFORD UNIV., CA. DEPT. OF CIVIL ENGINEERING.
Utilization of Dichloromethane by Suspended and Fixed-Film Bacteria,
W82-00577 5B

STATE UNIV. OF NEW YORK AT ALBANY.
Apparatus for the Simulation of Rain in the Laboratory,
W82-00807 2B

STATE UNIV. OF NEW YORK AT BUFFALO. DEPT. OF MECHANICAL ENGINEERING.
Buoyancy Force Reversals in Vertical Natural Convection Flows in Cold Water,
W82-00981 1A

STATE UNIV. OF NEW YORK AT BUFFALO. DEPT. OF MICROBIOLOGY.
Mechanism of Charged Membrane Ultrafiltration of Salt Solutions,
W82-00641 5D

STATE UNIV. OF NEW YORK COLL. AT FREDONIA. DEPT. OF ECONOMICS.
The Toxic Waste Dump Problem and a Suggested Insurance Program,
W82-00591 5E

STATION BIOLOGIQUE DE LA TOUR DU VALAT, ARLES (FRANCE).
Phosphate Models, a Gap to Bridge,
W82-00929 2H

STOCKHOLM UNIV. (SWEDEN). ARRHENIUS LAB.
A Numerical Comparison Between Lagrangian and Eulerian Rainfall Statistics,
W82-00803 2B

STOCKHOLM UNIV. (SWEDEN). DEPT. OF GEOLOGY.
A Review on Sediment Traps in Aquatic Environments,
W82-01020 7B

STONE AND WEBSTER ENGINEERING CORP., CHERRY HILL, NJ.
Numerical Simulation of Potentiometric Surface Changes Caused by a Proposed Open-Pit Anthracite Mine,
W82-00819 6A

SURREY UNIV., GUILFORD (ENGLAND). DEPT. OF MICROBIOLOGY.
A Note on the Fate of El Tor Cholera and Other Vibrios in Percolating Filters,
W82-00566 5D

SYBRON CORP., SALEM, VA. BIOCHEMICAL DIV.
Foam Control and Degradation of Nonionic Detergents,
W82-00637 5D

SYDNEY UNIV. (AUSTRALIA). DEPT. OF INORGANIC CHEMISTRY.
A Reduction-Spectrophotometric Method for the Determination of Sulphate in Waters,
W82-00850 5A

SYRACUSE UNIV., NY. DEPT. OF CIVIL ENGINEERING.
Economic Analysis of Granular-Bed Filtration,
W82-00975 5F

TECHNISCHE HOGESCHOOL TWENTE, ENSCHEDE (NETHERLANDS). DEPT. OF CHEMICAL ENGINEERING.
Interaction of Orthophosphate with Iron (III) and Aluminum Hydroxides,
W82-00783 2H

TERMINAL ISLAND TREATMENT PLANT, LOS ANGELES, CA.
Foam Control in Aeration Tanks,
W82-00525 5D

TEXAS A AND M UNIV., COLLEGE STATION. DEPT. OF OCEANOGRAPHY.
Uptake of Polychlorinated Biphenyls by Natural Phytoplankton Assemblages: Field and Laboratory Determination of C14-PCB Particle-Water Index of Sorption,
W82-01032 5B

TEXAS CHRISTIAN UNIV., FORT WORTH. DEPT. OF GEOLOGY.
Aerial Photography as an Aid to Cropland Erosion Analysis,
W82-00902 2J

TEXAS TECH UNIV., LUBBOCK. DEPT. OF PLANT AND SOIL SCIENCE.
Effects of Water Quality on Forage Production,
W82-01002 3C

TEXAS UNIV. AT AUSTIN.
Interpretation of Surface-Water Circulation, Aransas Pass, Texas, Using Landsat Imagery,
W82-00904 7B

TEXAS UNIV. AT AUSTIN. DEPT. OF CIVIL ENGINEERING.
Groundwater Contaminant Transport with Adsorption and Ion Exchange Chemistry: Method of Characteristics for the Case Without Dispersion,
W82-00551 5B

TEXAS UNIV., GALVESTON. MEDICAL BRANCH.
Chloramine-T as A Potential Scrubbing Agent: Removal of Odorous Sulfur-Containing Environmental Pollutants,
W82-00871 5D

THE HEBREW UNIV., REHOVOT (ISRAEL). DEPT. OF SOIL AND WATER SCIENCE.
The Effects of Sodium and Organic Matter In Sewage Effluent on Water Retention Properties of Soils,
W82-00663 3C

TOKYO METROPOLITAN UNIV. (JAPAN). DEPT. OF CHEMISTRY.
Vertical Distribution of Monosaccharides in Lake Water,
W82-00665 2H

Chemical Composition of Labile Fractions in DOM,
W82-00917 2H

TORO CO., SAN MARCOS, CA. (ASSIGNEE).
Traveling Sprinkler System and Method,
W82-00561 3F

TORONTO UNIV. (ONTARIO). DEPT. OF CIVIL ENGINEERING.
Water Quality Evaluation of Regional Wastewater Management,
W82-00977 5D

TORONTO UNIV. (ONTARIO). DEPT. OF ZOOLOGY.
Effect of Crude Oil and Petroleum-Degrading Microorganisms on the Growth of Freshwater and Soil Protozoa,
W82-00517 5C

TUDOR ENGINEERING CO., RIVERTON, WY.
Small Hydro Installations Spur Unique Engineering Solutions,
W82-00538 6B

UNIVERSIDAD AUTONOMA DE NUEVO LEON, MONTERREY (MEXICO).
Chemicals Disinfect Sludge,
W82-01003 5D

UNIVERSIDADE FEDERAL DE VICOSA (BRAZIL).
A Non-Equilibrium Thermodynamics Approach to Transport Phenomena in Capillary Porous Media,
W82-00697 2F

UNIVERSITY OF CENTRAL FLORIDA, ORLANDO. DEPT. OF CHEMISTRY.
Acid Rain at Kennedy Space Center, Florida: Recent Observations,
W82-00533 5B

UNIVERSITY OF EAST ANGLIA, NORWICH (ENGLAND). SCHOOL OF ENVIRONMENTAL SCIENCES.
Prediction of Phosphorus and Nitrogen Concentrations in Lakes from Both Internal and External Loading Rates,
W82-00928 2H

UNIVERSITY OF NEW ENGLAND, ARMIDALE (AUSTRALIA).
Research and Development to Service a Sustainable Agriculture,
W82-00669 3F

UNIVERSITY OF SOUTH FLORIDA, TAMPA. DEPT. OF CHEMISTRY.
Potential Management of Florida Red Tide Through Selective Photodynamic Action,
W82-00515 5G

UNIVERSITY OF SOUTH FLORIDA, TAMPA. DEPT. OF GEOLOGY.
Predictive Depositional Model for Glacial Aquifers,
W82-00828 2F

UNIVERSITY OF SOUTHERN CALIFORNIA, LOS ANGELES.
Effects of Thermal Effluents on Communities of Benthic Marine Macroalgae,
W82-00870 5C

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG (SOUTH AFRICA).
Settlement of a Compacted Unsaturated Earth Embankment,
W82-00678 8D

On August Mean Temperature and the Succeeding Season's Rainfall Over South Africa,
W82-00692 2B

UNIVERSITY OF WEST FLORIDA, PENSACOLA. DEPT. OF BIOLOGY.
Effects of Temperature, pH, Salinity, and Inorganic Nitrogen on the Rate of Ammonium Oxidation by Nitrifiers Isolated from Wetland Environments,
W82-00910 2L

UPPSALA UNIV. (SWEDEN). DEPT. OF LIMNOLOGY.
Reviving Acidified Lakes,
W82-00933 2H

UPPSALA UNIV. (SWEDEN). DIV. OF HYDROLOGY.
Spring Flood: Meltwater or Groundwater,
W82-00531 7B

UTAH WATER RESEARCH LAB., LOGAN.
Seeding-Opportunity Recognition in Winter Orographic Clouds,
W82-01005 3B

VANDERBILT UNIV., NASHVILLE, TN. DEPT. OF CHEMISTRY.
Electrical Aspects of Adsorbing Colloid Flotation. XI. Surfactant Adsorption Isotherms, Particle Displacement, and Differential Capacitance,
W82-00788 1B

VANDERBILT UNIV., NASHVILLE, TN. DEPT. OF GENERAL BIOLOGY.
Photosynthetic Recovery of Resurrection Spikemosses from Different Hydration Regimes,
W82-01010 2I

VICTORIA DEPT. OF AGRICULTURE (AUSTRALIA). ATTWOOD VETERINARY RESEARCH LAB.
Persistence and Distribution of Erysipelothrix Rhusiopathiae and Bacterial Indicator Organisms on Land Used for Disposal of Piggery Effluent,
W82-00686 5B

VICTORIA UNIV., WELLINGTON (NEW ZEALAND).
Effects of Tropical Cyclone Wally in Southeast Viti Levu, Fiji, Easter 1980,
W82-00670 2A

VICTORIAN DEPT. OF AGRICULTURE, FERNTREE GULLY (AUSTRALIA). SCORESBY HORTICULTURAL RESEARCH STATION.
The Effect of Temperature on Salt Uptake by Tomato Plants With Diurnal and Nocturnal Waterlogging of Salinized Rootzones,
W82-00608 2I

VIRGINIA INST. OF MARINE SCIENCES, GLOUCESTER POINT.
Kepone in the James River,
W82-00631 5B

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. CENTER FOR ENVIRONMENTAL STUDIES.
Industrial Effluent Monitoring Incorporating a Recent Automated Fish Biomonitoring System,
W82-00530 5A

Does Improved Waste Treatment Have Demonstrable Biological Benefits,
W82-00779 5C

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF BIOLOGY.
Seston Dynamics in Southern Appalachian Streams: Effects of Clear-Cutting,
W82-00543 4C

Preference-Avoidance Reactions of Crayfish to Sublethal Concentrations of Cadmium,
W82-00916 5A

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF CIVIL ENGINEERING.
Vacuum Filtration of Metal Hydroxide Sludges,
W82-00976 5D

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF ENTOMOLOGY.
Accurate and Efficient Estimation of Benthic Populations: A Comparison Between Removal Estimation and Conventional Sampling Techniques,
W82-00633 5A

VIRGINIA STATE WATER CONTROL BOARD, RICHMOND.
Ground Water Problems Virginia Portion Ohio River Basin,
W82-01059 4B

VIRGINIA UNIV., CHARLOTTESVILLE. DEPT. OF ENVIRONMENTAL SCIENCES.
Acid Precipitation: The Importance of Nitric Acid,
W82-00643 2K

VOLCANI INST. OF AGRICULTURAL RESEARCH, BET-DAGAN (ISRAEL). DIV. OF FIELD CROPS.
The Manifestation of Dehydration Avoidance in Wheat Breeding Germplasm,
W82-00958 2I

VOLCANI INST. OF AGRICULTURAL RESEARCH, BET DAGAN (ISRAEL). DIV. OF SOIL PHYSICS.
Transport of Salts in Soils and Subsoils, W82-00930 5B

VOLCANI INST. OF AGRICULTURAL RESEARCH, BET-DAGAN (ISRAEL). DIV. OF SOIL RESIDUES CHEMISTRY.
Dye-Sensitized Photooxidation of Bromacil in Water, W82-00514 5B

WASHINGTON STATE DEPT. OF ECOLOGY, OLYMPIA.
Effects of Renton Wastewater Treatment Plant Effluent on Water Quality of the Lower Green/Duwamish River, W82-01063 5D

The Impact of Effluent from the Renton Wastewater Treatment Plant on the Dissolved Oxygen Regimen of the Lower Green/Duwamish River, W82-01064 5D

An Industrial and Hazardous Waste Inventory of Washington's Manufacturing Industries (1980), W82-01065 5B

Assessment of Water Quality Conditions in Skamokawa Creek, Washington, W82-01066 5C

State of Washington Water Quality Assessment Report 1980. W82-01067 6E

Water Quality Conditions in the Bellingham Bay Area 1979-1980, W82-01068 5B

Wilson Creek Drainage - Surface and Ground Water Quality, July 1978 to July 1979. W82-01069 5B

Biological Testing Methods - Compliance with Hazardous Waste Regulation Chapter 173-302 WAC. W82-01071 5A

An Assessment of the Trophic Status of Deer, Loon, and Diamond Lakes, W82-01072 2H

WASHINGTON STATE DEPT. OF SOCIAL AND HEALTH SERVICES, OLYMPIA. OFFICE OF ENVIRONMENTAL PROGRAMS.
Giardia Prevalence in Commercially Trapped Mammals, W82-01046 5A

WASHINGTON STATE UNIV., PULLMAN. R. L. ALBROOK HYDRAULIC LAB.
Uranium Concentration in the Ground Waters of the Pullman-Moscow Basin, Whitman County, Washington, and Latah County, Idaho, W82-00809 5B

WASHINGTON UNIV., SEATTLE. COLL. OF FISHERIES.
Factors Affecting Puget Sound Coho Salmon (Oncorhynchus Kisutch) Runs, W82-00883 8I

WASHINGTON UNIV., SEATTLE. DEPT. OF CIVIL ENGINEERING.
Nitrogen and Phosphorus Recycling in Lake Sammamish, A Temperate Mesotrophic Lake, W82-00824 2H

WASHINGTON UNIV., SEATTLE. DEPT. OF ZOOLOGY.
The Effect of Changes in the Nutrient Income on the Condition of Lake Washington, W82-00987 2H

WASHINGTON UNIV., SEATTLE. FISHERIES RESEARCH INST.
Sea Urchin Sperm Bioassay for Sewage and Chlorinated Seawater and Its Relation to Fish Bioassays, W82-00988 5A

WATER POLICY TASK FORCE, LITTLE ROCK, AR.
Arkansas Water Policy. W82-00715 6D

WATER POLLUTION RESEARCH LAB., STEVENAGE (ENGLAND).
Anaerobic Biological Treatment of Food Industry Wastewaters, W82-00698 5D

WATER TREATMENT PLANT, TRAVERSE CITY, MI.
Direct Filtration Studies at Traverse City Water Treatment Plant, W82-00945 5F

WAUKESHA WATER UTILITY, WI.
Distribution System Liability, W82-01028 5F

WEIZMANN INST. OF SCIENCE, REHOVOT (ISRAEL). ISOTOPE DEPT.
The Use of Na/Cl Ratios to Trace Solute Sources in a Semiarid Zone, W82-00601 7B

WESSEX WATER AUTHORITY (ENGLAND).
The Control of Bacterial Pollution Caused by Sea Discharges of Sewage, W82-00699 5D

WEST KENT WATER CO. (ENGLAND).
Manganese Dioxide as an Adsorbant for Heavy Metals, W82-00775 5F

WEST VIRGINIA DEPT. OF NATURAL RESOURCES, CHARLESTON. DIV. OF WATER RESOURCES.
Ground Water Problems in West Virginia, W82-01060 4B

WEST VIRGINIA UNIV., MORGANTOWN.
Bentonite Liners for Power Plant Lagoons, W82-00617 5E

WEST VIRGINIA UNIV., MORGANTOWN. DEPT. OF BIOLOGY.
The Use of Algal Assays and Chlorophyll Concentrations to Determine Fertility of Water in Small Impoundments in West Virginia, W82-00919 2H

Vegetational Analysis of Big Run Bog, A Nonglaciated Sphagnum Bog in West Virginia, W82-00992 2I

Water Chemistry Changes During Artificial Aeration of Spruce Knob Lake, West Virginia, W82-01049 5G

WESTECH ENGINEERING, INC., SALEM, OR.
Why EPA's I/I Control Program Fails, W82-00790 8A

WESTERN AUSTRALIA UNIV., NEDLANDS.
A Comparison of Rainfall-Runoff Models, W82-00911 2A

WEYERHAEUSER CO., LONGVIEW, WA.
Aluminum Shadowing-Direct Projection Photomicroscopy of Diatom Frustules, W82-00884 5A

WEYERHAUSER CO., CENTRALIA, WA.
Moisture Transport in a Soil-Plant System: A Mathematical Model and Finite Element Analysis, W82-00648 2I

WHEELER AND GRAY, LOS ANGELES, CA.
Formulating Alternatives for Environmental Studies, W82-00997 6G

WILLIAMSPORT SANITARY AUTHORITY, PA.
What Caused the Bad Odor in the Drinking Water, W82-00527 5F

WISCONSIN UNIV.-MADISON.
Potential Impact of Size-Selective Planktivory on Phosphorus Release by Zooplankton, W82-00825 2H

WISCONSIN UNIV.-MADISON. DEPT. OF GEOLOGY AND GEOPHYSICS.
Groundwater Quality Models - State of the Art, W82-01061 5G

WISCONSIN UNIV.-OSHKOSH. DEPT. OF GEOLOGY.
Interstate Conflict Over Ground Water: Wisconsin-Illinois, W82-00818 6E

WOODS HOLE OCEANOGRAPHIC INSTITUTION, MA.
Growth of the Bay Scallop, Argopecten Irradians, in a Waste Recycling Aquaculture System, W82-00842 3C

Mean Summer Circulation in Lake Ontario Within the Coastal Zone, W82-00967 2H

WUIDART ENGINEERING LTD., SHEFFORD BEDS (ENGLAND).
Hydrogeological and Geophysical Logging. W82-00511 7B

WYOMING UNIV., LARAMIE. DEPT. OF BOTANY.
Temperature and Water Relation Patterns in Subalpine Understory Plants, W82-00760 2I

Leaf and Environmental Parameters Influencing Transpiration: Theory and Field Measurements, W82-00979 2D

YALE UNIV., NEW HAVEN, CT.
Asbestos Cement Pipe and Cancer in Connecticut 1955-1974, W82-01094 5C

ZOOLOGICAL STATION, TVARMINNE (FINLAND).
Factor Analysis of the Impact of the Environment on Microbial Communities in the Tvarminne Area, Southern Coast of Finland, W82-00672 5C

Effects of Environmental Factors on Microbial Populations in Brackish Waters off the Southern Coast of Finland, W82-00683 2L

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ACCESSION NUMBER INDEX

W82-00501 5B
W82-00502 5A
W82-00503 5A
W82-00504 2I
W82-00505 5A
W82-00506 6D
W82-00507 5B
W82-00508 5A
W82-00509 4D
W82-00510 6E
W82-00511 7B
W82-00512 3F
W82-00513 5B
W82-00514 5B
W82-00515 5G
W82-00516 5A
W82-00517 5C
W82-00518 5C
W82-00519 6B
W82-00520 2H
W82-00521 7B
W82-00522 6A
W82-00523 5D
W82-00524 3C
W82-00525 5D
W82-00526 5E
W82-00527 5F
W82-00528 5D
W82-00529 5D
W82-00530 5A
W82-00531 7B
W82-00532 5A
W82-00533 5B
W82-00534 5D
W82-00535 2H
W82-00536 6C
W82-00537 6B
W82-00538 6B
W82-00539 6A
W82-00540 1B
W82-00541 2L
W82-00542 6G
W82-00543 4C
W82-00544 3F
W82-00545 2H
W82-00546 5G
W82-00547 2L
W82-00548 5C
W82-00549 6A
W82-00550 5B
W82-00551 5B
W82-00552 2H
W82-00553 5B
W82-00554 8D
W82-00555 2A
W82-00556 8A
W82-00557 5B
W82-00558 5C
W82-00559 5B
W82-00560 2G
W82-00561 3F
W82-00562 5G
W82-00563 5B
W82-00564 3C
W82-00565 5E
W82-00566 5D
W82-00567 5A
W82-00568 5B
W82-00569 5A
W82-00570 5B
W82-00571 2H
W82-00572 5A
W82-00573 5A
W82-00574 5A
W82-00575 5B
W82-00576 5A
W82-00577 5B
W82-00578 5A
W82-00579 5A
W82-00580 5A
W82-00581 5A
W82-00582 5A
W82-00583 5C
W82-00584 5A
W82-00585 2H
W82-00586 5B
W82-00587 5C
W82-00588 5D
W82-00589 5C
W82-00590 5C
W82-00591 5E
W82-00592 5C
W82-00593 5C
W82-00594 5G
W82-00595 5B
W82-00596 5C
W82-00597 6G
W82-00598 6A
W82-00599 5B
W82-00600 2E
W82-00601 7B
W82-00602 2F
W82-00603 7B
W82-00604 2A
W82-00605 2G
W82-00606 2H
W82-00607 2I
W82-00608 2I
W82-00609 3B
W82-00610 5A
W82-00611 5D
W82-00612 5B
W82-00613 5F
W82-00614 5A
W82-00615 5A
W82-00616 5B
W82-00617 5E
W82-00618 5F
W82-00619 5F
W82-00620 5G
W82-00621 2K
W82-00622 5B
W82-00623 5D
W82-00624 4A
W82-00625 5F
W82-00626 5B
W82-00627 5A
W82-00628 5G
W82-00629 5B
W82-00630 5A
W82-00631 5B
W82-00632 5C
W82-00633 5A
W82-00634 5D
W82-00635 5A
W82-00636 5D
W82-00637 5D
W82-00638 5D
W82-00639 5D
W82-00640 5E
W82-00641 5D
W82-00642 5B
W82-00643 2K
W82-00644 5A
W82-00645 5F
W82-00646 5A
W82-00647 2A
W82-00648 2I
W82-00649 5A
W82-00650 5F
W82-00651 6G
W82-00652 2A
W82-00653 2H
W82-00654 2I
W82-00655 2D
W82-00656 2K
W82-00657 4A
W82-00658 3C
W82-00659 2H
W82-00660 2D
W82-00661 5E
W82-00662 5A
W82-00663 3C
W82-00664 2H
W82-00665 2H
W82-00666 2H
W82-00667 2H
W82-00668 2E
W82-00669 3F
W82-00670 2A
W82-00671 6A
W82-00672 5C
W82-00673 5C
W82-00674 5B
W82-00675 2H
W82-00676 2B
W82-00677 5C
W82-00678 8D
W82-00679 6A
W82-00680 7B
W82-00681 3C
W82-00682 5A
W82-00683 2L
W82-00684 6G
W82-00685 6D
W82-00686 5B
W82-00687 5C
W82-00688 5C
W82-00689 5D
W82-00690 5A
W82-00691 5C
W82-00692 2B
W82-00693 2I
W82-00694 2J
W82-00695 2J
W82-00696 3F
W82-00697 2F
W82-00698 5D
W82-00699 5D
W82-00700 6E
W82-00701 6E
W82-00702 6E
W82-00703 5G
W82-00704 5G
W82-00705 5G
W82-00706 5C
W82-00707 5C
W82-00708 5C
W82-00709 5B
W82-00710 5B
W82-00711 5B
W82-00712 5A
W82-00713 5C
W82-00714 6D
W82-00715 6D
W82-00716 6F
W82-00717 3C
W82-00718 6E
W82-00719 6E
W82-00720 6E
W82-00721 6E
W82-00722 6C
W82-00723 5B
W82-00724 2E
W82-00725 7C
W82-00726 2E
W82-00727 7C
W82-00728 7C
W82-00729 7C
W82-00730 6A
W82-00731 7C
W82-00732 7C
W82-00733 7C
W82-00734 7C
W82-00735 6B
W82-00736 6D
W82-00737 6G
W82-00738 6G
W82-00739 6D
W82-00740 5A
W82-00741 5A
W82-00742 6E
W82-00743 6E
W82-00744 6E
W82-00745 6E
W82-00746 6E
W82-00747 6E
W82-00748 6E
W82-00749 6E
W82-00750 6E
W82-00751 6E
W82-00752 6E
W82-00753 6E
W82-00754 6E
W82-00755 6E
W82-00756 7B
W82-00757 2L
W82-00758 2I
W82-00759 2I
W82-00760 2I
W82-00761 2I
W82-00762 2I
W82-00763 4A
W82-00764 3F
W82-00765 3F
W82-00766 4D
W82-00767 3C
W82-00768 5D
W82-00769 3C
W82-00770 5B
W82-00771 3F
W82-00772 6B
W82-00773 5F
W82-00774 5F
W82-00775 5F
W82-00776 2J
W82-00777 5B
W82-00778 5A
W82-00779 5C
W82-00780 6A
W82-00781 7B
W82-00782 6G
W82-00783 2H
W82-00784 10D
W82-00785 2G
W82-00786 5A
W82-00787 5A
W82-00788 1B
W82-00789 5C
W82-00790 8A
W82-00791 3A
W82-00792 2L
W82-00793 7B
W82-00794 5D
W82-00795 2L
W82-00796 5A
W82-00797 5B
W82-00798 5A
W82-00799 6E
W82-00800 6E
W82-00801 5B
W82-00802 6A
W82-00803 2B
W82-00804 8B
W82-00805 5C
W82-00806 2B
W82-00807 2B
W82-00808 2B
W82-00809 5B
W82-00810 2H
W82-00811 2I
W82-00812 2I
W82-00813 6G
W82-00814 2H
W82-00815 2J
W82-00816 7A
W82-00817 2F
W82-00818 6E
W82-00819 6A
W82-00820 5A
W82-00821 2K
W82-00822 2H
W82-00823 2K
W82-00824 2H
W82-00825 2H
W82-00826 7B
W82-00827 2F
W82-00828 2F
W82-00829 7B
W82-00830 7B
W82-00831 2F
W82-00832 4B
W82-00833 7B
W82-00834 5C
W82-00835 2B
W82-00836 2C

W82-00837 2H
W82-00838 2L
W82-00839 2I
W82-00840 7B
W82-00841 5D
W82-00842 3C
W82-00843 2H
W82-00844 2C
W82-00845 2C
W82-00846 2I
W82-00847 5D
W82-00848 5D
W82-00849 8B
W82-00850 5A
W82-00851 5D
W82-00852 2F
W82-00853 5B
W82-00854 2K
W82-00855 5A
W82-00856 5A
W82-00857 5A
W82-00858 6D
W82-00859 5A
W82-00860 5C
W82-00861 6C
W82-00862 8D
W82-00863 2A
W82-00864 2I
W82-00865 5A
W82-00866 5G
W82-00867 5F
W82-00868 5A
W82-00869 4D
W82-00870 5C
W82-00871 5D
W82-00872 5C
W82-00873 5B
W82-00874 5B
W82-00875 5A
W82-00876 5B
W82-00877 5B
W82-00878 5A
W82-00879 5A
W82-00880 8B
W82-00881 2J
W82-00882 2H
W82-00883 8I
W82-00884 5A
W82-00885 9A
W82-00886 5B
W82-00887 2K
W82-00888 5F
W82-00889 2L
W82-00890 4A
W82-00891 5A
W82-00892 7B
W82-00893 5G
W82-00894 2G
W82-00895 3F
W82-00896 2J
W82-00897 5D
W82-00898 6A
W82-00899 3F
W82-00900 3F
W82-00901 4D
W82-00902 2J
W82-00903 2J
W82-00904 7B
W82-00905 5D
W82-00906 5D
W82-00907 5B
W82-00908 6G
W82-00909 8G
W82-00910 2L
W82-00911 2A
W82-00912 2I
W82-00913 5D
W82-00914 2H
W82-00915 2H
W82-00916 5A
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W82-00918 2L
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W82-00920 2H
W82-00921 2L
W82-00922 2L
W82-00923 2H
W82-00924 5C
W82-00925 5C
W82-00926 2A
W82-00927 2A
W82-00928 2H
W82-00929 2H
W82-00930 5B
W82-00931 2D
W82-00932 2G
W82-00933 2H
W82-00934 4B
W82-00935 2I
W82-00936 2H
W82-00937 5D
W82-00938 4B
W82-00939 5D
W82-00940 3F
W82-00941 2J
W82-00942 3F
W82-00943 3F
W82-00944 2G
W82-00945 5F
W82-00946 5F
W82-00947 5D
W82-00948 5E
W82-00949 5D
W82-00950 5D
W82-00951 5D
W82-00952 5B
W82-00953 5F
W82-00954 5F
W82-00955 5D
W82-00956 5D
W82-00957 5D
W82-00958 2I
W82-00959 5A
W82-00960 8A
W82-00961 6A
W82-00962 5B
W82-00963 1A
W82-00964 2B
W82-00965 2B
W82-00966 2C
W82-00967 2H
W82-00968 5D
W82-00969 5D
W82-00970 5D
W82-00971 5D
W82-00972 6E
W82-00973 3C
W82-00974 5E
W82-00975 5F
W82-00976 5D
W82-00977 5D
W82-00978 6G
W82-00979 2D
W82-00980 2K
W82-00981 1A
W82-00982 5B
W82-00983 2B
W82-00984 2A
W82-00985 2F
W82-00986 2A
W82-00987 2H
W82-00988 5A
W82-00989 2J
W82-00990 2F
W82-00991 7A
W82-00992 2I
W82-00993 5B
W82-00994 2K
W82-00995 2B
W82-00996 6E
W82-00997 6G
W82-00998 5C
W82-00999 5A
W82-01000 5B
W82-01001 5E
W82-01002 3C
W82-01003 5D
W82-01004 7B
W82-01005 3B
W82-01006 2B
W82-01007 5D
W82-01008 5D
W82-01009 5D
W82-01010 2I
W82-01011 2I
W82-01012 7B
W82-01013 6E
W82-01014 3E
W82-01015 2K
W82-01016 2F
W82-01017 5A
W82-01018 2G
W82-01019 2H
W82-01020 7B
W82-01021 2K
W82-01022 5B
W82-01023 3F
W82-01024 5B
W82-01025 5B
W82-01026 5E
W82-01027 6A
W82-01028 5F
W82-01029 8A
W82-01030 6E
W82-01031 5C
W82-01032 5B
W82-01033 5C
W82-01034 2I
W82-01035 2D
W82-01036 2K
W82-01037 2E
W82-01038 1A
W82-01039 2I
W82-01040 5B
W82-01041 5A
W82-01042 5D
W82-01043 5A
W82-01044 2G
W82-01045 5F
W82-01046 5A
W82-01047 3C
W82-01048 5G
W82-01049 5G
W82-01050 2D
W82-01051 6E
W82-01052 4B
W82-01053 4B
W82-01054 4B
W82-01055 4B
W82-01056 4B
W82-01057 4B
W82-01058 4B
W82-01059 4B
W82-01060 4B
W82-01061 5G
W82-01062 4B
W82-01063 5D
W82-01064 5D
W82-01065 5B
W82-01066 5C
W82-01067 6E
W82-01068 5B
W82-01069 5B
W82-01070 2H
W82-01071 5A
W82-01072 2H
W82-01073 5D
W82-01074 5D
W82-01075 5D
W82-01076 5D
W82-01077 5D
W82-01078 6E
W82-01079 5C
W82-01080 2H
W82-01081 5G
W82-01082 5A
W82-01083 5A
W82-01084 5A
W82-01085 5A
W82-01086 5A
W82-01087 6G
W82-01088 5F
W82-01089 2I
W82-01090 5A
W82-01091 5C
W82-01092 6B
W82-01093 5B
W82-01094 5C
W82-01095 8B
W82-01096 2H
W82-01097 5A
W82-01098 5A
W82-01099 5A
W82-01100 5A

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Subject Fields

1 NATURE OF WATER

2 WATER CYCLE

3 WATER SUPPLY AUGMENTATION AND CONSERVATION

4 WATER QUANTITY MANAGEMENT AND CONTROL

5 WATER QUALITY MANAGEMENT AND PROTECTION

6 WATER RESOURCES PLANNING

7 RESOURCES DATA

8 ENGINEERING WORKS

9 MANPOWER, GRANTS, AND FACILITIES

10 SCIENTIFIC AND TECHNICAL INFORMATION

INDEXES

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSSION NUMBER INDEX

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AT URBANA-CHAMPAIGN

VOLUME 15, NUMBER 3
MARCH 1, 1982

W82-01101-- W82-01600
CODEN: SWRABW

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Office of Water Research and Technology,
U.S. Department of the Interior

VOLUME 15, NUMBER 3
MARCH 1, 1982

W82-01101 -- W82-01600

The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through August 31, 1983.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Office of Water Research and Technology. The cumlative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology
U.S. Department of the Interior
Washington, D.C. 20240

CONTENTS

SUBJECT FIELDS AND GROUPS

Please use the edge index on the back cover to locate Subject Fields and Indexes.

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

IDENTIFICATION OF THE WAIRAKEI GEOTHERMAL SYSTEM,
Department of Scientific and Industrial Research, Lower Hutt (New Zealand). Physics and Engineering Lab.
For primary bibliographic entry see Field 2F.
W82-01312

ON IDENTIFICATION AND VALIDATION OF SOME GEOTHERMAL MODELS,
Department of Scienfitic and Industrial Research, Lower Hutt (New Zealand). Physics and Engineering Lab.
For primary bibliographic entry see Field 6A.
W82-01467

1B. Aqueous Solutions and Suspensions

MODELING OF ACTIVATED CARBON AND COAL GASIFICATION CHAR ADSORBENTS IN SINGLE-SOLUTE AND BISOLUTE SYSTEMS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
W. E. Thacker, V. L. Snoeyink, and J. C. Crittenden.
Water Resources Center, University of Illinois, Research Report No 161, July, 1981. 166 p, 31 Fig, 18 Tab, 119 Ref. S-077-ILL.

Descriptors: *Adsorbents, *Mathematical models, Solutes, *Activated carbon, *Coal gasification, *Organic compounds, Hydrologic models, Films, Bed sediment, Mathematical studies, Influent streams, Mathematical equations, Bottom sediments.

This research project had three objectives: (1) to assess the ability of a fixed-bed model to predict the effect of a sustained step change in influent concentration and to describe the process of desorption; (2) to compare with a fixed-bed model the behavior of different adsorbents in the uptake of aqueous organics; and (3) to investigate with a fixed-bed model factors that affect desorption. Both single-solute and bisolute systems were studied. A mathematical model of fixed-bed adsorption was used to predict the bed response to a sustained step change and it was observed that, under conditions approximating a drinking-water plant, the time during which the effluent concentration of a desorbed species was higher than the influent concentration was significant, whether a reduced influent concentration or competition was responsible for the desorption. Model equations, which considered that film transfer and surface diffusion controlled the adsorption rate, were solved with the technique of orthogonal collocation. Three species--3,5-dimethylphenol; 3,4-dichlorophenol; and rhodamine 6G--were the single solutes studied and the two phenols were also examined as a mixture. Four activated carbons and a coal gasification char were the adsorbents studied. The model was used to compare the adsorbents in the removal of DMP, R6G and the bisolute mixtures. Equilibrium capacity was found to have a greater influence than kinetics on fixed-bed performance. Surface area was a better indicator of capacity than pore size distribution for the solutes and adsorbents examined. (Garrison-Omniplan)
W82-01447

2. WATER CYCLE

2A. General

MODELING HYDROLOGIC TIME SERIES FROM THE ARCTIC,
Underwood McLelland and Associates Ltd., Winnipeg (Manitoba).
P. C. Baracos, K. W. Hipel, and A. I. McLeod.
Water Resources Bulletin, Vol 17, No 3, p 414-422, June, 1981. 5 Fig, 8 Tab, 18 Ref.

Descriptors: *Arctic, *Hydrologic data, *Intervention analysis, Cold regions, Meteorological data collection, Stochastic hydrology, *Time series analysis, River flow.

The general intervention model was used with hydrologic and meteorologic data from the Arctic to account for environmental interventions, missing observations in the data, changes in data collection procedures, the effects of external impacts, and extreme seasonality and other autocorrelations. Flow data (10-15 years) from 16 rivers in the Canadian Northwest Territories and meteorological data (30-40 years) from five stations were used to demonstrate the flexibility of the model. Intervention analysis also permitted the extension of 8 years of hydrometric data for the Tree River to an artificially-extended 44-year series, using 44 years of meteorologic data from a nearby weather station at Coppermine. There was good agreement between predicted and observed flows, with largest errors being found in the magnitude of peak flows. (Cassar-FRC)
W82-01198

DRAINAGE NETWORK STRUCTURE AND THE DIAMETER-MAGNITUDE RELATION,
State Univ. of New York at Buffalo. Dept. of Geography.
R. S. Jarvis, and C. H. Sham.
Water Resources Research, Vol 17, No 4, p 1019-1027, August, 1981. 7 Fig, 4 Tab, 18 Ref.

Descriptors: *Drainage patterns, *River basins, *Tributaries, Morphology, Networks, Erosion, Geohydrology, River systems, Basins, Great Britain.

The variation of drainage network structure with basin size was studied in two areas in Britain, the 1400 sq dm Southern Uplands (high plateau, deeply hewn by glacial troughs) and the 1900 sq km Culm Measures region (nonglaciated, open rolling landscape of moderately low relief). The network parameters considered were diameter (maximum number of links in any flow path from a source to the outlet, an index of mainstream length) and magnitude (number of sources in the network, proportional to basin size). Diameter increased with magnitude, but at a decreasing rate as networks were sampled over a greater size range. In the glacial basin the streams tend to follow existing glacial troughs; tributaries are larger and form a more branched Y-shaped network. In a region of normal fluvial erosion, the river network is more elongated and consists of a dominant main stream receiving small tributaries, resembling the ribs of a leaf. The sequence of tributary magnitudes down a main stream is not random. Small tributaries follow other small tributaries along the river course, each requiring little basin space and each having little effect on the size of the next tributary. However, large tributaries spread over wide areas and preclude development of other large tributaries in the near vicinity on their side of the main stream. (Cassar-FRC)
W82-01308

OPTIMAL RISK-BASED DESIGN OF FLOOD LEVEE SYSTEMS,
Nevada Univ. System, Reno. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W82-01313

DRAINAGE DENSITY AS AN INDEX OF CLIMATIC GEOMORPHOLOGY,
Guyana Univ., Georgetown.
J. R. K. Daniel.
Journal of Hydrology, Vol 50, No 1-3, p 147-154, March, 1981. 2 Fig, 13 Ref.

Descriptors: *Drainage density, *Geomorphology, *Denudation, Rainfall-runoff relationships, Runoff, Sediment yield, Guyana, Precipitation, Rainfall, Climatology, Rain forests, Tropical regions, Grasslands, Streamflow.

Most studies on the relationships between climate and denudation in the humid tropics use sediment yield as an important parameter to measure the rate of denudation. Since this data is not available for all catchments, this paper uses drainage density as an alternative morphometric index, combined with mean annual precipitation, to examine a tropical rain forest and a savanna in Guyana. The drainage density was computed from topographic maps, also taking the contour crenulations into consideration. A typical area in the savannas had a drainage density of 2.83 (1.76 km per sq km), and in the tropical forest receiving twice the rainfall, 3.02 (1.88 km per sq km). Drainage density was inversely related to the amount of vegetative cover. Drainage density did not increase proportionately with the rainfall in the tropical forest. The savanna has a high drainage density caused by low rainfall during a short wet season, inhibited plant growth, and greater runoff. In the rain forest the drainage density reaches a maximum level at a mean annual precipitation of about 3000 mm per year, and remains constant or decreases. (Cassar-FRC)
W82-01324

THE WATER BALANCE OF THE BETWA BASIN, INDIA,
Institute of Hydrology, Wallingford (England).
J. V. Sutcliffe, R. P. Agrawal, and J. M. Tucker.
Hydrological Sciences Bulletin, Vol 26, No 2, p 149-158, June, 1981. 4 Fig, 3 Tab, 2 Ref.

Descriptors: *Hydrologic budget, *Soil water, *Groundwater recharge, Rainfall, Runoff, Water storage, Mathematical studies, River basins, *Betwa basin, *India.

An account is provided of the water balance of the Betwa basin, India, as a framework for detailed studies of the hydrological processes and of the hydrogeology. Determination of the water balance was part of an attempt to estimate the seasonal soil moisture storage and groundwater recharge. Data from 1926 through 1975 were used to study rainfall distribution, evaporation was estimated using the Penman method, and long-term annual total inflows to Dhukwan and Matatila dams were estimated. Gross and net rainfall were compared with annual runoff to summarize the water balance. Seasonal soil moisture recharge was estimated at 175 mm. This figure is the average amount of storage available to crops after the monsoon each year. Physical studies are needed to determine more precisely the groundwater recharge for surface and deeper water bodies. (Small-FRC)
W82-01354

OBSERVATIONS ON THE HYDROGRAPHY AND INSHORE PLANKTON OF THE BAY OF BENGAL OFF BALASORE,
Ravenshaw Coll., Cuttack (India). Dept. of Zoology.
S. Pati.
Hydrobiologia, Vol 70, No 1/2, p 123-132, April, 1980. 4 Fig, 34 Ref.

Descriptors: *River runoff *Salinity, *Monsoons, *Bay of Bengal, Zooplankton, Copepods, Path of pollutants, Phytoplankton, Water quality, Runoff, Nutrients, Biomass, Productivity, Invertebrates, *Plankton, Bioindicators, India.

The hydrology of the northern part of the Bay of Bengal near the Balasore coast is governed by the monsoons and the river runoff into the bay. In a study conducted from March 1972 to February 1974, salinity, which varied from 22.35 to 33.62 parts per thousand, was lowest in October, when the two large river systems, the Ganga and the Brahmaputra, discharge huge quantities of freshwater into this part of the bay. The peak values for nutrients (phosphates, 2.26 microgram atom per liter, and nitrates, 13.4 microgram atom per liter) were observed during July to November, coinciding with the southwest monsoons. Surface temperature of the water reached maxima of 19.5

degrees C in May and September, with a minimum of 25 degrees C in winter. Dissolved oxygen concentrations were generally high 3.02-5.30 ml per liter. pH varied from 7.2 to 8.2. Standing crop was highest June to November, with a minor peak in March-April. Plankton biomass, both phytoplankton and copepods, showed peaks in April, July-August, and October. (Cassar-FRC)
W82-01362

A CATCHMENT APPROACH TO FLOOD ESTIMATION,
Northumbrian Water Authority, Gosforth (England).
For primary bibliographic entry see Field 2E.
W82-01397

YEAR-TO-YEAR CHANGES IN THE SALINITY OF THE EASTERN ENGLISH CHANNEL, 1948-1973: A BUDGET,
Institute for Marine Environmental Research, Plymouth (England).
A. H. Taylor, P. C. Reid, T. J. Marsh, T. D. Jonas, and J. A. Stephens.
Journal of the Marine Biological Association of the United Kingdom, Vol 61, No 2, p 489-507, May, 1981. 12 Fig, 2 Tab, 21 Ref.

Descriptors: *Salinity, *Seasonal variation, *River runoff, Runoff, Model studies, *English Channel, Variability, Evaporation, Precipitation, Rainfall, Water circulation, Seawater, Mixing, Water currents, Tides.

River runoff and mixing by wind and tides are the main factors responsible for the seasonal changes of salinity in the eastern English Channel, according to predictions with a model using the calculated monthly mean total runoff data for 1948-73. Total runoff into the eastern English Channel from England and France was assessed at 214 mm or 889 cu m/sec. A long term mean salinity of 35.04 o/oo with a year-to-year variance of 0.0122 o/oo was predicted. This compares well with observed values for the main section of the channel, 35.019 o/oo with a variance of 0.0123 o/oo. Including the monthly evaporation and precipitation changes for 1961-73 improved salinity predictions. The model was able to predict about 80% of the variance of salinity in the eastern English Channel from knowledge of the salinity in the mouth of the Channel by using river runoff, evaporation, and precipitation data. About half the variance in annual mean salinity in the eastern English Channel is the result of abnormally high or low salinity water being transported through the region. Although water movements and salinity variations in the North Atlantic affect salinity of the channel mouth, there is no correlation between salinity fluctuations in the channel entrance and in the eastern English channel. (Cassar-FRC)
W82-01399

TIME DISTRIBUTION OF CLOCK HOUR RAINFALL,
Science and Education Administration, Columbia, MO.
A. T. Hjelmfelt.
In: CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems, Conservation Research Report Number 26, May, 1980, p 379-385, 8 Fig, 1 Tab, 8 Ref.

Descriptors: *Temporal distribution, *Rainfall, *Simulation, *Runoff, Rainfall-runoff relationships, Small watersheds, Model studies.

Simulation of runoff from rainfall events requires rainfall in time increments not greater than the time to equilibrium for the watershed. For small watersheds the time to equilibrium will be measured in minutes, whereas the easily available rainfall data will be available at clock-four intervals. A rainfall event indicated as occurring in a single clock hour will have an actual duration of not more than 60 minutes. The 60 minute equivalent is considered to be 1.13 times the clock hour rainfall. When determining time distribution of rainfall from clock hour quantities, the great variability in events must be recognized. At this time there seems little advantage in applying an average distribution to any storm with values recorded in 3 clock-hours or more. The average intensity for each hour is probably the best estimate. Most storms occurring in 1 clock-hour will last less than 60 minutes. Using the total hour as the duration will underestimate the peak discharge. Multiplying the clock hour value by 1.13 should result in the equivalent, on a return period basis, 60 minute catch on the average. The equivalent 60 minute catch can be used to obtain the time distribution for peak discharge estimates. (See also W82-10401) (Moore-SRC)
W82-01402

THE SIGNIFICANCE OF SNOWMELT ON WATER SUPPLIES IN THE NORTHEAST,
Jordan (Edward C.) Co., Inc., Portland, ME. Water Service Dept.
S. Medlar.
Journal of the New England Water Works Association, Vol 95, No 2, p 134-144, June, 1981. 4 Tab, 13 Ref.

Descriptors: *Snowmelt, *Snow depth, *Runoff, Groundwater recharge, Thaw, Rainfall, Snow density, Snow accumulation, Snow, Water supply, Northeastern United States, *New England.

Snowfall in New England for the winter of 1979-80 was analyzed to investigate the role of snowmelt in the availability of water supplies. Field information about depth and water content can be used to estimate potential runoff from snow. The average water content of snow in New England is about 18-19%, and the volume of snowmelt that reaches a reservoir depends on surface topography, frozen or thawed soil, air dynamics, watershed conditions, sunlight, temperature, wind, and vegetation. Snowmelt influences water quality by suspending turbidity, dissolving color, diluting chlorides, and changing pH. Evaporation from snow can be 80%, and snow on the ground will absorb rain until saturated. Snowmelt contributes to major flooding, and groundwater recharge is affected by snowmelt water infiltration. Rainfall has a greater recovery value than snow. The extent of this difference in recovery depends upon the time delay between precipitation and melting. (Small-FRC)
W82-01488

USING COMPUTED STREAM FLOW IN WATERSHED ANALYSIS,
Delaware Univ., Newark. Dept. of Geography.
J. R. Mather.
Water Resources Bulletin, Vol 17, No 3, p 474-482, June, 1981. 8 Fig, 3 Tab, 10 Ref.

Descriptors: *Hydrologic budget, *Streamflow, *Watersheds, Climatology, Rainfall-runoff relationships, River basins, Precipitation, *Delmarva Peninsula, Regression analysis, Runoff, Stream gages.

Observed and computed streamflows were compared on a monthly and annual basis for 28 basins on the Delmarva peninsula, a region with little snow cover. The results of correlation-regression analysis produced three groupings of basins. For the 8 basins in the first category, the calculations obtained from the climatic water budget were in good agreement with observed streams runoff figures (regression line slope = 1). In the second group of 10 basins a regression line slope = 1 was obtained, but it was displaced from the y = x line. A slight correction of the water budget (moisture storage in the root zone of the soil) produced good agreement between calculated and observed streamflow values. The third category, including 10 watersheds, had serious differences between values, which pointed to hydrologic peculiarities in the basins (deep aquifer leakage, interbasin transfers, gage error, and difference in root zone water storage). The Manokin Branch, which had the greatest differences (r = 0.61, y = 0.38 x plus 3.76) revealed a sharp change in correlation in 1968. A search of records uncovered that in that year ditching operations were started and sheet metal panels were installed around the gage. (Cassar-FRC)
W82-01538

018 MODELLING OF FRESHWATER INPUTS IN BAFFIN BAY AND CANADIAN ARCTIC COASTAL WATERS,
Quebec Univ., Montreal. Dept. of Earth Sciences.
For primary bibliographic entry see Field 2C.
W82-01590

2B. Precipitation

FATTY ACID AND HYDROCARBON CONTENT OF SETTLING SEDIMENTS IN LAKE MICHIGAN,
Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
For primary bibliographic entry see Field 2H.
W82-01154

A DENDROCLIMATIC RECONSTRUCTION OF ANNUAL PRECIPITATION AMOUNTS IN IOWA SINCE 1680,
Oak Ridge National Lab., TN.
D. N. Duvick, and T. J. Blasing.
Water Resources Research, Vol 17, No 4, p 1183-1189, August, 1981. 4 Fig, 2 Tab, 13 Ref.

Descriptors: *Drought, *Climatic data, *Dendrochronology, *Precipitation, *Iowa, Trees, Tree rings, Regression analysis.

Core samples from 30 white oak trees at each of three sites in central Iowa were used to determine the tree ring widths and, in turn, the total precipitation for the period about one year preceding the end of radial growth. Regression analysis of this data produced annual (August-July) precipitation information for the years 1680-1979. Predicted precipitation agreed well with precipitation in years for which data were available. Reconstructed data indicate five 10-year periods comparable in dryness to the 1930's: 1816-1825, 1735-1744, 1696-1705, 1931-1940, and 1791-1800, listed in order of decreasing dryness. The 12-year 1816-1827 period was an uninterrupted drought with yearly precipitation ranging from 62.8 cm to 79.1 cm. These values suggest that long-term planners should consider the possibility of about two such droughts each century. Such a dry spell could seriously affect water supplies in Iowa. (Cassar-FRC)
W82-01314

DEUTERIUM/HYDROGEN RATIOS IN AUSTRALIAN RAINFALL,
Australian Atomic Energy Commission Research Establishment, Lucas Heights.
P. E. Hartley.
Journal of Hydrology, Vol 50, No 1-3, p 217-229, March, 1981. 1 Fig, 1 Tab, 20 Ref.

Descriptors: *Deuterium, *Rainfall intensity, *Isotope studies, Dew point, Climatology, *Australia, Groundwater, Precipitation, Model studies.

A simple model was developed to clarify the way in which the isotopic composition of precipitation (deuterium/hydrogen ratios) is influenced by meteorological variables. The model is consistent with monthly data measured over 3 years at 14 Australian sites. The major influences on D/H ratios are dew point and rainfall intensity. Intense storms reduce the fractionation, producing isotopically lighter rain. The lower the average rainfall of a station, the lower its D/H ratio; but the higher the rainfall in any month at a given station, the lower the D/H ratio for that month. A low dew point is associated with isotopically light vapor and less intense rain, which is isotopically heavier for a given vapor composition, resulting in a negative correlation between D content and dew point at lower latitudes (12 to 30 degrees S) and a positive correlation at higher latitudes (32 to 38 degrees S). These findings show that false conclusions may be reached in attempts to relate climate to D/H ratios of ancient groundwaters by assuming that the isotopic composition of the precipitation causing re-

charge is always directly related to average annual temperature at the time of recharge. (Cassar-FRC)
W82-01325

NOTE ON PROBABILITY APPROACH TO STUDY THE OCCURRENCE OF RAINFALL AT HYDERABAD,
All-India Co-ordinated Rice Improvement Project, Hyderabad (India).
R. K. Mahajan, and A. V. Rao.
Indian Journal of Agricultural Sciences, Vol 51, No 1, p 62-65, January, 1981. 1 Fig, 1 Tab, 4 Ref.

Descriptors: *Rainfall, *Probability distribution, Probabilistic process, Mathematical studies, Stochastic process, Frequency distribution, Rainfall distribution, Farm management, Crop yield, Hyderabad, *India.

An attempt was made to study the behavior of occurrence of dry and wet days during the crop season of rice and to determine the optimum sowing time by computing the weekly rainfall probabilities. Data relating to rainfall from 1 June to 30 September was collected for studying the distribution of rainfall. The difference between the probabilities of wet day preceded by a dry day, P (W/D), and wet day preceded by a wet day, p (W/W) tested year-wise by the usual normal deviate statistic revealed that the occurrence of a wet (or dry) day was highly influenced by the previous day's weather in all the years studied. Thus the occurrence of wet and dry days in the given tract could be strictly described by a 2-state Markov chain with the transition probability as demonstrated. The occurrence of a dry day was more probable than the occurrence of a wet day. The expected cycle of wet and dry days was 7 days. The expected number of wet and dry days was 35 and 87 days, respectively. Such data are helpful in planning proper management of crops for highest potential yield. (Baker-FRC)
W82-01380

ANOMALOUS SNOWFALL CAUSED BY NATURAL-DRAFT COOLING TOWERS,
Rand Corp., Santa Monica, CA.
L. R. Koenig.
Atmospheric Environment, Vol 15, No 7, p 1117-1128, 1981. 11 Fig, 3 Tab, 19 Ref.

Descriptors: *Cooling towers, *Snow, Precipitation, Temperature effects, Plumes, Clouds, Water vapor.

The potential for snowfall from cooling-tower plumes was investigated. Occurrences of this type have been documented in the literature. Direct observations indicate that the areal extent of snowfall from cooling towers greatly exceeds the resolution of several satellite systems, and therefore should be detected in their imagery. The model used in the present study predicts the characteristics of a plume element, or puff, as it emerges from the cooling tower, rises, and travels downwind. In all cases reported, the moisture source flux is 1000 kg/sec. It is emitted to the atmosphere as saturated air having a temperature of 25 degrees C. These conditions are appropriate for wet towers at a plant delivering about 2500 MW of electricity. In the runs discussed in this problem, the plume depth was limited to 500 meters. It was concluded that the amount of snow falling from cooling towers plumes depends on the outcome of the competition between the evaporation of the plume and the total growth of ice particles. The depth of snow depends on these factors plus the dispersion of the snow. The growth of ice depends on the concentration of ice particles and their growth rates. The evaporation of the plume depends on the ability of the ambient air to receive water vapor and the rate of mixing between the plume and its surroundings. Criteria were figured to include temperatures below minus 13 degrees C and ambient water vapor deficits less than 0.5 g/cubic meter in order for measurable snow to fall within about 50 km of a 100 kg/sec water vapor source, assuming that wind speeds are about 10 m/sec at the plume. (Baker-FRC)
W82-01512

AN ANALYSIS OF ACIDIC PRECIPITATION IN SOUTH-CENTRAL ONTARIO USING AIR PARCEL TRAJECTORIES,
Ontario Ministry of the Environment, Toronto.
For primary bibliographic entry see Field 5B.
W82-01513

RECENT ACIDIFICATION OF PRECIPITATION IN NORTH AMERICA,
Cornell University, Ithaca, NY. Section of Ecology and Systematics.
For primary bibliographic entry see Field 5B.
W82-01514

THE INFERENCE OF GATE CONVECTIVE RAINFALL FROM SMS-1 IMAGERY,
National Hurricane and Experimental Meteorology Lab., Coral Gables, FL.
For primary bibliographic entry see Field 7B.
W82-01519

ICE NUCLEUS CONCENTRATIONS MEASURED DURING THE 1975 FLORIDA AREA CUMULUS EXPERIMENT (FACE),
MITRE Corp., McLean, VA.
For primary bibliographic entry see Field 7B.
W82-01522

AN IMPROVED METHOD FOR OBTAINING THE WATER CONTENT VALUES OF ICE HYDROMETEORS FROM AIRCRAFT AND RADAR DATA,
Air Force Geophysics Lab., Hanscom AFB, MA.
For primary bibliographic entry see Field 7B.
W82-01523

SIMULATION OF DAILY WEATHER DATA USING THEORETICAL PROBABILITY DISTRIBUTIONS,
Cornell Univ., Ithaca, NY. Dept. of Plant Pathology.
J. A. Bruhn, W. E. Fry, and G. W. Fick.
Journal of Applied Meteorology, Vol 19, No 9, p 1029-1036, September, 1980. 7 Tab, 25 Ref.

Descriptors: *Stochastic hydrology, *Weather data simulation, Distribution, Model studies, Computer models, Simulation, Agriculture, Meteorological data simulation, Precipitation, *Probability distribution, Temperature, Relative humidity, Solar radiation.

A computer model was developed to simulate daily weather data (precipitation, maximum and minimum temperature, minimum relative humidity, and total solar radiation) for agricultural purposes using a Monte Carlo technique. Two processes common to the generation of values for each weather variable were: (1) selection of a set of parameters to describe the appropriate probability distribution, using rainfall as a foundation and (2) generation of a random value from the selected probability distribution (the current day's value of the weather variable). Precipitation occurrence was described by a first order Markov chain; the amount of rain, by a probability distribution; minimum and maximum temperatures, by a trivariate normal probability distribution considering temperature on the previous and current days; and minimum relative humidity and total solar radiation, by normal distribution. The model was tested on actual weather data from Geneva, New York, and Fort Collins, Colorado, and good agreement was obtained between simulated and historical data regarding mean response, variability, and pattern of correlation associated with daily weather data from each location. Particularly accurate were precipitation, minimum temperature, and maximum temperature. (Cassar-FRC)
W82-01526

WEATHER MODIFICATION FROM COOLING TOWERS. A TEST BASED ON THE DISTRIBUTIONAL PROPERTIES OF RAINFALL,
Oak Ridge National Lab., TN. Engineering Technology Div.
A. A. N. Patrinos, and K. O. Bowman.
Journal of Applied Meteorology, Vol 19, No 3, p 290-297, March, 1980. 4 Fig, 4 Tab, 20 Ref.

Descriptors: *Weather modification, *Cooling towers, Model studies, Rainfall distribution, Artificial precipitation, Rainfall, Artificial storms, *Statistical analysis, Mathematical models.

A statistical technique is presented for the treatment of data from weather modification experiments. Data has been collected by 49 recording raingages and four recording windsets situated on a square grid installed in early 1978 to determine the potential precipitation modification effects of the Bowen Electric Generating Plant near Cartersville, Georgia. The statistical technique presented makes use of a design which resembles the crossover statistical design used in cloud seeding studies and employs the distributional properties of the sample skewness and kurtosis. The technique demonstrated an anomaly in the target area rainfall with a 90% confidence level. This anomaly is interpreted as a plant induced modification of the spatial variability of rainfall volume. No attempt was made to stratify the precipitation events by storm type or by power plant output. (Baker-FRC)
W82-01527

AN INDEX OF ARIZONA SUMMER RAINFALL DEVELOPED THROUGH EIGENVECTOR ANALYSIS,
Portland State Univ., OR.
D. M. Johnson.
Journal of Applied Meteorology, Vol 19, No 7, p 849-856, July, 1980. 7 Fig, 1 Tab, 14 Ref.

Descriptors: *Rainfall, *Mathematical studies, Variability, Spatial distribution, *Arizona, Mapping, Seasonal variation, *Summer rainfall.

Eigenvector analysis has been used to establish a single index to characterize the statewide pattern of Arizona summer rainfall. Summer storms are in most cases a response to subtropical atmospheric controls in this area. Summer rainfall contributes more to annual precipitation than does the total precipitation occurring during winter. All available climatological stations in Arizona and adjacent areas supplied data concerning the length and quality of summer precipitation records. The eigenvectors or a variance-covariance matrix are analogous to the principal components of a data set. The data matrix for this study consisted of the summer rainfall totals at 101 stations over a 50 year period. The eigenvectors become a new set of axes which represent the original data. The first time-series eigenvector was extracted and accounted for 70% of the variance. Geographic mapping of the multipliers revealed that the first eigenvector did adhere to physical reality, in that it reflected the dominant pattern of rainfall over the state. Thus its validity as an effective index was established. (Baker-FRC)
W82-01528

LIDAR DETERMINATIONS OF ATMOSPHERIC ICE CRYSTAL LAYERS AT SOUTH POLE DURING CLEAR-SKY PRECIPITATION,
Nevada Univ. System, Reno. Desert Research Inst.
For primary bibliographic entry see Field 2C.
W82-01529

A COMPARISON OF TWO SATELLITE RAINFALL ESTIMATES FOR GATE,
Hawaii Univ., Honolulu. Joint Inst. for Marine and Atmospheric Research.
For primary bibliographic entry see Field 7B.
W82-01533

DETERMINATION OF MOISTURE FROM NOAA POLAR ORBITING SATELLITE SOUNDING RADIANCES,
National Earth Satellite Service, Washington, DC.
C. M. Hayden, W. L. Smith, and H. M. Woolf.
Journal of Applied Meteorology, Vol 20, No 4, p 450-466, April, 1981. 8 Fig, 8 Tab, 11 Ref.

Descriptors: *Remote sensing, *Atmospheric water, *Moisture content, Meteorological data collection, *Satellite technology, Radiosondes, Clouds, Weather forecasting.

A newly-developed method improves the determination of atmospheric moisture from satellite measurements. The three major changes to current operational methods are: (1) the surface contribution to the out-going radiance is substracted before making temperature and moisture retrievals, allowing better definition of low-level moisture gradients. (2) The temperature/moisture solution is subjected to a one-channel iteration to ensure that the radiative transfer equation is satisfied for low-level moisture, valuable in cases of extreme dryness. (3) A cloud moisture model defines the atmospheric moisture below the cloud in areas of extensive cloud cover, permitting a more geographically uniform picture of the moisture. TIROS-N observations made on April 10, 1979, nearly coinciding with a tornado outbreak at Wichita Falls, Texas, were used in the simulation and found credible in estimating moisture in broad layers, surface to 700 mb and 850 to 500 mb. High moisture gradients are clearly defined, and horizontal consistency is achieved. Although point comparisons with radiosondes show large discrepancies, these are explained by the difference in sampling methods. (Cassar-FRC)
W82-01535

2C. Snow, Ice, and Frost

WAVE FORMATION AND HEAT TRANSFER AT AN ICE-WATER INTERFACE IN THE PRESENCE OF A TURBULENT FLOW,
Alberta Univ., Edmonton. Dept. of Mechanical Engineering.
R. R. Gilpin, T. Hirata, and K. C. Cheng.
Journal of Fluid Mechanics, Vol 99, No 3, p 619-640, August, 1980. 13 Fig, 42 Ref.

Descriptors: *Ice-water interfaces, *Wave propagation, *Heat transfer, *Turbulent flow, Waves, Flow, Accumulation, Melting, Temperature effects.

The stability and subsequent wave growth of disturbances to an ice-water interface in the presence of a turbulent boundary-layer flow were studied experimentally. Observation of instability in the presence of a well-defined flow regime made possible the comparison of the character and stability criterion for the waves. Stability was controlled by the heat flux from the interface into the ice. Generally, when the heat flux is small as during melting, the interface is most likely to be unstable. During ice accumulation, the heat flux is large and the interface is stable. Conditions necessary for unstable ice during ice accumulation were determined. These included a sufficiently large temperature ratio and a growing ice layer with a ratio of ice-side to water-side heat fluxes of up to 2.3. These results apply only where a turbulent boundary layer is present. The same controlling factors may also be important in other flows, however. (Small-FRC)
W82-01128

EFFECT OF GRAIN SIZE AND SNOWPACK WATER EQUIVALENCE ON VISIBLE AND NEAR-INFRARED SATELLITE OBSERVATIONS OF SNOW,
California Univ., Santa Barbara. Dept. of Geography.
For primary bibliographic entry see Field 7B.
W82-01311

WATER FROST AND ICE: THE NEAR-INFRARED SPECTRAL REFLECTANCE 0.65-2.5 MICRONS,
Hawaii Univ., Honolulu. Inst. for Astronomy.
R. N. Clark.
Journal of Geophysical Research, Vol 86, No B4, p 3087-3096, April, 1981. 11 Fig, 3 Tab, 19 Ref.

Descriptors: *Reflectance, *Ice, *Frost, Spectral analysis, *Remote sensing, Optical properties, Algorithms, Mathematical studies.

Reflectance spectra of water frost and water frost on ice are presented to demonstrate the large range of spectral contrasts and features which may be encountered in remote sensing of planetary surfaces. The data are presented with 1.5% spectral resolution in the 0.65 to 2.5 micron wavelength region. The following water absorption bands (in microns) are precisely defined: 2.0, 1.65, 1.5, the little-studied 1.25, and three previously unidentified bands (1.04, 0.90, and 0.81). A quantitative analysis was performed of the 1.5 band complex using a nonlinear least squares algorithm to resolve the band into four Gaussian components as a function of grain size and temperature. The 1.65 component was highly grain-size dependent and not a good temperature sensor as was previously thought. Also, width was found to depend on grain size but was independent of temperature. The apparent band depths seen in many planetary reflectance spectra may be explained by the fact that the relative apparent band depths are different for frost layers on ice than for thick layers of frost. (Small-FRC)
W82-01346

COMPATIBILITY OF CANADIAN SNOWFALL AND SNOW COVER DATA,
Atmospheric Environment Service, Downsview (Ontario).
B. E. Goodison.
Water Resources Research, Vol 17, No 4, p 893-900, August, 1981. 7 Fig, 3 Tab, 17 Ref.

Descriptors: *Snow cover, *Snow surveys, *Gaging, Snow depth, Snow accumulation, Snow density, Snow sampling, Snow courses, Model studies, Data collections, Precipitation, Network design, Sampling, Cold Creek basin, *Ontario, Water equivalent, *Moisture equivalent.

The accuracy and compatibility of different methods of measuring snowfall were studied in the Cold Creek Basin, Ontario. Snow was measured for snowstorms in the winter of 1972-73 using a ruler estimate based on the 10:1 ratio and the following gages: Nipher, unshielded Universal, unshielded and Alter-shielded Fischer and Porter, and Universal with Alter shield. Good agreement in storm or seasonal totals was obtained for the gaged installations after correction for environmental factors such as wind speed. The ruler estimation was inconsistent and unreliable for use in short-term analyses. The significant differences in snow cover between land use categories were maximum at the time of peak accumulation, reflecting the ability of different types of vegetation to accumulate and retain snow in an individual way. Open areas had the highest density, lowest snow water equivalent, lowest depth, and most variable snow cover. An increase in sampling density in these areas would improve reliability of results. A simple mass balance model, using corrected precipitation data, can also determine snowpack accumulation. Net snow cover determined in this manner less the melt losses and snow evaporation were within confidence limits of the mean snow cover measured in the basin. Hydrologic models can use data from various methods and locations provided: (1) precipitation measurements are corrected for gage catch variations, and (2) snow survey data represents the basin land use. (Cassar-FRC)
W82-01466

THE BEHAVIOR OF A POLAR ICE-DAMMED LAKE, ELLESMERE ISLAND, N.W.T., CANADA,
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
S. P. Blachut, and S. B. McCann.
Arctic and Alpine Research, Vol 13, No 1, p 63-74, February, 1981. 5 Fig, 1 Tab, 32 Ref.

Descriptors: *Iced lakes, *Polar regions, *Hydrologic budget, Ice dams, Flow discharge, Polar ice, *Canada, *Ellesmere Island, Watersheds, River flow, Flooding.

Most of the literature on ice-dammed lakes deals with lakes associated with temperate glaciers. However, recent observations indicate that there may be many lakes associated with cold or polar ice. Preliminary reconnaissance suggested that a small, deep, isothermal lake ponded against the western margin of the Ellesmere Ice Cap on Ellesmere Island in Canada might be an important source of sudden inputs of water into the main river system of the area. Sudden, partial drainage of this lake was observed in three successive years, 1973 through 1975. Glacier outburst floods (jokulhlaups) occurred in each of these years, with the 1973 event being the most severe. The water balance of the lake and the characteristics of the ice dam, monitored in 1974, indicated that barrier flotation was the key factor in the initiation of the jokulhlaups. There did not appear to be any leakage through the ice dam prior to the jokulhlaups, which began with a violent and forceful extrusion of water at high pressure at the outlet. The annual drainage events were separate events, with drainage initiated at progressively lower levels each year. Both the total volume of water discharged and the maximum rates of discharge were smaller with each successive year. The discharge rate decreased rapidly after the first few days of the drainage event. Barrier lifting and disturbance due to flotation of the shelf ice, resulting from rising lake levels during the first part of the summer season, appeared to be the trigger mechanism initiating lake drainage. The decreasing magnitude of the jokulhlaups and the fall in maximum lake levels over the 3 year period suggest that a series of annual drainage events might be succeeded by a period of nondrainage or lake recharge. (Carroll-FRC)
W82-01511

LIDAR DETERMINATIONS OF ATMOSPHERIC ICE CRYSTAL LAYERS AT SOUTH POLE DURING CLEAR-SKY PRECIPITATION,
Nevada Univ. System, Reno. Desert Research Inst.
V. N. Smiley, B. M. Whitcomb, B. M. Morley, and J. A. Warburton.
Journal of Applied Meteorology, Vol 19, No 9, p 1074-1090, September, 1980. 18 Fig, 3 Tab, 24 Ref.

Descriptors: *Ice, *Crystal growth, Crystals, Measuring instruments, Precipitation, Antarctic, *South Pole, Clouds, Cloud seeding, Temperature, Wind, *Water content, *Atmospheric ice.

An attempt was made to determine at what altitudes ice crystals form and grow during clear-sky precipitation events at the South Pole. The study was conducted between March and November of 1975. The usefulness of the lidar technique for studying atmospheric ice crystal layers was amply demonstrated by this study. Four distinct lidar signatures were observed for 36 clear-sky precipitation events. The air masses in which the clear-sky precipitation events were occurring were rising from lower terrain. The average height of the precipitation layer tops for the 36 events was 500 (plus or minus 160) meters, which was somewhat below the average inversion height of 560 (plus or minus 190) meters. In most all cases the formation layer tops were above the inversion level. The relationships between heights of precipitation layer tops and inversions and their respective temperatures demonstrate that the influence of layers above the precipitation layer is apparently quite important, as they were present in 75% of the 36 events. The larger crystals observed were plates and clusters. The maximum temperatures at the inversion for the six events for which replicator data were reduced were between -34.6 and 41.1 degrees C, and the larger crystals usually started growing at somewhat colder temperatures at heights varying from 300 to about 2000 meters. For the six days for which replicator data were reduced, the air was supersaturated with respect to ice over a range of several hundred meters above and below the inversion in at least four instances. (Baker-FRC)
W82-01529

ICE BLOCKS MELTING INTO A SALINITY GRADIENT,
Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.
H. E. Huppert, and J. S. Turner.
Journal of Fluid Mechanics, Vol 100, No 2, p 367-384, September, 1980. 11 Fig, 5 Tab, 15 Ref.

Descriptors: *Ice-water interfaces, *Melting, *Saline-freshwater interfaces, Icebergs, Melt

water. Ice-brine systems, Fluid mechanics, Arctic, Antarctic.

Water originating from ice melting in fluid stratified with salt undergoes little vertical displacement. The melt water flows out of a thin vertical boundary layer near the ice into a series of horizontal layers. This principle could be used in collecting fresh melt water from icebergs as a water supply source. The melting process takes place mainly on the vertical walls. Being lighter, the melt water rises up the sides of the iceberg in a thin layer. This inner layer of water mixes with that in a thicker, outer boundary layer which is moving downwards. When the downward moving water reaches the level where its density equals that of the far-field water, it starts to move horizontaly and produces layers, separated from each other by a thin interface. For Antarctic conditions the typical layer thickness may be 10-30 meters and for Arctic conditions, only a few meters. The melting process was studied in the laboratory in tanks using water of uniform salinity and linearly stratified with salt and either aluminum containers or ice blocks. Motions of the water were made visible with a shadowgraph technique or flourescein and were photographed for study. (Cassar-FRC)
W82-01530

MONITORING GLACIER OUTBURST FLOODS,
National Hydrology Research Inst., Ottawa (Ontario). Div. of Snow and Ice.
G. J. Young.
Nordic Hydrology, Vol 11, No 5, p 285-300, 1980. 6 Fig, 42 Ref.

Descriptors: *Glacial lakes, *Floods, *Monitoring, Lakes, *Glaciohydrology, Ice, Dams, Reviews, Disasters, Jokulhlaups, Forecasting, *Flood forecasting, Streamflow, Snowmelt, Glacial streams, Alpine regions.

The literature on jokulhlaups (an Icelandic term describing glacial outburst floods) is reviewed. This phenomenon occurs when water impounded by ice dams, or within or on top of glacial ice, is released. Jokulhlaups, found today in most glacier-covered areas, were probably more extensive and catastrophic during the height of the last glacial period. The most common type of lake is found in an ice-free tributary valley at the side of a major valley glacier. Other less common formations produce lakes between two converging glaciers, in major ice-free valleys, and within, under, and on the surface of glaciers. Very few outbursts have been observed and documented thoroughly because they may last only a few days once every several years and produce huge, hard-to-measure discharges. The dammed water may drain under, over, or through the ice. If an outburst coincides with a snowmlet flood or major rainfall, the event may be catastrophic. Since monitoring is very difficult, forecasters must rely on case histories. Present day lakes may be identified from air photographs or satellite imagery. Past lakes are located from geomorphological and vegetational records. Summit Lake, British Columbia, dammed by the Salmon Glacier and typical of the most common situation, is described in detail. It is 5.25 km long, 0.45 to 1.25 km wide and 200 meters deep at the ice front. Apparently no emptying occurred between 1900 and 1961. The five floods between 1961 and 1970 occurred between August and December. The lake did not always fill completely before discharging. When the lake surface reaches 800 meters above sea level, careful monitoring detects the beginning of the outflow, which reaches a peak in 3-5 days, allowing a mining company downstream to prepare for road washouts. (Cassar-FRC)
W82-01558

SNOWMELT PREDICTION IN A SUBARCTIC DRAINAGE AREA,
Saskatchewan Univ., Saskatoon. Dept. of Geography.
J. E. Fitzgibbon, and T. Dunne.
Nordic Hydrology, Vol 11, No 5, p 243-254, 1980. 3 Fig, 3 Tab, 8 Ref.

Descriptors: *Snowmelt, *Runoff, *Model studies, Subarctic zone, Vegetation effects.

Three methods for predicting snowmelt were tested in a variety of subarctic environments classified according to vegetation cover (closed lichen woodland, open lichen woodland, regenerating burn, and burn) near Schefferville, Quebec. The crown covers for each of these categories were 25-25%, 15-25%, 5-15%, and 0-5%, respectively. The temperature index method (using mean daily air temperature) and the U.S. Army Corps of Engineers empirical energy balance method gave adequate predictions in all four melt environments. Errors expressed in % of observed snowmelt were 14-26% and 14-24%, respectively, for each method. The physical energy balance method was good for the burn areas (9% error) and not as good for the other three environments (18-40% error). (Cassar-FRC)
W82-01571

EVALUATION OF ULTRAVIOLET SPECTROPHOTOMETRIC DETERMINATION OF NITRATE-NITROGEN IN GLACIAL SNOW, FIRN AND ICE,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
For primary bibliographic entry see Field 5A.
W82-01572

018 MODELLING OF FRESHWATER INPUTS IN BAFFIN BAY AND CANADIAN ARCTIC COASTAL WATERS,
Quebec Univ., Montreal. Dept. of Earth Sciences.
P. Bedard, C. Hillare-Marcel, and P. Page.
Nature, Vol 293, No 5830, p 287-289, September 24, 1981. 4 Fig, 16 Ref.

Descriptors: *Oxygen isotopes, *Isotopic studies, Arctic, Coastal waters, Canada, *Baffin Bay, *Sea ice, Melting, Model studies, Salinity, *Saline-freshwater interfaces, Glaciers, Icebergs, Fjords, Seawater, Greenland.

Measurements of 018 versus salinity in surficial samples of Arctic coastal waters from the north shore of Alaska to western Greenland disclosed three types of water: marine standard water, continental fresh water, and sea ice melt water. A three-component model (Tan and Strain, 1980), design for Baffin Bay waters, is applied here to a larger geographical scale. The Qaumarujuk Fjord, Greenland, is an example of a two-component model--glacial meltwater mixing with marine water, no sea ice component. The Cornelius Grinnell Fjord, Baffin Island, shows glacier water and standard marine water mixing and, towards the open sea, the influence of sea ice is noted. In the Beaufort Sea along the Yukon and Alaska coast, isotopic compositions reflect the composition of the water from the Mackenzie River drainage basin. A few samples show the presence of sea ice melt water. The Arctic archipelago and northern Baffin Bay waters reflect a heterogeneous and discrete continental input and a strong influence of sea ice melt water. Marine waters have salinities of about 34.9 o/oo and delta 018 values of 0 to -0.7 o/oo; continental waters, zero salinity and delta 018 of -17 o/oo to -21 o/oo; and sea ice melt water, salinity of 2 to 9.3 o/oo and variable delta 018. (Cassar-FRC)
W82-01590

2D. Evaporation and Transpiration

ESTIMATING EVAPOTRANSPIRATION FROM IRRIGATED CROPS IN SOUTHWESTERN ONTARIO,
Department of Agriculture, Harrow (Ontario). Research Station.
C. S. Tan, and J. M. Fulton.
Canadian Journal of Plant Science, Vol 61, No 2, p 425-435, April, 1981. 10 Fig, 27 Ref.

Descriptors: *Evapotranspiration, *Crop yield, Irrigation, Farming, Plant-soil-water relationships, Water conservation, Model studies, Climatology, *Ontario.

Meteorological data and measured evaporanspiration (ET) data from irrigated crops on Fox sandy loam were used to develop an equilibrium evapotranspiration (ETeq) model. The model inputs were daily maximum and minimum air temperatures and sunshine duration measurements, which are available from local weather stations. A simple equation was developed from the equilibrium model to estimate ET, and was tested on irrigated crops over a fairly wide range of moisture and foliage cover conditions. Reasonably good agreement was achieved between ET measured with floating lysimeters and ETeq estimated with the model. The total yields of irrigated early potatoes, corn and processing tomatoes were directly related to accumulated ET rates during the growing season in southwestern Ontario. When root zone water storage and available soil moisture were high (the latter above 60% for potatoes, 50% for tomatoes and 25% for corn) the ratio of evapotranspiration to equilibrium evapotranspiration remained fairly constant. However, below these limits the ratio declines rapidly with decreasing available soil moisture. (Baker-FRC)
W82-01116

ESTIMATING EVAPOTRANSPIRATION FROM THE SONOITA CREEK WATERSHED NEAR PATAGONIA, ARIZONA,
Ben Gurion Univ. of the Negev, Beersheba (Israel). Inst. for Desert Research.
J. Ben-Asher.
Water Resources Research, Vol 17, No 4, p 901-906, August, 1981. 4 Fig, 2 Tab, 12 Ref. OWRT-A-069-ARIZ(5).

Descriptors: *Evapotranspiration, *Small watersheds, Watersheds, *Sonoita Creek, *Arizona, Model studies, Soil-plant-water relationships.

As part of a general study on surface and groundwater regimes in the 620 sq km Sonoita Creek watershed, Arizona, a model of monthly evapotranspiration (Morton's conceptual approach for large areas) was tested. A unique aspect of this watershed is the strip of dense riparian vegetation where the actual evapotranspiration equals the potential evapotranspiration. For the rest of the watershed, actual evapotranspiration is less than the potential because it is dependent on rainfall. Climatological data included were solar radiation, dew point temperature, mean monthly temperature, and humidity. The model was validated by comparing predicted and actual evapotranspiration in Africa at a similar latitude and under conditions ranging from arid to humid. Model performance on data from the Sonoita Creek watershed was good on an annual basis (but not on a monthly basis) and in the hot seasons. To compensate for the errors in the cold seasons, advection was considered. Large errors were produced by the fact that the model neglects changes in net radiation due to surface moisture content. On an annual basis the error was 52%, and on a monthly basis it ranged from 29% in August to 111% in December. Potential evapotranspiration ranged from 60 mm per month in December to 235 mm per month in May; areal evapotranspiration, from 20 mm per month in October to 55 mm per month in May. (Cassar-FRC)
W82-01306

AUTOMATIC CLASS-A PAN-FILLING SYSTEM,
Science and Education Administration, Boise, ID. Northwest Watershed Research Center.
For primary bibliographic entry see Field 7B.
W82-01326

2E. Streamflow and Runoff

EVALUATION OF EFFECTIVE BOUNDARY ROUGHNESS FOR GRAVEL-BED RIVERS,
New Brunswick Univ., Fredericton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W82-01161

A MODEL FOR SIMULATION OF FLOW IN SINGULAR AND INTERCONNECTED CHANNELS,

Geological Survey, Reston, VA. Water Resources Div.
R. W. Schaffranek, R. A. Baltzer, and D. E. Goldberg.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $5.00. Geological Survey Techniques of Water-Resources Investigations, Book 7, Chapter C3, 1981. 110 p, 36 Fig, 3 Tab, 17 Ref, 4 Append.

Descriptors: *Model studies, *Unsteady flow, *Networks, *Flow characteristics, Open-channel flow, Streams, Surface water, Boundary conditions, Wind tides, Seiches, Simulation, Numerical analysis, Computer programs.

A one-dimensional model is presented for simulating the unsteady flow in singular riverine or estuarine reaches and in networks and interconnected channels. The model is both general and flexible in that it can be used to simulate a wide range of flow conditions for various channel configurations. The model accommodates tributary inflow into the network channels and includes the effects of wind shear on the water-surface as a forcing function in the flow equations. Water-surface elevations and flow discharges are computed at channel junctions, as well as at specified intermediate locations within the network channels. Five example applications of the flow model are illustrated which cover such diverse conditions as a singular upland river reach in which unsteady flow results from hydropower regulations, coastal river reaches of unsteady tidal-driven flow, and a multiply connected network of channels whose flow is principally governed by wind tides and seiches in the adjoining lakes. The report includes a listing of the Fortran IV computer program and a description of the input data requirements. Model supporting programs for the processing and input of initial and boundary-value data are identified, various model output formats are illustrated, and instructions are given to permit the production of graphical output on the line printer, electromechanical pen plotters, cathode-ray-tube display units, or microfilm recorders. (USGS)
W82-01210

REGIONAL FLOOD FREQUENCY ESTIMATION AND NETWORK DESIGN,
Princeton Univ., NJ. Dept. of Civil Engineering.
N. P. Greis, and E. F. Wood.
Water Resources Research, Vol 17, No 4, p 1167-1177, August, 1981. 9 Fig, 6 Tab, 22 Ref.

Descriptors: *Flood frequency, *Regional analysis, *Network design, Probability weighted moments, Regional floods, Flood recurrence interval, *Flood forecasting.

Regional estimates of flood recurrence quantile events in gaged and ungaged basins were improved by using the probability weighted moment technique (PWM). At gaged sites PWM gave better regional estimates than the conventional methods, method of moments and maximum likelihood estimates. For ungaged basins the PWM was combined with a second method for estimating mean peak flow. Estimates were especially improved when record lengths were shorter than 20 years. The regional PWM method had an average error of 10.3% for 7 sites and 17.5% for 10 sites in Pennsylvania. Seven other ungaged methods used on the same sites had errors ranging from 25.7% to 71.1%. In an Arizona network, improvement was 9% to 31% for selected flood frequency recurrence intervals using the regression-based NARI approach. (Cassar-FRC)
W82-01294

DETERMINATION OF THE CONFIDENCE INTERVALS OF THE WAKEBY DISTRIBUTION USING ORDER STATISTICS,
Institut Nationale de la Recherche Scientifique, Sainte Foy (Quebec).
B. Bobee, and P. Boucher.
Water Resources Research, Vol 17, No 4, p 1225-1230, August, 1981. 3 Fig, 1 Tab, 18 Ref.

Descriptors: *Wakeby distribution, *Statistical analysis, *Flood frequency, Order statistics, Flood flow, Flood forecasting.

The Wakeby distribution, which accounts for the effect of separation, represents flood flows adequately. The method presented in this paper, based on the distribution of order statistics, allows determination of confidence intervals for an event of a given return period at any level for given values of the parameters. If a sample is used to estimate parameters, the procedure is approximative and may produce a small overestimation. The method is of interest in the Wakeby distribution because (1) no explicit derivation of the variation of estimation of an event with a given return period has been made, and (2) the distribution function of the order statistics can be derived in an explicit form as a result of the inverse form of the Wakeby distribution. (Cassar-FRC)
W82-01317

PHYTOPLANKTON OF FOUR RIVERS, THE TYNE, WEAR, TEES AND SWALE,
Durham Univ. (England). Dept. of Botany.
N. T. H. Holmes, and B. A. Whitton.
Hydrobiologia, Vol 80, No 2, p 111-127, May, 1981. 5 Fig, 5 Tab, 39 Ref.

Descriptors: *Ecological effects, *Rivers, *Phytoplankton, Seasonal variations, Taxonomy, Temperature effects, *England, Water transfer, Low flow, Water management, Water quality, River flow, Comparison studies.

A comparison study was made of the phytoplankton populations in four relatively fast-flowing rivers in north-east England which are associated with a water transfer scheme. The total number of live cells ranged from 200 to 20,000 cells/ml. Input of plankton from a reservoir did not influence densities at a site 25 km downstream. Diatoms formed the majority of cells in most samples, with green algae second and cryptomonads third in importance. Among the diatoms, centrics were relatively more abundant at downstream sites. The ratios of live versus dead diatoms showed marked differences with season and between centric and pennate forms. Statistics demonstrate that active growth of centric diatoms in the plankton may be important in the summer. (Baker-FRC)
W82-01376

A CATCHMENT APPROACH TO FLOOD ESTIMATION,
Northumbrian Water Authority, Gosforth (England).
D. R. Archer.
Journal of the Institution of Water Engineers and Scientists, Vol 35, No 3, p 275-289, May, 1981. 5 Fig, 11 Ref.

Descriptors: *Flood forecasting, *Gaging stations, *Catchment basins, *Northumbrian Water Authority, *Great Britain, Flood data, Flood frequency, Flood recurrence interval, Flood Studies Report, Rivers, Snowmelt, Runoff, Rainfall-runoff relationships.

Methods are presented for the determination of flood discharges of given return period at ungaged sites using catchment and geiondal flood parameters with the Flood Studies Report (1980) statistical method. Flood data from gaging stations in the Northumbrian Water Authority area and a partial duration series were used to derive standard flood parameters. Mapping these parameters revealed patterns which can be used to improve the accuracy of estimations at ungaged sites in the Northumbrian region. Some conclusions obtained from this study are: 81) flood runoffs where snowmelt is the sole contributor are potentially far more serious than is suggested by meteorological snowmelt studies; (2) the partial duration series provides data on flood behavior at low return periods, not available through the annual maximum series; (3) persistence effects produce errors in currently used partial duration series models based on a Poisson distribution of the number of exceedences within a year and an exponential distribution of the magnitude of these exceedences; (4) channel morphology and overbank storage strongly affects the distribution shape and flood growth curve; (5) drier lowland catchments have steeper growth curves than wet upland catchments in this area; and (6) adjustments based on local data can greatly improve the reliability of estimates from the Flood Studies equation. (Cassar-FRC)
W82-01397

CONCENTRATED FLOW RELATIONSHIPS,
Science and Education Administration, Tucson, AZ. Southwest Rangeland Watershed Research Center.
For primary bibliographic entry see Field 2J.
W82-01409

MONITORING GLACIER OUTBURST FLOODS,
National Hydrology Research Inst., Ottawa (Ontario). Div. of Snow and Ice.
For primary bibliographic entry see Field 2C.
W82-01558

DEBRIS FLOWS IN SMALL MOUNTAIN STREAM CHANNELS OF COLORADO AND THEIR HYDROLOGIC IMPLICATIONS,
Denver Univ., CO. Dept., of Geography.
J. E. Costa, and R. D. Jarrett.
Bulletin of the Association of Engineering Geologists, Vol. 18, No 3, p 309-322, August, 1981. 14 Fig, 2 Tab, 44 Ref.

Descriptors: *Stream erosion, *Debris cone, *Flood flow, Soil erosion, Erosion, Sediment transport, Sediment erosion, Stream gages, Channel improvement, Bank stabilization, Streamflow, Alluvial fans, Detritius, Levees, Dams, Flood profiles, Alpine regions.

Debris flows in small mountain streams have often been confused with waterfloods on gaging-station records and on-site studies. In areas of flooding due to intense rainfall, geomorphic, sedimentologic and hydraulic evidence was attributed to debris flows in five of the seven sites examined. Debris flows are identified by poorly sorted, unstratified and unconsolidated deposits having well-defined levees and terminal lobes. Although large boulders may be moved in debris flows, often small trees are not damaged. High-water marks and gaging-station records downstream show that only a small percentage of the debris-flow dishcharge is water. Mitigating actions for waterfloods such as channelization and damming may have little effect on debris flows. Debris flows in the Rocky Mountains may lead to overestimates of flood levels. This may lead to faulty values for data used in the design of flood-control structures. (Geiger-FRC)
W82-01597

2F. Groundwater

SEASONAL REVERSALS OF GROUNDWATER FLOW AROUND LAKES AND THE RELEVANCE TO STAGNATION POINTS AND LAKE BUDGETS,
Wisconsin Univ.-Madison. Dept. of Geology and Geophysics.
M. P. Anderson, and J. A. Munter.
Water Resources Research, Vol 17, No 4, p 1139-1150, August, 1981. 11 Fig, 2 Tab, 25 Ref.

Descriptors: *Groundwater movement, *Lakes, *Groundwater divide, Flow patterns, Stagnation point, Seasonal variation, Lake basins, Lake beds, Lake bottom springs, *Snake Lake, *Wisconsin, Flow-through lakes, Recharge, Model studies, Simulation analysis, Groundwater level, Groundwater budget.

The groundwater flow around Snake Lake, Wisconsin, was investigated with two-dimensional transient groundwater flow computer models. This flow-through lake (receives groundwater through part of the basin and recharges groundwater through the rest) showed an unusual flow system in spring 1973. A groundwater mound, i.e., an area with a water table higher than the lake surface, and a stagnation zone, which caused a reversal in the direction of groundwater flow, formed. The model simulated the changes in size and shape of the groundwater mound and the stagnation zone, as

well as the effects on the lake's water budget. The groundwater component of the lake's water budget varied from -0.014 cu ft per sec at the beginning of the simulation to +0.21 cu ft per sec 36 days later. It is likely that this flow reversal occurs every year. Factors favoring the formation of the groundwater mound and stagnation point are: location on a groundwater divide, deposits of low permeability on the downgradient side, seasonally high recharge rate, reduced thickness of aquifer under the lake, and low regional hydraulic gradient. (Cassar-FRC)
W82-01103

MASS TRANSPORT OF SOLUTES IN DUAL-POROSITY MEDIA,
Water Research Centre, Marlow (England).
For primary bibliographic entry see Field 5B.
W82-01104

SOME RECENT STUDIES ON GROUNDWATER RADON CONTENT AS AN EARTHQUAKE PRECURSOR,
Southern California Univ., Los Angeles. Dept. of Geological Sciences.
T-L. Teng.
Journal of Geophysical Research, Vol 85, No B6, p 3089-3099, June, 1980. 19 Fig, 2 Tab, 17 Ref.

Descriptors: *Radon, *Earthquakes, *Water analysis, Correlation coefficient, *Groundwater, On-site data collections, California, China, Radioactivity techniques, *Earthquake predictions.

The suggested association between radon anomalies and earthquake occurrence is discussed by reviewing experimental and field evidence. Also, the current status of groundwater radon research in rélation to earthquake prediction is reviewed by the presentation of some representative studies. Experimental techniques for the detection of groundwater radon were developed in China, Japan, and the US. Radon measurement results include results from a California sampling network of 14 springs and wells. A weekly sampling program since 1974 has given an average of 3426 c/m kg. No clear correlation has been found between several small earthquake occurrences and radon variations. The extensive Chinese radon monitoring program, on the other hand, has resulted in earthquake predictions. In general, available evidence suggests an association between regional stress buildup and radon emission from crustal rocks. The discrete-sample groundwater radon measurement with the liquid N2 cold trap method has given better accuracy than continuous radon counting systems. However, it seems necessary to trade off some accuracy for the higher sampling frequency of continuous systems. (Small-FRC)
W82-01127

AN ANALYTICAL SOLUTION FOR SOLUTE TRANSPORT THROUGH FRACTURED MEDIA WITH MATRIX DIFFUSION,
National Hydrology Research Inst., Ottawa (Ontario).
G. E. Grisak, and J. F. Pickens.
Journal of Hydrology, Vol 52, No 1/2, p 47-57, June, 1981. 7 Fig, 1 Tab, 11 Ref.

Descriptors: *Solute transport, *Fracture permeability, Permeability, *Groundwater movement, Hydrology, Base flow, Infiltration, Percolation, Subsurface drainage, *Path of pollutants.

An analytical solution is presented for describing solute transport in fractured media where the solute diffuses from the fracture into the adjacent matrix. The solution is for nonreactive transport in both the fracture and the matrix. The governing conditions include one-dimensional advective transport in the fracture and one-dimensional diffusive transport, normal to the fracture, into the matrix. The utility of the solution is illustrated by applying it to laboratory data and by illustrating hypothetical cases of transport along a single fracture for large temporal and spatial scales. The Laboratory data used was derived from a column tracer test on fractured till. The retardation effect of the diffusion of the contaminant from the fracture into the matrix has important implications with regard to contaminant releases from the deep disposal or storage of toxic wastes in rock formations. For fracture water velocity, aperture and matrix diffusion coefficient of 100 meters/year, 100 micrometers and 0.000001 square centimeters/second, respectively, matrix diffusion reduces the average contaminant velocity to an exit point at 4000 meters to about 0.2% of the water velocity for media with even the least porous matrix, such as granite. (Baker-FRC)
W82-01179

GEOLOGIC AND HYDROLOGIC FACTORS CONTROLLING RADON-222 IN GROUND WATER IN MAINE,
Maine Univ. at Orono. Dept. of Civil Engineering.
W. F. Brutsaert, S. A. Norton, C. T. Hess, and J. S. Williams.
Ground Water, Vol 19, No 4, p 407-417, July/August, 1981. 11 Fig, 6 Tab, 30 Ref. OWRT-A-045-ME(4).

Descriptors: *Radon, *Granites, *Wells, *Maine, *Radioisotopes, Water analysis, Water quality, Metamorphic rocks, Pollutant identification, Water pollution sources, Groundwater, Geohydrology, Uranium, Well yield, Domestic water.

Radon-222, associated with groundwaters in uranium-containing granitic rocks in Maine, was found at concentrations up to 100,000 pCi per liter, much higher than the 500 pCi per liter recommended by the EPA. Water samples were collected from 136 granitic wells and 300 nongranitic wells in southern Maine, where the nation's top 10% incidence for some cancers occurs. The Mean Rn-222 value for groundwater from granites was 22,100 pCi per liter, range 5,000-100,000 pCi per liter; for high grade metamorphic rocks (sillimanite and sillimanite plus orthoclase), 13,630 pCi per liter, range 3,000-30,000 pCi per liter; and for low grade metasedimentary rocks (chlorite to staurolite), 1,100 pCi per liter. In granites Rn-222 increased slightly with well depth up to 50-75 meters and remained nearly constant at greater depths. Rn-222 values varied inversely with well yield and overburden thickness, and weakly inversely with Na+ values, indicative of surface water infiltration. With a given rock unit the other chemical parameters (K, Ca, Mg, Fe, Mn, Zn, and Cu) did not correlate with Rn-222 levels. (Cassar-FRC)
W82-01222

GROUND WATER,
Geraghty and Miller, Inc., Syosset, NY.
R. A. Saar, and O. C. Braids.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 921-925, June, 1981. 73 Ref.

Descriptors: *Groundwater, *Literature review, Solutes, Groundwater management, Water management, Groundwater movement, Groundwater recharge, Model studies, Nitrates, Chlorides, Organic compounds, Organic pesticides, Pesticides, Farm wastes, Leaching.

Recent developments in the area of groundwater research are cited in this literature review. Concerning water movement, studies were made of the problem of saturated-unsaturated flows in three dimensions from an injection well, examination was given to estimating the recharge of aquifers, and the numerical analysis of seepage and groundwater flow was reviewed in four sections dealing respectively with fundamental equations of seepage and groundwater flow, steady and time variant seepage, analysis of regional groundwater flow, and analysis of pumping tests. General studies on solute movement investigated waste disposal practices, leachate from landfills, and problems arising near drain fields of septic tanks. Specific solute research dealt with inorganic solutes such as calcium chloride, nitrates, and carbonates. In the area of organic sludge reports are cited which deal with the velocities of groundwater as affected by a series of homologous organic compounds, monitoring for atrazine, alachlor, and dieldrin in groundwater under farmland, ways in which viruses enter groundwater, and how soil and aquifer characteristics affect virus survival and migration rate. The importance of water reclamation through groundwater recharge was the topic of a water symposium. Groundwater resource planning was also studied heavily, with emphases on numerical models for groundwater management, mapping techniques, and specific studies of circulation of groundwater at particular sites. (Baker-FRC)
W82-01273

IDENTIFICATION OF THE WAIRAKEI GEOTHERMAL SYSTEM,
Department of Scientific and Industrial Research, Lower Hutt (New Zealand). Physics and Engineering Lab.
L. J. Fradkin.
Water Resources Research, Vol 17, No 4, p 921-927, August, 1981. 6 Fig, 1 Tab, 12 Ref.

Descriptors: *Geothermal power, *Model studies, *Wells, Thermal water, Groundwater movement, Powerplants, Wairakei, *New Zealand, Geothermal studies.

Several models describing the Wairakei geothermal system, New Zealand, were compared and the best candidates verified. The models were obtained by choosing different equations and using different parameter estimation algorithms. The least squares algorithm was found to be compatible with the chosen model structure. The identified model showed forecasting power in comparisons of predicted and observed data on pressure drops from 1969-79. The model, therefore, can be used to control the power plant, one of the oldest geothermal plants in the world. (Cassar-FRC)
W82-01312

A COMPARISON OF THE INCOMPLETE CHOLESKY-CONJUGATE GRADIENT METHOD WITH THE STRONGLY IMPLICIT METHOD AS APPLIED TO THE SOLUTION OF TWO-DIMENSIONAL GROUNDWATER FLOW EQUATIONS,
Geological Survey, Huron, SD. Water Resources Div.
L. K. Kuiper.
Water Resources Research, Vol 17, No 4, p 1082-1086, August, 1981. 3 Fig, 14 Ref.

Descriptors: Cholesky-conjugate gradient method, *Aquifers, *Transmissivity, Confined aquifers, Unconfined aquifers, *Groundwater movement, *Model studies, Comparison studies, Strongly implicit procedure.

The incomplete Cholesky-conjugate gradient method (ICCG) originally used on laser fusion problems was compared with the strongly implicit procedure (SIP) in five test problems involving steady state simulations of groundwater flow. Three were linear confined aquifer problems, and two were nonlinear water table aquifer problems. The ICCG method performed better than SIP on the confined aquifer problems and equally well on the water table problems. An ICCG iteration required 83% as much computational time as an SIP iteration. (Cassar-FRC)
W82-01315

A MATHEMATICAL MODEL OF WATER TABLE FLUCTUATION IN A SEMI-INFINITE AQUIFER INDUCED BY LOCALIZED TRANSIENT RECHARGE,
National Geophysical Research Inst., Hyderabad (India).
S. N. Rai, and R. N. Singh.
Water Resources Research, Vol 17, No 4, p 1028-1032, August, 1981. 5 Fig, 1 Tab, 11 Ref.

Descriptors: *Water table fluctuations, *Recharge, *Aquifers, *Model studies, Groundwater recharge, Groundwater movement, Reservoirs, Unconfined aquifers, Hydraulic conductivity, Specific yield.

This paper extends the work of Marino (1974), who derived an analytical model of water table fluctuation in an unconfined aquifer which is receiving localized recharge at a constant rate and is discharging into a surface reservoir. The model

presented here considers that the law of the rate of recharge decreases linearly with time and remains constant thereafter. Using three parameters (rate of recharge, hydraulic conductivity, and specific yield) it can be applied in a more general way than the pioneering study. The aquifer is defined as homogeneous, isotropic, underlain by a horizontal impermeable base, and connected with a surface reservoir on one side. The water table fluctuations caused by variations in the three parameters are described. Conclusions were: (1) the amplitude of the water table variation due to change in the rate of recharge or hydraulic conductivity is relatively larger within the zone of recharge, while the amplitude of the water table variation due to change in the specific yield continuously increases with distance beyond the zone of recharge, and (2) as hydraulic conductivity or specific yield increases, water table variations are smaller. (Cassar-FRC)
W82-01319

ORIGIN, AGE AND MOVEMENT OF PORE WATER IN AGRILLACEOUS QUATERNARY DEPOSITS AT FOUR SITES IN SOUTHWESTERN ONTARIO,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
D. E. Desaulniers, J. A. Cherry, and P. Fritz.
Journal of Hydrology, Vol 50, No 1/3, p 231-257, March, 1981. 7 Fig, 3 Tab, 43 Ref.

Descriptors: *Groundwater dating, *Permeability, *Clays, *Ontario, *Pore water, Geohydrology, Hydraulic conductivity, Isotope studies, Waste disposal, Groundwater movement, Porous media, Dating, Diffusion coefficient.

The hydrogeologic properties of four sites in southwest Ontario were investigated to determine their suitability for waste disposal and as protective covers for regional bedrock aquifers. These locations are typical of the widespread and thick deposits of clayey till and glaciolacustrine clay. Properties measured were textural qualities, hydraulic conductivity (on the order of 10 to the minus 8th power to 10 to the minus 7th power), vertical hydraulic gradients (0.13-0.26 cm per year), and ionic and isotopic contents (O18, H2, H3, C13, and C14). Tritiated pore waters were found only within 3-6 meters of the surface, indicating that waters below this depth were recharged prior to 1952. O18 values in the pore waters were characteristic of present-day precipitation (-9 to -10%) near the surface and characteristic of much cooler waters at 20-40 meters depths (-14 to -17%). The age of the deep groundwater was determined to be 11,000 to 14,000 years. The O18, H2 and chloride concentration profiles were simulated with a model for transport by advection and diffusion in a saturated porous medium, producing effective diffusion coefficients of 3.0 times 10 to the minus 6th power sq cm per s and groundwater velocities of 0.03-0.05 cm per year. Pore water in these clay deposits is a mixture of late Pleistocene and modern waters, with the distribution of O18, H2, and chloride influenced predominantly by molecular diffusion rather than hydraulic flow. (Cassar-FRC)
W82-01321

A NUMERICAL SOLUTION FOR THE MOVEMENT OF AN INTERFACE IN A LAYERED COASTAL AQUIFER,
Technion-Israel Inst. of Tech., Haifa.
J. Bear, and I. Kapuler.
Journal of Hydrology, Vol 50, No 1-3, p 273-298, March, 1981. 7 Fig, 1 Tab, 13 Ref.

Descriptors: *Saline water intrusion, *Coastal aquifers, Groundwater movement, Aquifers, Model studies, Mathematical models, Saline-freshwater interfaces, Israel.

Seawater intrusion in a coastal aquifer is studied. In this case the aquifer is divided into several subaquifers by thin impervious layers of clay extending 1 to 3 km landward and consists of a single aquifer for the remainder of the 15 km distance from the sea. Seawater intrusion occurs as a separate advancing wedge in each of the subaquifers because of differences in freshwater discharge. Assuming that flow is normal to the coast line and horizontal in both freshwater and salt water zones, a mathematical model is stated in terms of depth to the interface in each subaquifer. Then a numerical finite difference scheme is given for solving the model in the case of a 2-layered aquifer similar to that of coastal Israel. (Cassar-FRC)
W82-01327

URANIUM ISOTOPES AS A NATURAL TRACER IN THE WATERS OF THE BET SHEAN-HAROD VALLEYS, ISRAEL,
Tel Aviv Univ. (Israel). Dept. of Geophysics and Planetary Sciences.
J. Kronfeld, and E. Rosenthal.
Journal of Hydrology, Vol 50, No 1-3, p 179-190, March, 1981. 5 Fig, 3 Tab, 10 Ref.

Descriptors: *Uranium, *Isotope tracers, *Aquifers, *Groundwater movement, Tracers, Basalts, Carbonate rocks, Bet Shean Valley, Harod Valley, *Israel, Springs, Recharge, Groundwater recharge.

Uranium isotopes were determined in 34 samples of groundwater and springs in the Bet Shean-Harod Valleys, Israel. There was little variation in uranium content (0.40-4.20 micrograms per liter), but the U234/U238 activity ratios were distributed over a wide range (1.43-3.13). A plot of uranium content vs. U234/U238 activity ratio revealed 3 distinct clusters of samples. Waters from the Revaya well field, Cenomanian carbonate aquifer (karstic), contained 1.5 micrograms per liter U and had the highest degree of isotopic fractionation. These waters were the least mineralized and the freshest of those studied. A group with low activity ratios, caused by chemical weathering, and a broader range of U distribution were found in basaltic rocks. Intermediate in isotope ratios and U content was another carbonate group. These waters were more mature and more saline than the Revays samples because of longer residence time in low permeability carbonate aquifers. (Cassar-FRC)
W82-01328

YIELD VERIFICATION OF A DOLOMITE AQUIFER IN NORTHEAST ILLINOIS,
Illinois Inst. of Natural Resources, Champaign.
R. T. Sasman, R. J. Schicht, C. R. Benson, and R. S. Ludwigs.
Ground Water, Vol 19, No 4, p 370-375, July/August, 1981. 5 Fig, 5 Ref.

Descriptors: *Groundwater budget, *Water level, *Pumpage, *Chicago, Illinois, Groundwater management, Recharge, Groundwater recharge, Carbonate aquifers, Aquifers, *Well yield.

Groundwater withdrawals in a 700 sq mile study area including DuPage County in the western Chicago metropolitan region increased 92% during 1966-1978, amounting to 61.7 mgd in 1978 (57.3 mgd from the shallow dolomite aquifer and 4.4 mgd from sand and gravel). During this period water levels declined as much as 30 ft in some areas, causing concern that groundwater recharge estimates were too low. A groundwater budget study indicated that recharge estimates were of the correct order of magnitude. Specific yield was 0.017. Pumping in excess of recharge was balanced by water removed from storage in the shallow aquifers. About 7.3 billion cu ft of dolomite and 3.3 million cu ft of sand and gravel were dewatered between 1966 and 1979. About 5.9 billion gal of water in excess of recharge has been withdrawn. Continued pumpage approaching the projected rate of 97.2 mgd for the year 2000 would withdraw 18 mgd more than the potential yield of these aquifers and severely dewater extensive areas. (Cassar-FRC)
W82-01334

GEOHYDROLOGIC MODELS OF THE HOUSTON DISTRICT, TEXAS,
Geological Survey, Lawrence, KS.
D. G. Jorgensen.
Ground Water, Vol 19, No 4, p 418-428, July/August, 1981. 8 Fig, 1 Tab, 26 Ref.

Descriptors: *Water level, *Land subsidence, *Saline water intrusion, Model studies, *Houston, Texas, *Geohydrology, *Aquifers, Clays, Compaction, Simulation analysis, Analog models, Potentiometric level, Groundwater movement.

The decline of water levels, land subsidence, and salt water intrusion in the Houston district were studied with three different models. Since this complex aquifer system is composed of discontinuous sand layers and easily compressible clay layers, land surface subsidence up to 210 cm at Pasadena and salt water intrusion at a rate of several hundred meters per year have resulted. The first electric analog model in the early 1960's simulated water level declines well in the city of Houston, but not at distances from the city. It pointed out that the available data and the two-aquifer conceptual model were not adequate for simulation of groundwater systems. There was no attempt to simulate land subsidence. The second analog model in the early 1970's, using new data, simulated water table declines in both aquifers (Chicot and Evangeline) very accurately. The distribution of land subsidence was only approximated. A digital model, developed in 1979, using five layers simulated water level declines, water from clay compaction, and land subsidence very accurately, but could not predict salt water intrusion. (Cassar-FRC)
W82-01335

COMPUTER MODELING AND GROUNDWATER PROTECTION,
GeoTrans, Inc., Reston, VA.
C. R. Faust, L. R. Silka, and J. W. Mercer.
Ground Water, Vol 19, No 4, p 362-365, July/August, 1981. 2 Tab.

Descriptors: *Model studies, *Groundwater movement, *Hydrologic models, Path of pollutants, Computer models, Regulations.

Although groundwater modeling has evolved to a high level, there is a danger that hydrologists and regulators will rely too strongly on this tool. A matrix is presented to help evaluate the reliability and credibility of models for different uses, such as quantity of groundwater available, pollutant movement in spills and at disposal sites, and seawater intrusion. The matrix uses a rating system from 0 to 4 to describe the suitability of a model for specific applications. A rating of 4 implies that a model is reliable for a particular application and that the data can be acquired at reasonable cost. A rating of 3 means that a model can be used for short-term (a few years) predictions or for general problems. Models rated 2 have not been sufficiently verified for specific issues but may be useful as conceptual tools for investigating general problems. The models rated 1 are in the evolutionary and research stage. Generally, model predictions may be extended with confidence into the future for about twice the period for which historical data are available. (Cassar-FRC)
W82-01336

AN APPROACH TO DETERMINING PATHWAYS AND RESIDENCE TIME OF GROUNDWATERS: DUAL RADIOTRACER DATING,
Physical Research Lab., Ahmedabad (India).
S. K. Gupta, D. Lal, and P. Sharma.
Journal of Geophysical Research, Vol 86, No C6, p 5292-5300, June, 1981. 9 Fig, 17 Ref.

Descriptors: *Flow velocity, *Radioactive tracers, *Tracers, *Groundwater movement, Model studies, Aquifers, Carbon radioisotopes, Silicon radioisotopes, Porous media.

Use of two radioactive tracers with widely differing half lives, Si32 and C14, was considered in a diffusion-advection equation for calculating steady state groundwater movement through porous media. This procedure is an improvement over the piston flow model, which overestimates flow velocity in highly dispersive groundwater systems, especially in the case of young water leaking into unconfined aquifers from overlying shallow aquifers. Simultaneous measurements of the two radioactive tracers can produce information flow velocity, dispersion coefficient, and leakage.

Errors in estimation of the mean dispersion time can arise from finite errors in the measurement of tracer concentrations and from finite nonradioactive loss of the tracers in the aquifer. (Cassar-FRC)
W82-01348

GROUNDWATER INVESTIGATIONS IN THE VALE OF STATHMORE,
Water Research Centre, Stevenage (England).
L. Clark.
Water Services, Vol 85, No 1023, p 219-220, May, 1981. 2 Fig.

Descriptors: *Groundwater availability, *Aquifer characteristics, *Geologic fractures, Fissure water, Geologic joints, Aquifer testing, Sandstones, Vale of Strathmore, *United Kingdom.

Various strategies are being investigated to provide supplementary water supplies for the Vale of Strathmore area. Early reconnaissance, geological, photo-geological, and existing-well surveys were performed to establish some understanding of the aquifer. A clear picture has emerged of the hydrogeology of the Old Red Sandstone. The Old Red Sandstone is acting as a regional fissured aquifer in which groundwater moves through a system of joints or bedding planes and not through intergranular voids as in a normal aquifer. Major water entry is through a fissure at 125 m from the surface. Most of the fissures seen on surface exposures must be closed at depth. The majority of wells in Strathmore are poor, and the water tends to be hard. The siting of a public-supply well should be aimed at intersecting a major fissure system. As yet, the extent of groundwater available from the aquifer has not been established. A production well is now being pumped to prove the resource. When used for a public supply, the water will have to be softened or blended. (Small-FRC)
W82-01400

A ONE-DIMENSIONAL, FINITE ELEMENT SALT WATER INTRUSION MODEL,
Guam Univ., Agana. Water Resources Research Center.
For primary bibliographic entry see Field 7A.
W82-01452

CARBON 14 DATING OF GROUNDWATER IN CONFINED AQUIFERS: IMPLICATIONS OF AQUITARD DIFFUSION,
Waterloo Univ., (Ontario). Dept. of Earth Sciences.
E. A. Sudicky, and E. O. Frind.
Water Resources Research, Vol 17, No 4, p 1060-1064, August, 1981. 4 Fig, 12 Ref.

Descriptors: *Aquitards, *Diffusion coefficient, *Dating, Groundwater movement, *Carbon radioisotopes, Confined aquifers, Aquifer systems, Tracers, Radioactive dating, Porous media, Velocity, Carbon-14.

Errors in carbon-14 dating of groundwaters in confined aquifers can be introduced by diffusive losses into fine-grained aquitards. In this theoretical analysis, a quati-two-dimensional approach is used which accounts for C14 losses by diffusion into aquitards as well as advection-dispersion transport in the aquifer. The overall effect of diffusion is to produce a slower advance of C14 along the aquifer, giving an underestimation of groundwater velocity. Errors are enhanced by small aquifer thicknesses, large diffusion coefficients, large aquitard porosity compared with aquifer porosity, and use a radioisotope with a very long half-life. Large errors are likely in stratified argillaceous aquifers unless the results are corrected for diffusion effects. The steady state distribution of C14 is relatively insensitive to the magnitude of the longitudinal dispersivity value of the aquifer, except for constituents with large half lives or for aquifers with very small groundwater velocities. An equation is presented to correct the C14 data to account for diffusion, providing the system is relatively homogeneous and stratigraphically simple. This procedure is also applicable to age dating in fractured porous media. (Cassar-FRC)
W82-01464

HYDROCHEMICAL FACIES IN A TERTIARY BASIN IN THE MILLIGAN CANYON AREA, SOUTHWEST MONTANA,
Indiana Univ. at Bloomington. Dept. of Geology.
N. C. Krothe, and M. P. Bergeron.
Ground Water, Vol 19, No 4, p 392-399, July/August, 1981. 8 Fig, 1 Tab, 12 Ref.

Descriptors: *Chemical composition, *Water quality, *Aquifers, Carbonate aquifers, Groundwater movement, *Milligan Canyon, *Montana, Anhydrite, Gypsum, Calcium bicarbonate, Sodium bicarbonate, Bicarbonates, Calcium sulfate.

Groundwater chemistry and artesian flow were studied in a synclinal basin near Three Forks, Montana, because future agricultural development in this area will increase the demand for groundwater. Water samples were collected from 29 wells and springs in the Milligan Canyon area, July 26-28, 1977, and tested for chemical parameters. Most waters in the Tertiary sediments and Madison Group carbonates are calcium bicarbonate or calcium sulfate waters, supersaturated with respect to calcite. Sodium bicarbonate waters exist in some areas. The ranges of ionic concentrations (in mg per liter) are as follows: Ca(2+), 13-246; bicarbonate, 112-328; sulfate, 29-114; and Na(+), 10-312. Flow direction is toward the east. Calcium bicarbonate waters are present in the recharge area (formed by dissolution of limestone), calcium sulfate in the center region (formed by water flowing through gypsum and/or anhydrite), and sodium bicarbonate in the discharge region (formed by cation exchange with clay minerals of volcanic origin). Decreases in concentrations of total dissolved solids and sulfate downgradient indicate sulfate reduction, followed by dilution of calcium sulfate waters by calcium bicarbonate waters originating from recharge areas to the north, northeast, and south portions of the basin. (Cassar-FRC)
W82-01481

GASEOUS NITROGEN AS EVIDENCE FOR DENITRIFICATION IN GROUNDWATER,
National Physical Research Lab., Pretoria (South Africa).
For primary bibliographic entry see Field 2K.
W82-01485

2G. Water In Soils

SCALING OF INFILTRATION BEHAVIOR IN DISSIMILAR POROUS MATERIALS,
Rothamsted Experimental Station, Harpenden (England). Dept. of Physics.
E. G. Youngs, and R. I. Price.
Water Resources Research, Vol 17, No 4, p 1065-1070, August, 1981. 9 Fig, 2 Tab, 13 Ref.

Descriptors: *Infiltration, *Soil physics, *Porous media, Soil water, Hydraulic conductivity, Capillary conductivity, Particle size.

The microscopic characteristic lengths of porous materials were obtained by three indirect methods and used in the definition of scaled variables to describe flows in their accompanying boundary conditions. The three methods used involved measurements of hydraulic conductivity at saturation, soil water pressure at half saturation, and the integral of hydraulic conductivity with soil water pressure. The porous materials tested were glass beads, washed sands, slate dust, sandy loam, and silt loam. Particle sizes varied from 2-60 micrometers in the silt loam to 350-500 micrometers in a sand. The ratios of the microscopic characteristic lengths obtained from the three methods were fairly constant between materials. Experiments with packed columns of the porous materials were used to study vertical downward infiltration, horizontal infiltration, and vertical upward capillary rise. The scaled results for these materials agreed with the theoretical predictions. This relationship may be useful in estimating soil water behavior in both dissimilar and similar porous materials, especially in field situations where soil water properties vary spatially. (Cassar-FRC)
W82-01105

STATISTICAL ANALYSIS OF THE BROOKS-COREY AND THE GREEN-AMPT PARAMETERS ACROSS SOIL TEXTURES,
Maryland Univ., College Park. School of Engineering.
R. H. McCuen, W. J. Rawls, and D. L. Brakensiek.
Water Resources Research, Vol 17, No 4, p 1005-1013, August, 1981. 4 Fig, 5 Tab, 18 Ref.

Descriptors: *Infiltration, *Soil texture, *Statistical analysis, Brooks-Corey model, Green-Ampt model, Model studies, Mathematical models, Soil water, Soil types, Silt, Clays, Loam, Hydrologic models, Error analysis.

The Brooks-Corey and Green-Ampt parameters used in infiltration equations varied significantly across the soil texture classes. Infiltration data from the literature were subjected to analysis of variance, which resulted in numerous anomalies; therefore, multivariate analysis of variance was applied. The standard errors for each soil class (clay, silt, and sand, plus all combinations) are shown in the texture triangle for the following parameters: Brooks-Corey--square root of lambda, bubbling pressure, total porosity, and soil water content; and Green-Ampt--saturated hydraulic conductivity, effective porosity, and wetting front capillary pressure term. The Duncan test was used to identify the soil texture classes for which significant differences could be identified for each infiltration model. For the Brooks-Corey model all pairs of means were significantly different at the 1% level except for (1) loam and sandy clay, (2) silt loam and clay loam, and (3) silty clay loam and silty clay. Pairs (2) and (3) are adjacent on the texture triangle; pair (1) is not. In the Green-Ampt model seven pairs were not significantly different: (1) sand and loamy sand, (2) loam and clay loam, (3) loam and sandy clay, (4) clay loam and sandy clay, (5) silty clay loam and silty clay, (6) silty clay loam and clay, and (7) silty clay and clay. All but pairs (3) and (6) are adjacent on the triangle. The parameters used in these two models are unique for each soil class and should be applied separately. The soil texture class at an ungaged site can be used in calibrating infiltration parameters. (Cassar-FRC)
W82-01107

VARIATIONS OF PH WITH ANNUAL CUMULATIVE PRECIPITATION IN ACID FOREST SOILS,
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Geography.
C. B. Crampton.
Canadian Journal of Soil Science, Vol 60, No 2, p 385-387, May, 1980. 1 Fig, 7 Ref.

Descriptors: *Soil properties, *Seasonal variation, Precipitation, Acidity, Soil moisture, Moisture availability, Rain forests, *Forests, *British Columbia, *Acidic soils.

Systematic colorimetric soil pH measurements were made over an area in Belcarra Mountain in the rain forest of British Columbia. These studies were conducted over a 4 year period from 1975 to 1978. Summer values increased somewhat with total cumulative precipitation. After dry winters, lower pH values in both A and B horizons were recorded. The increase in acidification was so marked on the sandy Podzols as compared to the less light-textured Brunisols that the normal increase in pH down the profile was reversed. A substantial amount of precipitation during winter raises the water table and increases soil moisture reserves, appearing to prevent a decrease in summer pH values. It is also possible that a drying effect may have occurred during specific seasons, resulting in increased soil acidity. A summer increase in acidity would also be influenced by soil texture, as evidenced by comparing the summer pH values following the relatively wet 1975/76 winter and the relatively dry 1976/77 winter. Knowledge of the variation in soil pH values is essential for characterizing the properties of the Orthic Humo-Ferric Podzols of the area. (Baker-FRC)
W82-01118

WATER AND SALT MOVEMENT IN A SALINE-SODIC SOIL IN SOUTHERN ALBERTA,
Department of Agriculture, Lethbridge (Alberta). Research Station.
T. G. Sommerfeldt, and C. Chang.
Canadian Journal of Soil Science, Vol 60, No 1, p 53-60, February, 1980. 2 Fig, 5 Tab, 15 Ref.

Descriptors: *Soil properties, *Drainage, Seepage, Irrigation, Salts, Acidity, *Saline soils, Soil types, Water table, *Alberta, Canada.

A study was conducted on a shallow Chin loam near Vauxhall, Alberta, Canada, that had become saline-sodic, in order to better understand the internal drainage of such a system. The soil was underlain by till at 51 cm from the surface. Average water intake or infiltration for the profile was 3.76 cm/day. The Btj horizon could be a limiting layer for vertical flow. The observed horizontal hydraulic conductivity indicated that lateral flow of water in the C horizon, 36 cm/day, and in the surface of the till, 22 cm/day, could be as much as five times greater than that of Ah, 5 cm/day, and Btj, 8 cm/day, horizons. Salts were leached from the profile by application of 22 cm of water. The internal drainage of the soil was apparently sufficient to accommodate infiltrated water under normal conditions, and thus the buildup of a water table and salinization of the soil were probably due to lateral flow of water from canal seepage and irrigation mismanagement. The lateral transmission of water probably took place in the C horizon and the upper layer of till, where the horizontal hydraulic conductivity was five to seven times greater than that of the Btj and Ah horizons. The downward leaching of salts apparently was sufficient to cause the high salt buildup to occur in the Btj and C horizons rather than in the surface soil as one might expect in a semiarid, temperate climate. (Baker-FRC)
W82-01119

NITRATE REDUCTION IN AN ORGANIC SOIL-WATER SYSTEM,
Agricultural Research and Education Center, Sanford, FL.
For primary bibliographic entry see Field 5B.
W82-01129

A STUDY OF A METHOD FOR DISPLACING SOIL SOLUTION BY CENTRIFUGING WITH AN IMMISCIBLE LIQUID.
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Land Resources Management.
For primary bibliographic entry see Field 5B.
W82-01131

CHANGES IN SOIL WATER QUALITY RESULTING FROM THREE TIMBER CUTTING METHODS AND THREE LEVELS OF FIBER UTILIZATION,
Montana Univ., Missoula. School of Forestry.
N. Stark.
Journal of Soil and Water Conservation, Vol 35, No 3, p 183-187, July/August, 1980. 6 Tab, 14 Ref.

Descriptors: *Forest management, *Nutrients, *Soil chemistry, *Soil water, Calcium, Copper, Iron, Potassium, Manganese, Magnesium, Sodium, Zinc, Forest soils, Clays, Trees, *Logging, *Water quality, Montana.

The effects of timber harvesting methods on soil water quality were evaluated in heavy soils (30-40% clay) in the Lubrecht Experimental Forest, Montana. Methods used were: (1) clearcutting, (2) overstory removal, and (3) understory removal. Within each harvesting method there were three levels of further utilization--slash left untouched, heavy slash removal, and burning of all slash. Nutrient losses were greater in clearcutting and overstory removal treatments. Although none of the losses were excessive, Ca, Cu, Mn, and Zn are potentially limiting in terms of total ions yet to be released. Burning caused the heaviest losses of the three slash treatments, except in the clearcut-burn combination, and reduced the amount of iron in soil water. Leaving the slash in place was least damaging. These heavy textured soils have low nutrient loss and have a biological life of 9,500 (limit of Cu supply) to 9 million years (limit of Fe supply), if only woody components are removed in a 70-year rotation. Depleted Na or Cu, and Zn or Fe toxicity will ultimately limit tree growth. There is an excess of Ca and moderate quantities of K and Mn in the forest soil water. (Cassar-FRC)
W82-01135

HYDRODYNAMIC DISPERSION DURING CONSTANT RATE ABSORPTION OF WATER BY SOIL,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
D. E. Smiles, K. M. Perroux, S. J. Zegelin, and P. A. C. Raats.
Soil Science Society of America Journal, Vol 45, No 3, p 453-458, May/June, 1981. 6 Fig, 1 Tab, 11 Ref.

Descriptors: *Flow characteristics, *Soil water, *Unsaturated flow, Hydrodynamics, Absorption, Soil science, Soil columns, Mathematical studies, Soil physics.

A group of experiments is described which explored the process of hydrodynamic dispersion during transient flow in substantially unsaturated columns at whose surface water is supplied at a constant rate. A dispersion coefficient is combined with space- and time-like variables to analyze the problem. The use of constant flux adsorption and also permits simplification of the salt flow problem. The analysis is a potentially useful technique for studying dispersion during transient water flow when the soil surface is unsaturated. The method is demonstrated using a chemically inert sandy soil. In these experiments, during transient, unsaturated flow, a simple piston flow model described the process over a range of water types. The method may also be useful in the study of the process in structured soils and when chemical reactions play an important role. (Small-FRC)
W82-01174

PREDICTION OF DIFFUSION COEFFICIENTS FROM THE ELECTRICAL CONDUCTANCE OF SOIL,
Department of Agriculture, Lethbridge (Alberta). Research Station.
C. J. Plamer, and R. W. Blanchar.
Soil Science Society of America Journal, Vol 44, No 5, p 925-929, September/October, 1980. 4 Fig, 2 Tab, 24 Ref. OWRT-A-101-MO(3).

Descriptors: *Mathematical models, *Elctrical conductivity, *Salts, Soil science, Diffusion coefficient, Cation exchange.

A two-component model was developed which used electrical conductance to predict salt movement through soil by diffusion. The model considers electrical conductance in soil to be a combination of a solution and a surface process. The diffusion coefficient for K(+) in four soils with 0.0133M KCl varied from 1.64 times 10 to the -6 power to 5.0 times 10 to the -6 power eq cm/sec when computed from electrical conductivity. It varied from 1.84 times 10 to the -6 to 0.33 times 10 to the -6 sq cm/sec when computed from self-diffusion. In the soil solution, the fraction of the electrical current carried by the 0.0133M KCl varied from 0.85 to 0.13 and was inversely related to the cation exchange capacity. Good agreement was found when diffusion coefficients estimated from the self-diffusion of 42K and 24Na in concentrated and dilute systems were compared. Diffusion measurements made by electrical conductance seem to be more reproducible than those made by self-diffusion. (Small-FRC)
W82-01224

APPORTIONMENT OF NET RECHARGE IN LANDFILL COVERING LAYER INTO SEPARATE COMPONENTS OF VERTICAL LEAKAGE AND HORIZONTAL SEEPAGE,
Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.
J. J. Lentz.
Water Resources Research, Vol 17, No 4, p 1231-1234, August, 1981. 3 Fig, 1 Tab, 2 Ref.

Descriptors: *Soil water, *Leachates, *Infiltration, *Landfills, Path of pollutants, Groundwater, Recharge, Seepage, Drainage, Input-output analysis, Runoff.

Equations are developed to determine the water surplus in a sloping cover placed over an above-ground landfill. The water surplus in the cover is separated into vertical leakage and lateral seepage fractions using input-output analysis. The hypothetical landfill contains multiple cells 40 feet high, covered with 0.5 to 3 ft of soil, with cell surfaces sloped toward a centerline drain which removes surface water and seepage without backwater effects. This procedure allows calculation of the quality of soil water penetrating the landfill cover and thus the quantity of leachate, an important factor in the study of groundwater pollution. An example of a typical landfill is given in which 0.36 cm of soil moisture becomes available the first day and 0.05 cm more on the second day. The amounts of water accumulating in the cover layer, leaking into the waste, and seeping into the drain are calculated for each day. After 4 days the cover layer is dry, 0.313 cm has leaked to the waste, and 0.096 cm has seeped into the drain. (Cassar-FRC)
W82-01298

MEASURING THE HYDRAULIC CONDUCTIVITY OF SOIL ADJACENT TO TILE DRAINS IN A HEAVY CLAY SOIL IN THE NETHERLANDS,
Soil Survey Inst., Wageningen (Netherlands).
J. Bouma, J. W. Van Hoorn, and G. H. Stoffelsen.
Journal of Hydrology, Vol 50, No 1/3, p 371-381, March, 1981. 5 Fig, 3 Tab, 6 Ref.

Descriptors: *Hydraulic conductivity, *Tile drains, *Soil compaction, Drains, Clays, *Netherlands, Infiltration, Soil water, Percolation rate.

A new technique for measuring hydraulic conductivity was applied to heavy clay soils adjacent to tile drains. The method involves excavation of a cube of soil 25 cm on a side around a drain tile. The tile is cut so that the two ends each protrude 5 cm from the cube. Then the cube is removed from the site and covered on five sides with gypsum, which is allowed to harden. The cube is turned upside down and infiltration measured from the exposed surface. Then this surface is covered with gypsum, the opposite surface uncovered, and the measurements repeated. These measurements are characteristic of the undisturbed soil below the drain and the fill soil above the drain, respectively. Methylene blue added to the percolating water traces patterns of water movement. Tests of 12 cubes of soil and three types of pipes (fired clay, slotted plastic, corrugated plastic) showed average hydraulic conductivity values of 10 meters per day for soil below the drain and 5 meters per day above the drain. Dye studies indicated that water movement was almost exclusively along cracks, not rootholes. (Cassar-FRC)
W82-01323

REMOTE SENSING OF SOIL MOISTURE CONTENT OVER BARE FIELD AT 1.4 GHZ FREQUENCY,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 7B.
W82-01345

DETERMINATION OF SOLUTION ELECTRICAL CONDUCTIVITY FROM BULK SOIL ELECTRICAL CONDUCTIVITY MEASUREMENTS BY THE FOUR-ELECTRODE METHOD,
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Div. of Soil Physics.
A. Nadler, and H. Frenkel.
Soil Science Society of American Journal, Vol 44, No 6, p 1216-1221, November-December, 1980. 3 Fig, 5 Tab, 24 Ref.

Descriptors: *Conductivity, *Salinity, *Soil water, *Electrical properties, Soil physical properties, Soil chemistry, Mathematical studies, Resistivity.

A proposed linear relationship between soil electrical conductivity and soil water electrical conductivity was valid only at high salinities, greater than 4 mmho per cm, when measured by the four-electrode method. At low salinity levels, the surface conductance was not constant and made a higher contribution than soil water electrical conductivity to measured soil electrical conductivity. A method for correcting this inadequacy used the Waxman-Smits equation. Comparisons between theoretical and experimental soil electrical conductivity values for low salinities showed agreement. (Cassar-FRC)
W82-01458

NITROGEN LEACHING AS INFLUENCED BY NITROGEN MANAGEMENT AND SUPPLEMENT IRRIGATION LEVEL,
Scientific and Education Administration, Morris, MN. North Central Soil Conservation Research Lab.
For primary bibliographic entry see Field 5B.
W82-01472

SPATIAL VARIABILITY OF STEADY-STATE INFILTRATION RATES AS A STOCHASTIC PROCESS,
New Mexico Agricultural Experimental Station, Las Cruces.
J. B. Sisson, and P. J. Wierenga.
Soil Science Society of America Journal, Vol 45, No 4, p 699-704, July/August, 1981. 9 Fig, 1 Tab, 22 Ref.

Descriptors: *Stochastic processes, *Infiltration rate, Sampling, *Soil properties, Spatial distribution, Statistical analysis, *Soil water.

Autocorrelation was estimated between field-measured infiltration rates to show how this correlation affects the variance of composited samples. Space series analysis was used. Steady-state infiltration rates were measured with infiltrometers of 5, 25, and 127 cm inside diameter in a field plot. Infiltration rates were lognormally distributed for all ring sizes and autocorrelated for the 5-cm ring size. A power spectrum was computed for each of the realizations to a lag of 40. Most of the variance among observations occurred at lower frequencies or at large distances between samples. The results supported the hypothesis that sampling variance is a function of distance between observations. Recommendations include sampling in space and repeated sampling in time to detect treatment effects. For sampling a field for some attribute, the samples should be from widely dispersed locations. For sampling repeatedly in time, several dispersed samples should be composited and the exact location of each marked permanently. At the next hold effects of spatial variability to a minimum. (Small-FRC)
W82-01560

HYDRAULIC PROPERTIES OF FULLERTON CHERTY SILT LOAM,
Oak Ridge National Lab., Environmental Sciences Div.
R. J. Luxmoore, T. Grizzard, and M. R. Patterson.
Soil Science Society of America Journal, Vol 45, No 4, p 692-698, July/August, 1981. 7 Fig, 3 Tab, 13 Ref.

Descriptors: *Permeability coefficient, *Soil properties, *Loam, *Soil water, Tensiometers, Watersheds, Measuring instruments, Hydrology, Walker Branch Watershed, Tennessee.

A field drainage study was established on Fullerton cherty silt loam as a component of the hydrologic characterization of Walker Branch Watershed in eastern Tennessee. Soil water content was monitored after the soil was saturated and during free drainage using a neutron probe at depths of 10, 28, 37, 47, 89, 117, and 177 cm. The changes in water content and matric potential with time and the laboratory data on retention properties of soil cores were used to calculate the hydraulic conductivity. The data are tabulated. Field plot tensiometer results could not be clearly interpreted because of poor correspondence between tensiometer and neutron probe measurements at any given depth. The small-diameter tensiometer cups grouted into aggregated clay subsoil were not suitable for the determination of hydraulic gradient or field retention characteristics. They may be useful in determining soil macroporosity when used in combination with neutron probe measurements. The maximum hydraulic conductivity derived by the instantaneous profile method was 58 to 177 cm per day for two locations. (Small-FRC)
W82-01561

SUPER SLURPER EFFECTS ON CRUST STRENGTH, WATER RETENTION, AND WATER INFILTRATION OF SOILS,
Oklahoma State Univ., Stillwater. Dept. of Agronomy.
P. Hemyari, and D. L. Nofziger.
Soil Science Society of America Journal, Vol 45, No 4, p 799-801, July/August, 1981. 1 Fig, 2 Tab, 10 Ref.

Descriptors: *Soil water, *Infiltration, Soil properties, Sand, Clays, Soil strength, Super slurper, Soil amendments, Soil absorption capacity, Soil water retention, Soil crust strength.

The effect of hydrolyzed starch polyacrylonitrile graft copolymer, commonly called super slurper, on soil crust strength, soil water retention, and infiltration rate was investigated for three soils. Soils were a Teller sandy loam, a Tillman-Hollister clay loam, and a Cobb loamy sand. The modulus of rupture decreased significantly for each soil as the rate of super slurper use increased. A multiple range test was used to compare the water contents of six different soil treatments at each of six suctions for each soil. Tillman-Hollister clay loam had increased water retention after super slurper treatment. Super slurper at rates of 0.025, 0.5, and 0.1% did not increase water retention in Teller sandy loam or Cobb loamy sand. Super slurper decreased the rate of water entry into all three soils. Thus, super slurper has the potential for modifying soil properties, although additional research is needed to determine the longevity of the treatment effects under field conditions. (Small-FRC)
W82-01562

2H. Lakes

AN EXAMPLE OF THE APPLICATION OF STATISTICAL TECHNIQUES TO PREDICT LAKE LEVEL ELEVATIONS,
Department of the Environment, Edmonton. Div. of Design and Construction.
For primary bibliographic entry see Field 6A.
W82-01111

A QUANTITATIVE STUDY OF SHORELINE MARSH COMMUNITIES ALONG LAKE HURON IN ONTARIO,
University of Western Ontario (London). Dept. of Plant Sciences.
D. Fahselt, and M. A. Maun.
Canadian Journal of Plant Science, Vol 60, No 2, p 669-678, April, 1980. 3 Fig, 4 Tab, 13 Ref.

Descriptors: *Lake Ontario, Lakes, *Marshes, *Nuclear powerplants, Powerplants, Shoreline cover, Vegetation, Coastal marshes, Wetlands, Swamps, Nuclear reactors, Heated water, Plumes, *Thermal pollution, Temperature effects, *Ontario.

Ten marshes along the east coast of Lake Huron were surveyed. All ten were open to the influence of the lake. The lake bottom sloped away gradually from all marshy sites, and offshore the water depth was less than 2 meters for a distance of about 0.4 km. All had a basically westerly exposure, included a homogeneous area of 800 square meters or more and showed little or no evidence of human disturbance. Two Baie du Dore marshes selected for study were each treated as two separate homogeneous areas. The mean dry weight of each plant species found was determined per unit area in every marsh, and the diversity and dominance indices were calculated. Application of the sums of squares agglomeration technique showed that the two northernmost sites were the most distinctive floristically. Three of the more southern marshes located near the Bruce Nuclear Power Development clustered together into a separate group. Clustering of marshes cannot be expected to reveal whether the species composition of marshes near the power development has been affected by thermal discharges, since baseline studies had not been conducted before the plant was built. It is expected that heated effluents may cause some changes in vegetation. It is suggested that a resurvey of the area in the vicinity of the power plant be conducted in a few years when both reactors are working at full capacity. Submerged hydrophytes offshore should also be studied. (Baker-FRC)
W82-01122

CHANGES IN LAKE ONTARIO TOTAL PHOSPHORUS CONCENTRATIONS, 1976-1978,
Canada Centre for Inland Waters, Burlington (Ontario); and National Water Research Inst., Burlington (Ontario). Aquatic Physics and Systems Div.
A. S. Fraser.
Journal of Great Lakes Research, Vol 6, No 1, p 83-87, 1980. 1 Fig, 3 Tab, 13 Ref.

Descriptors: *Phosphorus, *Seasonal variation, Lakes, Fate of pollutants, *Lake Ontario, Water quality, Sedimentation, Phytoplankton.

Lake Ontario's total phosphorus levels, which normally show a high peak in spring and an abrupt drop in late summer, were about 4 micrograms P per liter lower than expected in 1977 and 1978. Spring phosphorus levels for the whole lake were approximately 19.5 micrograms per liter in 1977 and 20.0 micrograms per liter in 1978, compared with the 1976 value, about 23.5 micrograms per liter. Loading reduction for this period accounted for only 10% of the change. The probable explanation for the lower P levels is a change in sedimentation rate of total P, such as caused by the death and sedimentation of a large phytoplankton crop just prior to overturn. It is unknown whether the lower P levels in 1977 and 1978 reflect a downward trend or whether new seasonal patterns have been established. (Cassar-FRC)
W82-01126

PETROLEUM HYDROCARBONS IN SEDIMENTS OF SAGINAW BAY, LAKE HURON,
Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
For primary bibliographic entry see Field 5A.
W82-01141

FERROMANGANESE NODULES FROM LAKE ONTARIO (BAY OF QUINTE): MINOR ELEMENT GEOCHEMISTRY,
University of Western Ontario (London). Dept. of Geology.
W. S. Fyfe, B. I. Kronberg, M. Peirce, and G. G. Leppard.
Journal of Great Lakes Research, Vol 6, No 3, p 203-209, 1980. 1 Fig, 3 Tab, 38 Ref.

Descriptors: *Trace elements, *Nodules, *Geochemistry, Lakes, Lake sediments, Sediments, *Lake Ontario, Ferromanganese nodules, Chemical analysis.

Ten ferromanganese nodules found in eastern Lake Ontario in the Bay of Quinte near Glenora were analyzed by spark source mass spectroscopy. Concentrations of 51 minor elements were compared with those in ferromanganese concretions from other lakes, the marine environment, and the earth's crust. Levels of minor elements were: Ba, 1%; Sr, 0.1%; F, S, Co, Zn, and La, 100 micrograms per g range; and others, 1-100 micrograms per g. Compared with marine nodules, lake nodules contained lower levels of all minor elements except Ge and were amorphous rather than crystalline. Lake nodules in this area are found in water depths of 4-8 meters and therefore have not been

exposed to water volumes as great as those in the marine environment. (Cassar-FRC)
W82-01143

A SURVEY OF ATP CONCENTRATIONS IN LAKE ONTARIO, 1975-1976,
Canada Centre for Inland Waters, Burlington (Ontario).
M. MacKinnon, and R. E. Kwiatkowski.
Journal of Great Lakes Research, Vol 6, No 3, p 177-183, 1980. 7 Fig, 3 Tab, 21 Ref.

Descriptors: *Biomass, *Adenosine triphosphate, Microorganisms, Lakes, *Lake Ontario, Chlorophyll a, Seasonal variation, Phosphorus, Organic carbon, Particulate matter, Microbiological studies.

Total microbial biomass concentrations of Lake Ontario were estimated by the adenosine-5'-triphosphate (ATP) technique for three seasons in 1975-1976. The inshore waters had a mean integrated ATP concentration of 0.142 mg per cu meter in December and 0.189 mg per cu meter in April; offshore waters, > 0.050 mg per cu meter. There was no significant difference between surface samples (0-20 meters) and bottom samples. In August, the surface layer had a mean ATP concentration of 0.452 mg per cu meter, bottom inshore waters, 0.238 mg per cu meter, and mid-water samples, 0.040 mg per cu meter. The ATP/particulate organic carbon ratio was relatively constant throughout the lake in winter and spring, but increased in summer, while the chlorophyll/particulate organic carbon ratio was constant with the season. The stepwise regression technique showed that ATP variability was explained in winter-spring by chlorophyll a and in summer by phosphorus. (Cassar-FRC)
W82-01144

A CLASSIFICATION AND DESCRIPTION OF SOME NORTHEASTERN ONTARIO LAKES INFLUENCED BY ACID PRECIPITATION,
Laurentian Univ., Sudbury (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 5B.
W82-01145

SOLUBLE ELEMENT CONCENTRATIONS AND COMPLEXATION IN SOUTHEASTERN LAKE MICHIGAN,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
R. Rossmann.
Journal of Great Lakes Research, Vol 6, No 1, p 47-53, 1980. 6 Tab, 16 Ref.

Descriptors: *Trace elements, *Solubility, *Chelation, Hypolimnion, Epilimnion, Lakes, Water quality, *Lake Michigan, Minerals.

Water samples were collected from both epilimnion and hypolimnion of nearshore southeastern Lake Michigan near the Donald C. Cook Nuclear Plant during 1974 and 1975. The mean elemental soluble (< 0.45 micrometers) concentrations in log(moles per liter) for the 88 epilimnion samples were: Ba, -6.5; Ca, -3.1; Co, -7.7; Cr, -7.5; Cu, -7.4; Fe, -6.9; K, -4.5; Mg, -3.3; Mn, -8.1; Mo, -6.9; Na, -3.6; Ni, -6.9; Sr, -5.9; Zn, -7.1; Cl, -3.5; soluble reactive phosphate-P, -7.5; sulfate, -3.7; and soluble reactive silica, -5.3. Values for the hypolimnion were similar except for soluble reactive silica, which was more concentrated in the hypolimnion in July of 1974 and 1975. Ions with more than 10% of their activity accounted for by complexes were: Co(2+), Cu(2+), Fe(3+), Mn(2+), Ni(2+), carbonate, sulfate, and phosphite. These estimates were obtained from thermodynamic data and solving simultaneous equations. During July 1974 the epilimnion was supersaturated with respect to dolomite, malachite, hydroxyapatite, fluoroapatite, hydroxoapatite, X-ray amorphour (Fe(OH)3, and goethite. It was undersaturated with respect to calcite, aragonite, rhodochrosite, barite, and strengite. (Cassar-FRC)
W82-01147

PHOSPHORUS UPTAKE DYNAMICS AS RELATED TO MATHEMATICAL MODELING OF CLADOPHORA AT A SITE ON LAKE HURON,
Michigan Univ., Ann Arbor.
For primary bibliographic entry see Field 5C.
W82-01149

HYPOLIMNION FLOW BETWEEN THE CENTRAL AND EASTERN BASINS OF LAKE ERIE DURING 1977 (INTERBASIN HYPOLIMNION FLOWS)
Canada Centre for Inland Waters, Burlington (Ontario); and National Water Research Inst., Burlington (Ontario).
F. M. Boyce, F. Chiocchio, B. Eid, F. Penicka, and F. Rosa.
Journal of Great Lakes Research, Vol 6, No 4, p 290-306, 1980. 12 Fig, 4 Tab, 12 Ref.

Descriptors: *Oxygen transfer, *Lake basins, *Hypolimnion, *Water circulation, Dissolved oxygen deficit, *Lake Erie, Water currents, Lakes, Lake morphology, Interbasin transfers, Wind-driven currents, Water currents.

The two basins of Lake Erie (eastern basin, mean depth 28.5 m, and central basin, mean depth 19 m) are separated by the Pennsylvania Ridge, extending southward between the base of Long Point, Ontario to Erie, Pennsylvania. This ridge lies at 15 m depth except for a narrow 24 m deep notch. During 1977 data from ship cruises and from a network of current meters installed on and near the ridge were collected to estimate the hypolimnion flux across the sill area. A strong correlation between winds and mean flux was observed. The dynamic balance appear to be one in which the surface pressure gradient created by wind stress is opposed by internal pressure gradients and by bottom friction. Two major bursts of transport from the deeper eastern basin to the shallower central basin hypolimnion occurred, mid-June to mid-July (13 cu km of water or 20-25% of the hypolimnion volume) and July 31-August 13 (7 cu km of 17% of the hypolimnion volume). Both of these transfers were associated with persistent east winds. The August event was important in transferring dissolved oxygen to the central basin's hypolimnion during the summer oxygen depletion period, raising the mean concentration oxygen in the central basin between 0.5-1.0 mg per liter, or a quarter to a half of the oxygen demand of the central basin hypolimnion. However, this oxygen enrichment does not reach the western 2/3 of the central basin. (Cassar-FRC)
W82-01153

FATTY ACID AND HYDROCARBON CONTENT OF SETTLING SEDIMENTS IN LAKE MICHIGAN,
Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
P. A. Meyers, S. J. Edwards, and B. Eadie.
Journal of Great Lakes Research, Vol 6, No 4, p 331-337, 1980. 4 Fig, 1 Tab, 24 Ref.

Descriptors: *Lake sediments, *Hydrocarbons, *Fatty acids, Organic compounds, *Lake Michigan, Algae, Bacteria, Lakes, Sedimentation, Organic matter, Particulate matter, Aquatic plants, Zooplankton, Phytoplankton.

Sediments were collected in traps suspended at three depths (35 m, 73 m, and 82 m) in southeast Lake Michigan near the Grand River mouth. The lake depth at this point was 83 m and the metalimnion/hypolimnion boundary at 35 m. Fatty acid concentrations were (in mg per g sediment from shallowest to deepest sample, respectively) 9.8, 5.3, and 1.7, indicating active microbial reworking and dilution by resuspended sedimentary materials. Distributions of the straight chain acids were similar in all three samples, dominated by C14, C16, and C18 acids characteristic of algae and bacteria and aquatic plants. The hydrocarbon concentrations at the three depths (micrograms per g sediment, shallowest to deepest sample, respectively) were 147.6, 35.8 and 53,4. Distributions of hydrocarbons differed markedly at the various depths. The 35 m sample had large amounts of C17-C31, typical of terrigenous plants. The two deeper samples were dominated by C27-C31 and had little C17-C19 hydrocarbons. Petroleum may be a source of some of the hydrocarbons in the 35 m sample, whereas resuspended sediments dilute the organic content of the trapped sediment at lower depths. Estimated fluxes to the bottom of the lake in this area are organic carbon, 6.59 g per sq m; fatty acids, 1.8 g per sq m and aliphatic hydrocarbons, 27 mg per sq m. (Cassar-FRC)
W82-01154

WAVE CLIMATE AND POTENTIAL LONGSHORE SEDIMENT TRANSPORT PATTERNS, NOTTAWASAGA BAY, ONTARIO,
Guelph Univ. (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2J.
W82-01156

A BIOASSAY STUDY OF EFFECTS OF ZOOPLANKTON, IRON AND NTA ON THE PHYTOPLANKTON PRODUCTIVITY OF A MARL LAKE,
Michigan State Univ., Hickory Corners. W. K. Kellogg Biological Station.
S. F. Mitchell, and R. G. Wetzel.
Hydrobiologia, Vol 68, No 3, p 235-241, February, 1980. 2 Fig, 4 Tab, 26 Ref.

Descriptors: *Phytoplankton, *Zooplankton, *Iron, *Nitrilotriacetic acid, Productivity, *Lakes, Lawrence Lake, Gull Lake, *Michigan, Chelation, Grazing, Daphnia.

Additions of nitrilotriacetic acid (NTA) and iron (in the form of FeC13) to water samples from two calcareous Michigan lakes (Lawrence and Gull) slightly stimulated phytoplankton producivity in autumn and winter. The two chemicals were added in all possible combinations of 0, 10 or 50, 100, and 200 mg per cu meter and incubated up to 168 hours. These results contrasted with a 4-fold increase in productivity found during in situ studies on marl lakes in the summer. Greatest increases in productivity were 20 and 37% at 96 hour and 168 hours, respectively, using NTA alone. In other experiments with Fe and NTA the greatest response was 5%. Daphnia pulex added to cultures reduced phytoplankton productivity by half for every 20-30 animals per liter present. Reductions were seen at all levels of addition--from 4 to 32 animals per litter. In summer up to 150 Daphnia per liter were required to halve the phytoplankton production. Possible reasons for the seasonal differences are the differences in species composition, microflagellates dominating in winter and diatoms, green algae and blue-green algae in summer. In addition, phytoplankton productivity responds much more strongly to temperature than do D. pulex filtering rates; winter zooplantkton grazing rates (8-10% per day) were on the same order as winter phytoplanton renewal rates (2-10%). (Cassar-FRC)
W82-01157

BIOGEOCHEMICAL INVESTIGATION OF BIG CREEK MARSH, LAKE ERIE, ONTARIO,
National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
A. Mudroch.
Journal of Great Lakes Research, Vol 6, No 4, No 4, p 338-347, 1980. 1 Fig, 6 Tab, 23 Ref.

Descriptors: *Marshes, *Water quality, *Sediments, Wetlands, *Big Creek Marsh, *Lake Erie, Ontario, Nutrients, Metals, Aquatic plants, Insecticides, DDT, Polychlorinated biphenyls, Pollutant identification, Fate of pollutants.

Sediment composition, nutrient and metal uptake by macrophytes, and nutrient and metal concentrations in water were studied at 6 stations in the 850 ha Big Creek Marsh, Ontario. Concentrations of Mg, Ca, Na, K, Mn, and P in surface sediments were similar at all stations with the exception of 20.95% Ca dry weight at a site covered with Elodea, which accumulates Ca. Marsh sediments were lower in Pb, Cu, Ni, and Cr than Lake Erie sediments (highest values in micrograms per g sediment dry weight: 86, 38, 48, and 119, respectively). Several samples exceeded Lake Erie

values: Zn, 1 sample, 383 micrograms per g; As, 2 samples, 64 and 112 micrograms per g; and Hg, 2 samples, 0.930 and 0.530 micrograms per g. Up to 0.018 micrograms per g p,p'-DDE and 0.013 micrograms per g p,p'-TDE, both DDT metabolites, and maximum of 0.51 micrograms per g polychlorinated biphenyls were found in sediment samples. Maximum concentrations of metals (mg per liter) in marsh water samples were: Cu, 0.078; Pb, 0.001; Ni, 0.001; and Zn, 0.018. Increases of total Kjeldahl N and ammonium-N were seen in some marsh water samples in November. This was ascribed to decomposition of some macrophytes. Submerged plants, Myriophyllum, Chara, and Elodea sp, accumulated larger quantities of Pb, Cu, Ni, Cr, and Cd than emergent plants. Ca accumulating plants had higher levels of Pb, Cu, Ni, Cr, and Cd, but Zn levels showed no correlation. (Cassar-FRC)
W82-01163

PHYTOPLANKTON PRODUCTIVITY AND STANDING CROP IN THE VICINITY OF THE LAKE HURON-SAGINAW BAY FRONT,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
R. A. Moll, C. O. Davis, and C. L. Schelske.
Journal of Great Lakes Research, Vol 6, No 3, p 232-246, 1980. 7 Fig, 3 Tab, 41 Ref.

Descriptors: *Phytoplankton, *Interfaces, *Eutrophication, Bays, *Lakes, Lake Huron, *Saginaw Bay, Chlorophyll a, Productivity, Nutrients, Phosphorus, Seasonal variation, Path of pollutants.

The front or interface between eutrophic Saginaw Bay water and oligotrophic Lake Huron water was located by continuous underway sampling at 1 m depth during four research cruises. Samples were analyzed for temperature, nutrients, and chlorophyll distributions. Chloride was a reliable indicator of the front, which was highly mobile. Subsequently, stations in the bay and lake were established for further sampling. Phytoplankton production began earlier in the spring in the warmer, more eutrophic bay water than in the cold, open lake water. There was less difference in phytoplankton densities by late summer. Comparing water quality by t-tests showed that the conservative variables (temperature, chloride, and extinction coefficient) and chlorophyll a and total phosphorus showed highly significant differences between bay and lake water, less significant differences between interfaces and lake, and no difference between bay and interface. Silicate, pH, and C14 uptake had significant differences between bay and interface, but not between lake and interface. The phytoplankton community at the nutrient interface had high chlorophyll a biomass (4.47 micrograms per liter), low C14 uptake (7.12 micrograms per liter per hour) and high bacterial activity (V max, 1.33), indicating the presence of a senescent assemblage. Much of the phytoplankton in the bay was removed from the water column by decomposition and settling before mixing into the open lake. However, during mid-summer several large outputs of nutrients and/or phytoplankton from bay to lake were observed. Although total phosphorus moved readily across the front, chlorophyll biomass did not. (Cassar-FRC)
W82-01164

POSTSPAWNING MORTALITY OF RAINBOW SMELT IN WESTERN LAKE SUPERIOR,
Brigham Young Univ., Provo, UT. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W82-01189

ORGANOCHLORINE INSECTICIDES AND PCB IN SURFICIAL SEDIMENTS OF LAKE MICHIGAN (1975),
Ontario Ministry of Agriculture and Food, Guelph. Pesticide Residue Lab.
For primary bibliographic entry see Field 5A.
W82-01190

TRACE METAL MINERAL EQUILIBRIA IN LAKE ERIE SEDIMENTS,
Case Western Reserve Univ., Cleveland, OH. Dept. of Geological Sciences.
G. Matisoff, A. H. Lindsay, S. Matis, and F. M. Soster.
Journal of Great Lakes Research, Vol 6, No 4, p 353-366, 1980. 3 Fig, 3 Tab, 76 Ref.

Descriptors: *Chemical precipitation, *Lake sediments, *Trace metals, *Lake Erie, Sediments, Lakes, Saturation index, Pore water, Sulfides, Phosphates, Minerals, Carbonates, Fate of pollutants, Zinc, Cadmium, Calcium, Iron, Manganese, Lead.

An ion pair model of interstitial water chemistry of Lake Erie sediments was used to calculate the thermodynamic precipitation tendency of metal phosphate and carbonate mineral phases. It is suggested that detrital calcite, aragonite, and dolomite are dissolving and Fe and Mn carbonates are precipitating. Regenerated phosphate should be removed from solution by reacting with Ca, Fe, Mn, and Pb, with whitlockite, Ca3(PO4)2, being the predicted primary controlling phase. Apatites are supersaturated and may be precipitating. The most probable controlling mechanisms for Zn and Cd are sulfide phases, mixed mineral phases, adsorption, and/or ion exchange equilibria. Inclusion of organic complexes in the model would not improve the results significantly, except for slight reductions in predicted supersaturation.(Cassar-FRC)
W82-01191

SEASONAL FEATURES OF ZOOPLANKTON ASSEMBLAGES IN THE NEARSHORE AREA OF SOUTHEASTERN LAKE MICHIGAN,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
M. S. Evans, B. E. Hawkins, and D. W. Sell.
Journal of Great Lakes Research, Vol 6, No 4, p 275-289, 1980. 4 Fig, 8 Tab, 45 Ref.

Descriptors: *Zooplankton, *Seasonal variation, *Water depth, Lakes, *Lake Michigan, Plankton, Phytoplankton, Fish, Predation, Invertebrates.

Abundance of zooplankton within 11 km north, south, and offshore from the Donald C. Cook Nuclear Power Plant, southeastern Lake Michigan, varied with year, season, and depth during the period 1971-77. Results demonstrate that long-term changes in zooplankton populations can be documented convincingly only if comparisons are made in similar areas of the lake at the same time of year. Zooplankton assemblages were strongly related to water depth from mid-spring to mid-autumn. The shallowest zone studied, 5-10 m, had the least abundance and most variability in zooplankton populations. From mid-spring to mid-autumn zooplankton abundance in the 5-10 m zone was lower; after destratification, higher. Densities were low in spring ($<$10,000 per cu meter) and highest in summer ($>$50,000 per cu meter) and declined through autumn. During autumn the inshore region was dominated by cladocerans and the outer region by copepods. Factors implicated in the seasonal variations are temperature regimes, phytoplankton standing stocks, and predation. (Cassar-FRC)
W82-01192

EFFECTS OF ATMOSPHERIC PRECIPITATION ADDITIONS ON PHYTOPLANKTON PHOTOSYNTHESIS IN LAKE MICHIGAN WATER SAMPLES,
Argonne National Lab., IL.
J. I. Parker, G. T. Tisue, C. W. Kennedy, and C. A. Seils.
Journal of Great Lakes Research, Vol 7, No 1, p 21-28, 1981. 4 Fig, 3 Tab, 35 Ref.

Descriptors: *Lakes, *Phytoplankton, Aquatic plants, Plankton, Phytotoxicity, Zinc, Cadmium, Copper, *Precipitation, *Lake Michigan, Phosphates, Nitrates, Nutrients, Ammonia, Photosynthesis.

Chemical analyses were made of local precipitation in the Lake Michigan area. The effects of incremental additions of rain or snow-melt water on the photosynthetic rate of phytoplankton from the offshore water of Lake Michigan were also investigated. In three of the four experiments conducted, wet deposition was used, and in one experiment a melted snow core was used as the incremental addition. Photosynthesis was significantly increased in three experiments. In the other experiment, photosynthesis was greater than in control samples, and this precipitation sample appeared to stimulate primary productivity. Lake water averages for phosphate, nitrate, and ammonia concentration were exceeded in the precipitation samples by factors of 10, 2, and 50, respectively. Precipitation levels of silicon were lower than the concentration in lake water, but this apparently did not limit photosynthesis. Acidity of lake water was reduced only slightly by added precipitation, and no consistent relationship between these slight reductions in acidity and reduced photosynthesis could be established. Treated samples showed very significant reductions in alkalinity. Levels of zinc, cadmium, and copper in the precipitation samples greatly exceeded the lake water averages, thus producing a high potential for toxic effects on photosynthesis at treatment levels greater than 10%. The results suggest that algal nutrients and toxic trace elements in atmospheric precipitation may interact in a competitive manner to either stimulate or depress phytoplankton photosynthesis in water samples from Lake Michigan. (Baker-FRC)
W82-01196

SEDIMENT DISTRIBUTION OF METHANOGENIC BACTERIA IN LAKE ERIE AND CLEVELAND HARBOR,
Ohio State Univ., Columbus. Dept. of Microbiology.
T. E. Ward, and J. I. Frea.
Applied and Environmental Microbiology, Vol 39, No 3, p 597-603, March, 1980. 2 Fig, 3 Tab, 30 Ref. OWRT-A-040-OHIO(2).

Descriptors: *Sediments, *Bacteria, Cleveland Harbor, *Lake Erie, *Harbors, Fluorescence, Methane bacteria, Seasonal variation, *Sediment distribution.

Results are presented from a survey made with fluorescent-antibody techniques of the seasonal and sediment distribution of a select number of known methanogens which occur naturally in the sediments of Lake Erie and Cleveland Harbor. The most numerous methanogen found in regions of high-organic-silt sediments was Methanobacterium ruminatium. The population of this species ranged from 10 to the 6th power to 10 to the 9th power cells/gram of dry sediment. Identifications were made in sand-silt, clay, or sand sediments of Methanobacterium strain MoH and Methanosarcina barkeri. These methanogens ranged in density from 10 to the 6th power to 10 to the 7th power cells/g of dry sediment. Methanospirillum hungatii was noted only after an organic enrichment was done on Cleveland Harbor sediments. The seasonal and selective sediment distribution of these methanogens appears related to the type and concentration of carbon substrate as well as to the activities of heterotrophic and sulfate-reducing bacteria. The application of the fluorescent antibody technique to these naturally occurring methanogens should increase the acquired knowledge of aquatic methanogenesis. (Baker-FRC)
W82-01233

EUTROPHICATION,
Colorado Univ. at Boulder.
A. J. Medine, and D. B. Porcella.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 908-916, June, 1981. 119 Ref.

Descriptors: *Eutrophication, *Literature review, Phytoplankton, Macrophytes, Lakes, Nutrients, Model studies, Watershed protection.

Recent progress made in the field of eutrophication studies is summarized in this review article. Specific research was conducted concerning nutrient loading, effects of controlling nutrient loads, correlations and indicators. Effects of nutrient in-

crease were seen to be dependent upon the Vollenweider phosphorus loading relationship. The proper management and economic policies to arrest water quality deterioration or reverse undesirable trends were investigated. Regional surveys were conducted of various lake systems. Efforts in the area of eutrophication and ecosystem modeling have produced new data on the physical transport coupled with biological and chemical transformations. Phosphorus uptake rates of Cladophora growing near Harbor Beach, Michigan were modeled as a function of internal phosphorus levels. Long-term responses of Lake Ontario water quality parameters were simulated. Results of a holistic approach to ecosystem modeling were presented. Nutrient sources and sinks represent another area that saw increased research in recent years. The impacts of sediment, nitrogen, and phosphorus on aquatic biota were reviewed. The roles of phosphorus loading and dynamics in lake water were noted and related to agricultural impacts, loading functions, internal loading, epilimnetic recirculation, the role of organisms in the phosphorus cycle, and phytoplankton impacts. A linear programming model, designed for use in management decisions in a Pennsylvania 208 planning area, was used to analyze the impacts and economic aspects of conservation alternatives for controlling downstream dissolved and sediment associated phosphorus loads to lakes. Pollutant transport, the atmospheric loading of phosphorus, and a study of phosphorus release in 4-liter reaction vessels using lake sediments and distilled water were each investigated. Progress was also made in the areas of biological and chemical interactions and lake restoration. (Baker-FRC)
W82-01271

THE USE OF THE EQUILIBRIUM TEMPERATURE TO ESTABLISH THE HEAT BALANCE OF A WATER SURFACE (SUR L'UTILIZATION DE LA TEMPERATURE D'EQUILIBRE POUR L'ETABLISSEMENT DU BILAN THERMIQUE D'UN PLAN D'EAU),
Complexe Scientifique des Cezeaux, Aubiere (France). Lab. Associe de Meteorologie Physique.
C. Boutin, J. P. Albignat, and H. Isaka.
Hydrological Sciences Bulletin, Vol 26, No 2, p 159-170, June, 1981. 3 Fig, 3 Tab, 11 Ref. (English summary).

Descriptors: *Lakes, *Heat balance, *Equilibrium, Mathematical studies, Heat, Water temperature, Lake Godivelle, *France.

A series of daily heat balances was determined for La Godivelle lake in France, and daily estimates of the rate of heating of the lake were made using the methods developed by Edinger et al. (1968) and Keijman (1974) for equilibrium temperature. Using these methods, the exchange coefficient and the equilibrium temperature can be calculated to yield the best possible estimate of the rate of temperature increase. Also, data are used to describe the daily and seasonal behavior of the exchange coefficient and the equilibrium temperature for the summer and autumn stratification phases of the lake. (Small-FRC)
W82-01353

DATA ON THE STAGNANT PONDS OF THE SAVANNAH OF LAMTO (IVORY COAST) (DONNEES SUR LES MILIEUX LIMNIQUES STAGNANTS DES SAVANES DE LAMTO (COTE D'IVOIRE)),
Ecole Normale Superieure, Abidjan (Ivory Coast).
P. Forge.
Hydrobiologia, Vol 72, No 3, p 293-300, July, 1980. 9 Fig, 2 Tab, 15 Ref.

Descriptors: *Ephemeral lakes, *Aquatic life, *Stagnant water, Physicochemical properties, Lakes, Ponds, Species diversity, *Ivory Coast, Water quality, Vegetation, Savannah ponds, Savannah of Lamto.

The size variation through the season of the numerous temporary ponds in the savannah at Lamto, Ivory Coast, is explained by the theoretical water surplus, calculated as a function of temperature and rainfall. Five pond types were identified: ponds on burnt savannah, ponds on non-burnt savannah, forest ponds, and pools on rocks with high and low conductivity. Except for the high conductivity rock pools, the waters were slightly acid (pH 5.5-6.0), high in iron (1-5 ppm), and low in conductivity (30-80 micromho per cm). Four depth correlated vegetation zones were apparent. The savannah ponds had the most diverse fauna, whereas the forest and rock pools had limited numbers of life forms. (Cassar-FRC)
W82-01357

MINERAL IMPACT OF LAKES AS BACKGROUND FOR THEIR BIOGENIC DYNAMICS,
Max Planck Inst. fuer Limnologie zur Holstein (Germany, F.R.).
W. Ohle.
Hydrobiologia, Vol 72, No 1/2, p 51-59, July, 1980. 15 Fig, 4 Tab, 11 Ref.

Descriptors: *Primary production, *Turbidity, *Sedimentation, Lakes, Water quality, Algae, Phytoplankton, Minerals, *Light penetration, Secchi disks, Holstein area, Germany.

Two types of lakes were identified near Holstein, Germany. The Schohsee and Schluensee were enriched with clay, silt, sand and the hydroxides of Fe and Mn as a result of construction of an embankment and influx of wash water from a gravel pit, respectively. Grossner Ploner See and Pluss-See were not subject to mineral turbidity. During windy weather the mineral-impacted lakes were very turbid, but in clear weather, very clear. The Secchi disk readings were 4.6-6.0 meters for the mineral lakes and 2.5-3.8 meters for the other two. Epilimnic phosphates were low, 5-10 mg P per cu meter in the mineral lakes and 50-150 mg P per cu meter in the other lakes. The mean value of primary productivity in Schohsee was 0.33 g C per sq meters per day and in Pluss-See, 1.05 g C per sq meters per day. In Schohsee the carbon was reused 1.7 times before settling to the sediments; in Pluss-See, 15 times. The lakes receiving mineral matter, analogous to alpine lakes receiving turbid snowmelt waters, lost small phytoplankton cells and nutrients through adsorption on detritus and greater sedimentation rates. (Cassar-FRC)
W82-01359

PHYSICO-CHEMISTRY, DESTRATIFICATION AND NUTRIENT BUDGET OF A LOWLAND EUTROPHICATED MALAYSIAN RESERVOIR AND ITS LIMNOLOGICAL IMPLICATIONS,
Malaya Univ., Kuala Lumpur (Malaysia). Dept. of Zoology.
P. T. Arumugam, and J. I. Furtado.
Hydrobiologia, Vol 70, No 1/2, p 11-24, April, 1980. 6 Fig, 4 Tab, 28 Ref.

Descriptors: *Eutrophication, Destratification, *Nutrients, Phosphates, *Lakes, Water quality, Subang Lake, Buloh River, *Malaysia, Lake circulation, Stratification, Fishkills, Phytoplankton, Water pollution sources, Limnology, Reservoirs, Eutrophic lakes.

Extensive algal blooms and poor water quality prompted a limnological investigation of the eutrophied Subang Lake, Malaysia. Determination of the nutrient budgets showed that the reservoir is naturally oligotrophic, having very soft water with a low total dissolved iron concentration and extremely low levels of phosphate. The reservoir, similar to most Malaysian lakes, has a weak thermal stratification, an oxygenated euphotic zone, and a stable deoxygenated hypolimnion. This stratification provides for great species diversity and, at one station, vertical layering of plankton communities. The destratification that occurs on occasion results in sudden mass fish mortality and phytoplankton kills, algal blooms because of sudden liberation of nutrients from the hypolimnion, and poor taste and odor. (Cassar-FRC)
W82-01360

COMPARATIVE LIMNOLOGY OF NINE LAKES OF JAMMU AND KASHMIR HIMALAYAS,
Sri Pratap Coll., Srinagar (India). Hydrobiology Lab.
D. P. Zutshi, B. A. Subla, M. A. Khan, and A. Wanganeo.
Hydrobiologia, Vol 72, No 1/2, p 101-112, July, 1980. 4 Fig, 5 Tab, 33 Ref.

Descriptors: *Eutrophication, *Water quality, Water pollution effects, *Lakes, Himalayas, Physicochemical properties, *Limnology, Vegetation, Aquatic plants, Lake morphology, Kashmir, *India, Phytoplankton, Productivity, Algae, Comparison studies.

The physicochemical and biological features of nine lakes in the Kashmir Himalayas were studied. Two of the lakes are located in the lower Siwalik (altitude 604 meters), five in the Kashmir Valley (altitude 1584 meters), and two in the alpine region (above 2000 meters). The Siwalik lakes are subtropical, monomictic; the valley lakes are monomictic or develop unstable thermal stratification; and the alpine lakes are dimictic. The high altitude lakes have very low electrical conductivity, which increases with decreases in altitude. Most are of the medium hard water type. Ca and bicarbonate are most abundant. Cyanophycear dominate in eutrophic lakes, and diatoms and Chlorophyceae in less eutrophic lakes. Rotifers are the most common zooplankton. Macrophytes, present in 8 lakes, are not related to either altitude or physicochemical properties. One lake, Trigam, is classified as eutrophic, two lakes as meso-eutrophic and in rapid evolution, five as mesotrophic, and one as oligotrophic. Eutrophication is the result of increased human settlement in the drainage basins. (Cassar-FRC)
W82-01361

HYDROBIOLOGICAL STUDIES ON THE AJWA RESERVOIR, THE SOURCE OF RAW WATER SUPPLY TO THE BARODA WATER WORKS,
National Environmental Engineering Research Inst., Ahmedabad (India). Ahmedabad Field Centre.
I. Jayangoudar.
Hydrobiologia, Vol 72, No 1/2, p 113-123, July, 1980. 4 Tab, 22 Ref.

Descriptors: *Water quality, *Water supply, *Aquatic life, Lakes, *Reservoirs, *Ajwa Reservoir, *India, Physicochemical properties, Zooplankton, Phytoplankton, Photosynthesis, Productivity, Nutrients, Aquatic plants, *Hydrobiology.

Hydrobiological studies (April 1963 to December 1964) of the Ajwa Reservoir, India, raw water source for the Nimeta Water Works, Baroda, indicated that the surface layers are comparatively clearer and cleaner than the bottom layers from which raw water is presently being drawn for purification. No persistent thermal stratification was present. The pH was 8.1-8.7, i.e., 0.1-0.6 units lower in the bottom water than in the surface water. Total solids were maximum in June or July and minimum in August or September; water level and total solids were inversely correlated. Photosynthetic oxygen production varied considerably, 1.24-4.02 g per sq meter per day in 1963 and 0.46-1.23 g per sq meter per day in 1964. Free ammonia, nitrates, nitrites, and phosphates were absent from surface and bottom waters. Silica levels were greater in bottom waters than in surface waters. Oxidizable organic matter (permanganate value) was higher in bottom water, 1.22-5.30 ppm, than in surface water, 0.78-1.92 ppm. Zooplankton were found in far larger numbers than the nutrient-limited phytoplankton. (Cassar-FRC)
W82-01364

BALANCE OF BIOGENIC ELEMENTS IN THE ARAL SEA UPON A DROP OF ITS LEVEL,
State Oceanographic Inst., Moscow (USSR).
V. N. Bortnik.
Water Resources (English Translation), Vol 7, No 5, p 457-462, September/October, 1980. 4 Tab, 17 Ref. Translated from Vodnye Resursy, No 5, p 140-147, September/October, 1980.

Descriptors: *Water, *Hydrologic budget, *Water level, *Aral Sea, Mathematical equations, Math-

ematical studies, Nitrogen, Phosphorus, Silicon, Aquatic productivity, Chemical analysis, Russia.

The Aral Sea is experiencing considerable changes in the balance of bigenic elements, significant salinization, and restructuring of its hydrobiological regime as a result of a drop in the level of the sea, a reduction of its area and volume, and substantial changes in the quality of river water entering the Sea. The main component of the income part of the balance of both dissolved and solid forms of biogenic elements is the biogenic content of the Amu Darya and Syr Darya rivers. During the period 1961 through 1977, the transport of the suspended load of the Syr Darya decreased in proportion to the decrease in its water discharge, while the suspended load discharge of the Amu Darya increased by about 1.5 times in spite of a considerable decrease in volume of water discharge. The average annual specific inflow of gross nitrogen with respect to the area and volume of the sea increased by about 33 percent between 1961 and 1977. The specific inflow of gross phosphorus increased by 33 to 36 percent, while that of dissolved silica decreased by about one-third. The average annual depositions of dissolved biogenic elements now exceed their total income with river runoff and precipitation. The balances of dissolved and solid biogenic elements in the Aral Sea are almost completely determined by its water balance. (Carroll-FRC)
W82-01370

DIURNAL, DEPTH-WISE, AND SEASONAL CHANGES OF PHYSICO-CHEMICAL FACTORS IN SATHIAR RESERVOIR,
Madurai Kamaraj Univ. (India). Dept. of Biological Sciences.
V. Kannan, and S. V. Job.
Hydrobiologia, Vol 70, No 1/2, p 103-117, April, 1980. 14 Fig, 48 Ref.

Descriptors: *Water quality, *Seasonal variation, *Diurnal distribution, Lakes, *Sathiar Reservoir, *India, Reservoirs, Eutrophic lakes, Eutrophication, *Physicochemical properties.

Physicochemical factors were studied diurnally, seasonally, and depth-wise in the highly eutrophic Sathiar Reservoir in the Sirumalai range, India, from April 1977 to March 1978. Water level fluctuated 2 to 6 meters, maximum being reached during the heavy monsoon season of August to November. Phytoplankton concentrations decreased with dilution and increased with lowered water levels. Transparency varied from 11.25 in April to July to 36.0 cm in winter. Transparency was governed not only by plankton density but also by solar radiation. Surface temperatures ranged from 26.4 degrees C in December to 32.4 degrees C in May. Maximum difference in temperature between surface and bottom was 5.5 degrees C. Dissolved oxygen at the surface varied between 15 mg per liter in the late afternoon to 4.82 mg per liter prior to sunrise and did not change with the season. There was a clinograde oxygen curve and an anoxic hypolimnion. Surface pH changed 0.22 to 0.9 units with photosynthetic activity. Redox potential at the surface coincided with oxygen and pH changes and decreased at night. Total phosphorus, nitrate and Kjeldahl nitrogen values indicate that the lake is eutrophic. (Cassar-FRC)
W82-01372

INVESTIGATIONS INTO THE OCCURRENCE OF MIDGE PLAGUES IN THE VICINITY OF HARDERWIJK (NETHERLANDS),
Limnological Inst., Oosterzee (Netherlands). Tjeukemeer Lab.
D. M. Beattie.
Hydrobiologica, Vol 80, No 2, p 147-159, May, 1981. 9 Fig, 6 Tab, 18 Ref.

Descriptors: *Midges, *Lakes, Eutrophication, Nuisance, Lighting, Insects, Aquatic insects, *Netherlands, Wolderwijd.

In response to complaints about midge swarms, a study was made of the total chironomid larval population in Wolderwijd, a large shallow Dutch lake, between February and October of 1977. The main species distribution pattern was of the same order of magnitude in both sand and stony substrates, based on substrate and total larval population size. Eutrophication did not cause extraordinarily large chironomid populations to produce excessive numbers of adult midges. The midge plagues experienced in the area are ascribed to the attraction of the midges for artificial light displayed by housing estates in the neighborhood of the lake. Unfavorable weather conditions occurring during 1977 prevented the normal development of larval populations in the lake during the summer, but the life cycle data indicate that in most years, one or more summer generations will occur with population sizes similar to that recorded for the overwintering generations. This would increase the number of occasions on which midges would be present during the summer, but not increase the number of midges on any one occasion. It was concluded that the number and frequency of midges emerging from Wolderwijd are not extraordinarily high for a shallow, temperate-zone lake of it's size. Midge larval eradication programs could upset the lake ecosystem balance. Selective light attraction and killing of adults might reduce the nuisance. (Baker-FRC)
W82-01378

THE CRUSTACEAN ZOOPLANKTON OF MALI (WEST AFRICA),
Ghent Rijksuniversiteit (Belgium). Zoology Inst.
H. J. Dumont, J. Pensaert, and I. Van de Velde.
Hydrobiologia, Vol 80, No 2, p 161-187, May, 1981. 14 Fig, 2 Tab, 55 Ref.

Descriptors: *Lakes, *Zooplankton, *Chemical composition, Chemical properties, Minerals, *West Africa, *Mali, Crustaceans, Aquatic life.

A study of the zooplankton of aquatic biotopes in Mali revealed 48 species of Phyllopoda, 24 species of Copepoda, and a freshwater shrimp. A total biogeographical discussion is not possible at this point, since, for many species, both taxonomical position and chronological records are fragmentary and uncertain. At least 29 species, however, seem to be restricted to Africa, and some even to West Africa. The water chemistry of the lakes is characterized by a low mineral content, but seems not to be distributive to any of the numerous zooplankton species encountered. The zooplankton communities are typically composed of numerous species. The Niger delta appears to be part of the biological boundary of the Sahara as far as aquatic invertebrates are concerned. West African equatorial climate endemics and arid to semi-arid endemics meet and interpenetrate each other's ranges over short distances. (Baker-FRC)
W82-01379

PHYSICAL AND CHEMICAL STUDIES OF LAGO TUPE; A CENTRAL AMAZONIAN BLACK WATER 'RIA LAKE',
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).
H. Rai, and G. Hill.
Internationale Revue der Gesamten Hydrobiologie, Vol 66, No 1, p 37-82, 1981. 34 Fig, 5 Tab, 85 Ref.

Descriptors: *Dystrophic lakes, *Physicochemical properties, Lakes, Oligotrophic lakes, *Limnology, Lake morphology, Alkalinity, Acidity, Thermal stratification, Seasonal variation, Suspended solids, Dissolved oxygen, Oxygen, Minerals, Iron, Phosphates, Nutrients, *Brazil, Lago Tupe.

All depths of the Lago Tupe, a Central Amazonian dystrophic black water, were studied for a period of one year to determine the physical and chemical properties of the lake. Thermal properties, suspended matter and dissolved solids were studied, in addition to ionic composition, alkalinity, hardness, pH and dissolved oxygen. The lake was formed in the pleistocene era; it has a surface area of 48 ha and a length of 3 km. Temperatures in this oligomictic lake varied only 0.7 degrees C at all depths for the year, but thermal stratification was exhibited. Suspended solids and salinity were low. Lago Tupe is a sodium sulfatochloride water type and showed a striking anion excess, presumably created as a result of organometal formation. All cations increased at low lake levels. According to iron levels, the lake was put into Yoshimura's category. Low alkalinity and hardness complete the profile of a system poor in minerals. The pH varied from 4.4 in wet weather to 5.8 in drier times and demonstrated a uniform vertical distribution. Dissolved oxygen was in general about 6 mg/liter but occasionally reached 11.4 mg/liter, showing a clinograde profile. Phosphates averaged 11.6 micrograms/liter and were of major importance to primary and bacterial production. Nitrate nitrogen averaged 21.68 micrograms/liter, and no evidence of nitrification was noted. Ammonia was seen as the major contributor to the nitrogen pool. Silica averaged 2.4 mg/liter and did not appear to be a distinguishing characteristic of this tropical system. Physical and chemical attributes of Lago Tupe can be viewed as an extension of and a complement to the river system of which it is an integral part. (Baker-FRC)
W82-01381

THE EFFECT OF FERTILIZATION WITH PHOSPHORUS AND NITROGEN VERSUS PHOSPHORUS ALONE ON EUTROPHICATION OF EXPERIMENTAL LAKES,
Fisheries and Marine Service, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 5C.
W82-01457

COMPARISON OF FIRST-ORDER ERROR ANALYSIS AND MONTE CARLO SIMULATION IN TIME-DEPENDENT LAKE EUTROPHICATION MODELS,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
D. Scavia, W. F. Powers, R. P. Canale, and J. L. Moody.
Water Resources Research, Vol 17, No 4, p 1051-1059, August, 1981. 7 Fig, 1 Tab, 36 Ref.

Descriptors: *Error analysis, *Monte Carlo method, *Model studies, *Lakes, *Eutrophication, Saginaw Bay, Lake Huron, Algae, Nutrients, Phosphorus, Nitrogen, Zooplankton, Phytoplankton, Variation coefficient, Simulation analysis, Comparison studies.

Two methods for estimating variance associated with eutrophication model output were examined: Monte Carlo simulation and first-order variance propagation. The lake eutrophication model used for study simulated dynamics of phytoplankton, herbivorous and carnivorous zooplankton, three nitrogen forms, and two phosphorus forms. It was applied in this case to Saginaw Bay, Lake Huron. Results of analysis showed that the two methods had some differences. Monte Carlo means were most like the measurements, but Monte Carlo medians were most like the deterministic model output. The two methods agreed most closely on both state variable values and their variances when Monte Carlo output distributions were symmetric. Under these conditions, both estimates were measures of variance associated with total populations (such as total algae). Distributions changed dramatically with time for most state variables. For asymmetric distributions first-order variance estimates measured variability about the typical component of the total population (such as a particular species) and Monte Carlo variance estimates measured variability of the population mean, which is usually of more interest. The Monte Carlo analysis requires along computations in both long-term predictions and examination of relative error sources in complex models. (Cassar-FRC)
W82-01460

APPLICATION OF NUTRIENT-SATURATED GROWTH MODEL TO PHYTOPLANKTON MANAGEMENT IN FRESHWATER PRAWN (MACROBRACHIUM ROSENBERGII) PONDS IN HAWAII,
Hawaii Univ., Honolulu. Dept. of Oceanography.
E. A. Laws, and S. R. Malecha.
Aquaculture, Vol 24, No 1/2, p 91-101, May, 1981. 4 Fig, 1 Tab, 17 Ref.

Descriptors: *Aquaculture, *Nutrients, *Model studies, Phytoplankton, Ponds, Oxygen, Aquatic plants, *Hawaii.

A model of nutrient-saturated growth of Chlorella with significant modification in only two of nine parameters was found to provide an excellent description of experimental data collected from six large experimental tanks and one earthen production pond. The results suggest that in order to maintain system stability with respect to oxygen fluctuations, primary production rates in other commercial ponds are usually kept well below levels that could be obtained under optimal conditions. Application of the model to field data shows that phytoplankton populations in prawn ponds should be kept between 150 and 400 mg/cubic meter chlorophyll a (Chl a) in order to prevent anoxia in worst case situations such as calm nights. Due to a negative correlation between light-limited growth rates and Chl a concentrations, little increase in photosynthesis occurs if Chl a concentrations are raised above 2 g/cubic meter, and there is a negative correlation between photosynthesis and Chl a concentrations for Chl a values greater than 5 g/cubic meter. Therefore even under ideal conditions 1 meter deep ponds should probably be operated with Chl a concentrations less than 2 g/cubic meters. The success of the light limited model in describing data from both monospecific continuous culture systems and diverse populations in prawn ponds suggests that the model may have wide applicability in algal mass culture systems. (Baker-FRC)
W82-01483

NEPHELOID AND SUSPENDED PARTICULATE MATTER IN SOUTH-EASTERN LAKE MICHIGAN,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
R. L. Chambers, and B. J. Eadie.
Sedimentology, Vol 28, No 3, p 439-447, June, 1981. 7 Fig, 24 Ref.

Descriptors: *Sediment distribution, *Suspended sediments, *Nepheloid layer, Lakes, *Lake Michigan, Great Lakes, Lake sediments, Sediments, Particulate matter, Thermocline, Thermal stratification, Stratification.

A benthic nepheloid layer observed in southeastern Lake Michigan was studied during April 1977 to October 1979. This layer, with high total suspended matter and high total particulate surface area, started to develop in late April and formed a distinct benthic zone by mid May. At 1 meter from the bottom, the concentrations of total suspended matter increased by 2-20 times compared with the hypolimnion. Greatest increases were observed at the shelf-slope boundary, which is also the approximate mean depth of the thermocline. Thickness of the layer varied from a few meters at the shelf-slope boundary to greater than 10 meters at the base of the slope. The particulate flux increased exponentially from 10 meters above the bottom to 1 meter above the bottom, suggesting that a large fraction of the collected material came from resuspension. It is hypothesized that currents generated during the thermal bar period resuspend the winter accumulation of surficial shelf sediments, transport it lakeward, and create the nepheloid layer. (Cassar-FRC)
W82-01499

RELEASE OF PHOSPHORUS BY CERTAIN BENTHIC INVERTEBRATES,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
W. S. Gardner, T. F. Nalepa, M. A. Quigley, and J. M. Malcyzk.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 8, p 978-981, August, 1981. 1 Tab, 25 Ref.

Descriptors: *Invertebrates, *Phosphorus, *Nutrient release, *Lake Michigan, Lakes, Metabolism, Macroinvertebrates, Benthic fauna, Aquatic animals, Midges, Oligochaetes, Tubificids, Stylodrilus, Phosphates, Excretion, Sediments.

Three benthic invertebrates from Lake Michigan (Stylodrilus heringianus, tubificids, and Chironomus spp.) were incubated in wet sand at 5 and 20 C for 24 hours with full and empty digestive systems to determine phosphate release rates. Results suggest that phosphate excretion could account for virtually all of the P released from aerobic sediments and must be considered an important mechanism for nutrient release into the lake. Mean weight-specific inorganic phosphate release rates ranged from 0.1 to 0.8 nmol P per mg ash free dry weight per hour. Chironomids release rates (0.27-0.81 nmol P per mg per hour) were significantly greater than rates for oligochaetes (0.12-0.27 nmol P per mg per hour). There were no significant differences in inorganic P release rates from animals with full or empty guts, with the exception of S. heringianus in the 24 hour study. Short-term experiments (30 min) showed much higher values (3.34 + or - 1.78 nmol inorganic P per mg per hour and 3.59 + or - 4.06 nmol organic P per mg per hour). Temperature effects on release rates were not as great as expected, and definitive conclusions were not possible. (Cassar-FRC)
W82-01502

THE EFFECT OF CHANGING SEDIMENT SUPPLY ON SEDIMENTATION IN A GLACIER-FED LAKE,
Illinois Univ. at Chicago Circle, Chicago. Dept. of Geological Sciences.
N. D. Smith.
Arctic and Alpine Research, Vol 13, No 1, p 75-82, February, 1981. 5 Fig, 18 Ref.

Descriptors: *Lake sediments, *Glacial sediments, *Sediment distribution, Glacial lakes, Sedimentation rates, *Canada, *Bow Lake, Alpine regions, Glacial streams.

Bow Lake, located in Alberta, Canada, has been studied as part of an investigation of sedimentation in glacier-fed intermontane lakes. This deep, thermally stratified alpine lake is fed by an overland meltwater stream from Bow Glacier, which has been generally receding from its Neoglacial maximum. The sedimentation regime of the lake was abruptly changed when a pond, acting as a sediment trap, developed at the margin of the receding glacier in 1955. Prior to this development, underflows which formed thick varves in the lower areas of the lake floor dominated sedimentation in Bow Lake. The reduction in sediment input caused the dominant mechanism of sediment dispersal to change from underflows to interflows. The inflows are now dispersed through rightward-deflected interflows moving above the hypolimnion and unaffected by bottom topography. The sediment-trapping capabilities of temporary marginal ponds and the effects which they trigger should be considered as potentially important means of creating variations in the lateral and vertical dispositions of glaciolacustrine sediments. (Carroll-FRC)
W82-01510

HISTORICAL CHANGES AND RELATIONSHIP TO INTERNAL LOADING OF SEDIMENT PHOSPHORUS FORMS IN HYPERTROPHIC PRAIRIE LAKES,
National Water Research Institute, Winnipeg (Manitoba). Freshwater Inst.
R. J. Allan, J. D. H. Williams, S. R. Joshi, and W. F. Warwick.
Journal of Environmental Quality, Vol 9, No 2, p 199-206, April/June, 1980. 4 Fig, 3 Tab, 17 Ref.

Descriptors: *Eutrophication, *Phosphorus, *Water pollution effects, *Lake sediments, Bottom sediments, Nutrients, Lake beds, Lake classification, Eutrophic lakes, Trophic level, Core logging, Geologic time, Canada.

A study was conducted on five Canadian mainstream lakes and two sloughs to see of historical changes in phosphorus form concentrations in sediment cores would provide clues to presettlement trophic state and to elucidate the role of sediment in internal nutrient loading of hypertrophic lakes. Nonapatite phosphorus levels in sediment cores showed that most Prairie water bodies were eutrophic prior to European settlement and extensive farming in the area. Urban and agricultural effluents have caused increased levels of nonapatite phosphorus in surface sediments. Organic phosphorus increases in surface sediments are attributed to post-settlement increases in lake productivity. Increases in nonapatite inorganic phosphorus in surface sediments reflect urban and/or agricultural effluents modified by upward migration and pooling. Internal loading is evidenced by declines in surface sediment nonapatite inorganic phosphorus. (Geiger-FRC)
W82-01516

ZOOPLANKTON ABUNDANCE AND DIVERSITY IN CENTRAL FLORIDA GRASS CARP PONDS,
Central Florida Univ., Orlando. Dept. of Biological Sciences.
D. L. Fry, and J. A. Osborne.
Hydrobiologia, Vol 68, No 2, p 145-155, January, 1980. 7 Fig, 6 Tab, 48 Ref.

Descriptors: *Zooplankton, *Carp, Fish, *Temporal distribution, Plankton, Distribution, Rotifers, Aquatic animals, *Ponds, *Comparison studies, Florida.

Three adjacent ponds were constructed and filled during June of 1975 at the University of Central Florida. The depth ranged from surface to 1.5 meters. Water level was maintained throughout the study by weekly filling. Nine species of rooted aquatic plants were planted in pure stands in the ponds prior to filling. In November, 9 grass carp were stocked in pond 1 and 85 grass carp were stocked into pond 2. In December the ponds were drained, and the weights, lengths, and body condition of the grass carp were determined. Grass carp did not affect the quality of the water, and they also had little direct or indirect effect on the zooplankton in the ponds. The abundance and species diversity of zooplankton were not significantly different between ponds prior to grass carp stocking. What variation in species between the ponds did exist was more likely due to temporal variation rather than to the grass carp. The number of zooplankton species was highest during the fall in pond 1, and during the summer in ponds 2 and 3. Rotifer species were in the main responsible for the seasonal variation in zooplankton species numbers. The monthly mean number of species prior to grass carp was near 10 in pond 1, elevating to 12 for pond 3. After the grass carp were placed into the ponds, the monthly mean number of species was 9 for pond 1, and more than 12 for ponds 2 and 3. Measurements of orthophosphate, nitrite nitrogen, and nitrate nitrogen changed little throughout the study. (Baker-FRC)
W82-01520

THE EFFECTS OF A NEW RESERVOIR ON THE ATTACHED DIATOM COMMUNITIES IN HUNTINGTON CREEK, UTAH, U.S.A.,
Brigham Young Univ., Provo, UT. Dept. of Botany and Range Science.
L. E. Ross, and S. R. Rushforth.
Hydrobiologia, Vol 68, No 2, p 157-165, January, 1980. 3 Fig, 4 Tab, 14 Ref.

Descriptors: *Diatoms, *Population dynamics, *Reservoirs, Dams, Population density, Populations, *Powerplants, *Ecological effects, Dam construction, Huntington Creek, *Utah.

The effects of a new power plant and reservoir were examined on the structure of the attached diatom communities of Huntington Creek, Utah. Construction of the coal-fired generating plant and Electric Lake Dam was begun in 1970. One sampling site was located about 14 km below the main diversion dam on Huntington Creek. Three additional sites were established below the generating plant. A fifth site is 5 km above the North Huntington Reservoir diversion dam, near the Utah Power and Light Company. Two additional sites are at two campgrounds, while the 8th site is at the junction of the Left and Right Forks of Huntington Creek and the ninth site is 2.2 km below Stuart Fire Station at an elevation of 2250 meters. One hundred diatom taxa were identified during the study. No seasonal patterns could be identified

from the resulting phenogram, and no significant differences were seen between the 1971-72 and 1976-77 collections, before and after the completion of the power plant. Diatom communities near the dam were apparently not significantly affected by construction of the reservoir. The two most prevalent species were Achnanthes minutissima and Navicula radiosa var. tenella. These two species were collected at all nine sites, and generally were abundant throughout all collection periods. It was concluded from various statistical analyses that the reservoir had not greatly affected net-plankton and nannoplankton assemblages in the stream. (Baker-FRC)
W82-01521

COLLAPSING APHANIZOMENON FLOS-AQUAE BLOOMS: POSSIBLE CONTRIBUTIONS OF PHOTO-OXIDATION, O2 TOXICITY, AND CYANOPHAGES,
Manitoba Univ., Winnipeg. Dept. of Botany.
A. M. Coulombe, and G. G. C. Robinson.
Canadian Journal of Botany, Vol 59, No 7, p 1277-1284, July, 1981. 3 Fig, 1 Tab, 29 Ref.

Descriptors: *Algae, *Toxicity, Cyanophyta, *Eutrophication, Lakes, Eutrophic lakes, Pathogens, Viruses, *Oxidation.

Four bloom collapses of Aphanizomenon flos-aquae in three shallow eutrophic pothole lakes in southwest Manitoba were examined; for the triggering mechanism. The environmental conditions before and during the blooms were not the same for each event. Therefore, a single triggering mechanism could not be cited as a cause. Three of the bloom collapses (two in mid-July 1979, one in mid-August 1979) began when the lakes were thermally stable and conditions were favorable for death from photo-oxidation and/or oxygen toxicity. The fourth, in mid-August 1973, began during a period of lake thermal instability, ruling out photo-oxidation and oxygen toxicity as the triggering mechanism in this case. Virus like particles were detected by electron mircoscopy in cells from three of the blooms (cells from the fourth could not be examined). They were polyhedral and 50-60 micrometers in diameter. Since transmission and isolation of these viruslike particles has not been proved, it cannot be stated that they triggered collapse by viral infection. Cyanophage-induced algal lysis, perhaps caused by thermal instability, may have been a factor in the algal population decline. Other contributing factors not tested in this study are bacterial and fungal pathogens of algae, autolysis, and senescence. (Cassar-FRC)
W82-01595

2I. Water In Plants

CANOPY TEMPERATURE AS A CROP WATER STRESS INDICATOR,
Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
R. D. Jackson, S. B. Idso, R. J. Reginato, and P. J. Pinter, Jr.
Water Resources Research, Vol 17, No 4, p 1133-1138, August, 1981. 6 Fig, 1 Tab, 22 Ref.

Descriptors: *Water stress, *Canopy, *Temperature, Evapotranspiration, Crop water stress index, Wheat, Irrigation requirements, Soil moisture, Agriculture.

A crop water stress index (CWSI) may be useful for quantitative determination of crop water stress. The CWSI is readily calculated by hand calculator or computer from canopy temperature (measured with an infrared thermometer), wet- and dry-bulb air temperature, and estimated net radiation. The index can be used in place of the stress-degree-day in situations where vapor pressure deficit data are available. The relationship can be expressed as: CWSI = 1 - E/E sub p, where E and E sub p are the actual and potential evapotranspiration. In four experimental wheat plots subjected to different degrees of water stress, pertinent variables were measured. The calculated CWSI, plotted as a function of time, closely paralleled a plot of the extractable soil water in the 0 to 1.1 meter zone. Errors may result from excess wind (increases CWSI), rapidly changing cloud conditions, inaccurate wet- and dry-bulb readings, inadequate calibration of the infrared thermometer, or including some of the soil background in the infrared reading. The CWSI may be useful as an irrigation guide for grains and alfalfa, but probably not for potatoes. (Cassar-FRC)
W82-01106

EFFECT OF WATER, NITROGEN AND ROW SPACING ON THE YIELD AND OIL CONTENT OF SAFFLOWER,
Central Arid Zone Research Inst., Jodhpur (India).
S. D. Singh, and M. Yusuf.
Indian Journal of Agricultural Sciences, Vol 51, No 1, p 38-43, January, 1981. 3 Fig, 1 Tab, 7 Ref.

Descriptors: *Crop yield, *Moisture availability, Nitrogen, Farm management, Moisture stress, Soil moisture, Safflower oil, *Safflower, Water use efficiency.

The quantitative relationship of water, nitrogen, and row spacing to yield and oil content of safflower was investigated. Field experiments were conducted using 'A 300' safflower during 1972-75. The site was in an arid climate, with an average period of bright sun for 9-10 hr, and an average daily maximum temperature of 26 degrees C during winter and 36 degrees C during March-April. Low humidity, light wind, and high open water evaporation were characteristic of the area. The soil was a coarse loam with a pH of 7.5. No contribution was made of water to the crop by rain or upward movement from lower soil depths. The yield response of safflower to N was quadratic under adequate (51 cm), negligible, and restricted (8 cm) supplies of moisture. Narrow row spacing (20 cm) required less water and N to produce optimum crop yields than did wider row spacings of 60 cm. The oil content had a quadratic relation with moisture supply but was independent of spacing. Its relationship was inverse with N levels when water supply was restricted, and direct when it was adequate. Narrow row spacing, optimum water supply of 29 cm, and adequate N of 80 kg/ha were needed to obtain optimum oil yields. (Baker-FRC)
W82-01112

COMPARISON OF TESTS CHARACTERIZING VARIETIES OF BARLEY AND WHEAT FOR MOISTURE STRESS RESISTANCE,
Department of Agriculture, Charlottetown (Prince Edward Island). Research Station.
H. G. Nass, and J. D. E. Sterling.
Canadian Journal of Plant Science, Vol 61, No 2, p 283-292, April, 1981. 5 Tab, 24 Ref.

Descriptors: *Crops, *Moisture stress, Soil moisture, Soil moisture retention, Available water, Moisture availability, Testing procedures, Barley, Wheat.

A number of simple tests were evaluated for moisture stress tolerance and avoidance in characterizing cereal cultivars. Eight cultivars of wheat and seven cultivars of barley were evaluated. Of the avoidance tests, visual wilting correlated well with tiller survival, but the water loss from leaves and stomatal diffusion resistance tests did not. Of the tolerance tests, root weight under moisture stress showed a good relationship with survival. Root weight without moisture stress correlated well with survival for wheat and somewhat less for barley. A comparison of root and leaf weight in two soils differing in moisture-holding ability was useful but less correlated with survival. An unsatisfactory tolerance test was that of germination in mannitol, as there was no correlation in rankings with drought survival. Two semi-dwarf wheat cultivars, Pitic and Fielder, and the two-rowed barley cultivars Nordal and Volla demonstrated the greatest moisture stress resistance. This study of avoidance and tolerance tests leads to the conclusion that no one test used alone has sufficient reliability to determine overall cultivar drought response in wheat and barley. At least one test measuring avoidance and one measuring tolerance should be used. (Baker-FRC)
W82-01114

CLIMATIC FACTORS CONTRIBUTING TO YEAR-TO-YEAR VARIATION IN GRAIN YIELD OF CORN ON BROOKSTON CLAY,
Department of Agriculture, Harrow (Ontario). Research Station.
V. A. Dirks, and E. F. Bolton.
Canadian Journal of Plant Science, Vol 61, No 2, p 293-305, April, 1981. 4 Fig, 11 Tab, 19 Ref.

Descriptors: *Crop yield, *Seasonal variations, Prediction, Moisture availability, Clays, Soil types, Farming, Farm management, *Corn, Climatology, Brookston clay, *Ontario.

Some climatic components contributing to the year-to-year variation in a 13 year rotation experiment involving corn grown on Brookston clay are reported. Brookston clay is an orthic humic gleysol. The results are interpreted in regard to their significance for corn production in southwestern Ontario and for the possible development of predictive models for yield. Four climatic vectors accounted for as much as 80% of the total year variance of grain yield. These four factors were moisture deficit days, available moisture, corn heat units, and an effect allowing for the special weighting of these factors during the critical tasselling-silking period. The nature of the response of corn yield to these climatic vectors depended on the level of N supplied via fertilizer, soil condition, and fertility as maintained by rotation. Prediction of yield using weather data and water budget to estimate moisture deficit days for the soil type appears feasible where corn is fertilized, and can be done by the 15th of August, which is about 6 weeks before the corn is mature. The need for basing area predictions on soil type and farm management practices is discussed. (Baker-FRC)
W82-01115

THE EFFECT OF SNOW TRAPPING AND CROPPING SEQUENCE ON MOISTURE CONSERVATION AND UTILIZATION IN WEST-CENTRAL SASKATCHEWAN,
Department of Agriculture, Swift Current (Saskatchewan). Experimental Farm.
For primary bibliographic entry see Field 3F.
W82-01117

YIELD AND PHENOTYPIC TRAITS OF SEMIDWARF AND NORMAL-STATURED BARLEY (HORDEUM VULGARE L.) GENOTYPES GROWN UNDER DIFFERING LEVELS OF MOISTURE STRESS,
Department of Agriculture, Swift Current (Saskatchewan). Research Station.
R. B. Irvine, B. L. Harvey, and B. G. Rossnagel.
Canadian Journal of Plant Science, Vol 60, No 2, p 733-736, April, 1980. 3 Tab, 10 Ref.

Descriptors: *Crop yield, *Moisture stress, Soil moisture, Barley, Moisture availability, Comparison studies.

Several environments were used to grow semidwarf and normal-statured barley genotypes. These environments differed mainly in the levels of plant available soil moisture. Grain yields differed significantly due to environment and genotype, and there was a nonsignificant tendency for semidwarf genotypes to yield less, relative to their tall counterparts, when grown in environments with restricted moisture supply. The stature of the genotype did not appear to influence the expression of yield components, harvest index or flag leaf area. This study indicates that plant stature is not consistently associated with the magnitude of any yield component, so selection procedures followed in normal-statured barleys should be effective in semidwarf populations. (Baker-FRC)
W82-01121

A PARAMETRIC CROP WATER USE MODEL,
California Univ., Los Angeles. Dept. of Geography.
J. E. Burt, J. T. Hayes, P. A. O'Rourke, W. H. Terjung, and P. E. Todhunter.
Water Resources Research, Vol 17, No 4, p 1095-1108, August, 1981. 10 Fig, 4 Tab, 80 Ref.

Descriptors: *Parametric hydrology, *Agricultural hydrology, *Water requirements, Model studies, Mathematical models, Computer models, Water consumption, Evapotranspiration, Crop production, Droughts, Soil-water-plant relationships.

Agricultural water consumption, both temporal and spatial, can be predicted with a model, WATER, which is a compromise between area-specific, data-based regression models and expensive, complex energy-mass exchange models. Among the crops for which fluctuating water demand can be simulated are wheat, corn, rye, barley, rice, potatoes, and alfalfa. Model validation was accomplished by comparison of calculated results with lysimeter data at four grain corn-growing locations in the Western states during the 1974 growing season. The model is useful in predicting the effects of droughts and other weather variables on crop water requirements. Usable in any region, it can also identify areas of optimum or marginal water conditions, adjust choice of crops to the available water, and simulate interactions of climate and plant growth to reduce the necessity for field studies. (Cassar-FRC)
W82-01310

DROUGHT SUSCEPTIBILITY OF TWO TOMATO (LYCOPERSICUM ESCULENTUM) VARIETIES,
Ibadan Univ. (Nigeria). Dept. of Agronomy.
O. Babalola, and M. O. A. Fawusi.
Plant and Soil, Vol 55, No 2, p 205-214, 1980. 4 Fig, 2 Tab, 16 Ref.

Descriptors: *Moisture stress, *Crop yield, *Tomatoes, Soil moisture, Drought, Moisture availability, *Soil-water-plant relationships.

Some effects of identical moisture stress levels were measured under field conditions on two tomato varieties. Drought susceptibility of these cultivars was measured under soil moisture conditions in greenhouse experiments. Plant height, root length, number of flowers and total dry matter production were significantly affected by soil water potential treatments. Only root length and total dry matter production were significantly different between cultivars. Fruit yield was significantly affected by soil water potential treatments and the interaction between variety and moisture. Generally the drought susceptibility factor increased with decreasing soil water potential. Findings suggest that the stomata of Fireball remained partially closed under conditions of stress in order to reduce vapor losses, thereby accounting for the higher yields under stress conditions. The slightly deeper rooting system for the Fireball variety is also a definite advantage under stress conditions, as the exploitation of the subsoil is facilitated when the soil surface dries out. (Baker-FRC)
W82-01369

HYDRAULIC CONDUCTIVITY OF FOUR COMMERCIAL CITRUS ROOTSTOCKS,
Agricultural Research and Education Center, Lake Alfred, FL.
J. P. Syvertsen.
Journal of the American Society for Horticultural Science, Vol 106, No 3, p 378-381, May, 1981. 2 Fig, 1 Tab, 21 Ref.

Descriptors: *Citrus fruits, *Permeability coefficient, Conductivity, Roots, Drought resistance, *Hydraulic conducting.

The growth characteristics and hydraulic conductivity of intact root systems of four citrus rootstocks commonly used in Florida were investigated. The plants used were 6- and 12-month old greenhouse grown seedlings of RL, sour orange (SO), Carrizo citange (Car), and Cleopatra mandarin (Cleo). Six-month old RL seedlings had the largest leaf area, while Car had the smallest. There was no difference among the root dry weights. The hydraulic conductivity of roots of 6-month old RL seedlings was significantly greater than that of SO and Cleo seedlings. Conductivities of Car were intermediate and not significantly different from either RL or SO and Cleo. Carrizo had the highest conductivity of the 12-month old seedlings, however. Rough lemon seedlings had conductivities that were significantly less than those of Car, but greater than conductivities of SO and Cleo. SO and Cleo had similar root conductivities. The hydraulic conductivity of roots of all four rootstocks increased linearly with temperatures between 15 and 30 degrees C. The slope of root conductivity vs. temperature associated with the Cleo data is significantly less than that of the other rootstocks. It is possible that differences in hydraulic conductivity of roots could result from differences in root extension or suberization as a result of differences in soil, water stress, or other environmental conditions. The relatively high root growth rate and hydraulic conductivity of RL can be used to explain its greater efficiency of soil water extraction and its ability to produce larger trees than many other citrus rootstocks. Drought resistance may also be partly explained by the hydraulic conductivity of the roots. (Baker-FRC)
W82-01546

2J. Erosion and Sedimentation

TRANSPORTS IN THE DULUTH-SUPERIOR HARBOR,
Minnesota Univ.-Duluth. Dept. of Physics.
For primary bibliographic entry see Field 5B.
W82-01136

WAVE CLIMATE AND POTENTIAL LONGSHORE SEDIMENT TRANSPORT PATTERNS, NOTTAWASAGA BAY, ONTARIO,
Guelph Univ. (Ontario). Dept. of Geography.
R. G. D. Davidson-Arnott, and W. H. Pollard.
Journal of Great Lakes Research, Vol 6, No 1, p 54-67, 1980. 9 Fig, 4 Tab, 30 Ref.

Descriptors: *Sediment transport, *Waves, *Shores, Model studies, Littoral drift, Lake shores, Lakes, Lake Ontario, *Nottawasaga Bay, Beach erosion, Wasaga Spit, Computer models, Sediment deposition, Erosion, Ontario.

A storm wave climate was hindcast for Nottawasaga Bay, Ontario, using wind records at Cove Island for 1966-70 and the Sverdrup-Munk-Bretschneider technique. This information is necessary for predicting the effects of human activities such as dredging, shore development, and oil spills on the lake coastal zone. A computer model of wave refraction within the bay incorporates 13 wave classes, defined on the basis of significant wave height, period, and direction. The total and the longshore component of wave energy flux are determined for each wave class. The total annual energy flux and net longshore component are determined for 55 points spaced at 1 km intervals by multiplying the value of energy flux at each point by the mean annual frequency for that wave class and summing the values for all relevant waves. A simple model of potential erosion, transport, and desposition patterns within the bay is developed from the variation in net longshore component values. Model predictions are compared with sediment transport patterns visible in aerial photographs and with measurements of erosion and accretion at selected points. It is concluded that deposition of sediment from the Nottawasaga River, not littoral transport, causes the eastward growth of Wasaga Spit. (Cassar-FRC)
W82-01156

A VERIFICATION STUDY ON A RESERVOIR SEDIMENT DEPOSITION MODEL,
Kentucky Univ., Lexington. Dept. of Agricultural Engineering.
A. D. Ward, D. L. Rausch, C. T. Haan, and H. G. Heinemann.
Transactions of the ASAE, Vol 24, No 2, p 340-352, March/April, 1981. 8 Fig, 3 Tab, 16 Ref.

Descriptors: *Sediment deposition. *Reservoir silting, Hydrographs, DEPOSITS model, Model studies, Mathematical models, *Agricultural reservoirs, Missouri.

Seven years' data from monitoring two agricultural reservoirs in Missouri were used to verify the DEPOSITS model, a conceptual design model for predicting the sediment trapping prformance of small impoundments. Both the model and its sedimentgraph default option gave good estimates of the reservoirs' performance during the 13 storm events in this study. The EPA overflow rate method gave poorer results. (Cassar-FRC)
W82-01176

AQUATIC SEDIMENTS,
Clarkson Coll. of Technology, Potsdam, NY.
For primary bibliographic entry see Field 5B.
W82-01279

CHANNEL INSTABILITY IN A BRAIDED, SAND BED RIVER,
Arizona State Univ., Tempe. Dept. of Geography.
W. L. Graf.
Water Resources Research, Vol 17, No 4, p 1087-1094, August, 1981. 5 Fig, 3 Tab, 26 Ref.

Descriptors: *Braided rivers, *Probabilistic process, *Channel morphology, Rivers, Aggrading rivers, Alluvial rivers, *Gila River, *Arizona, Unstable channels, Alluvial channels, Prediction, *Sedimentation, Sediment transport, Erosion.

Probabilistic approaches are a reliable guide to future behavior of braided, sand bed rivers in alluvial valleys, if no large scale interruptions interfere (large dam or bridge construction, wholesale phreatophyte changes, extensive sand and gravel mining, or radical climate change). The Gila River, Arizona, representative of this type of river, does not meet assumptions of equilibrium. Analysis of maps and photographs dating back to 1868 produced at intervals over this 112-year period reveals a pattern of instability and destructive channel migration. Zones of stability and hazardous instability alternate at about 3.2 km intervals. The sinuosity of the main channel has been close to 1.18 through the past century, although actual location of the flow has varied. Instability zones correspond with the surface of the sediment wedge behind the dam and areas of dense phreatophyte growth; stable zones, with areas controlled by bedrock, man made structures, and the requirement to maintain consistent sinuosity. (Cassar-FRC)
W82-01316

SITES OF RIVER-DERIVED SEDIMENTATION IN THE OCEAN,
Delaware Univ., Newark. Coll. of Marine Studies.
For primary bibliographic entry see Field 7B.
W82-01332

GEOMORPHOLOGY OF THE COLORADO RIVER IN THE GRAND CANYON,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
A. Howard, and R. Dolan.
Journal of Geology, Vol 89, No 3, p 269-299, May, 1981. 12 Fig, 6 Tab, 40 Ref.

Descriptors: *Geomorphology, *Sedimentation, Rivers, Alluvial deposits, Fluvial sediments, Floods, Dams, Canyons, *Colorado River, *Grand Canyon, Glen Canyon Dam, Channeling.

Three types of sedimentary deposits in the Grand Canyon, caused by the differential transport of sediment according to size, are discussed. These types are locally derived alluvial fan debris, cobble bars, and sandy alluvium. The process of sediment addition and removal is reviewed, and the effect of the Glen Canyon Dam upon the sediment budget is considered. The completion of the Dam caused a four-fold reduction in peak discharge of the river sediments, such that new fan debris may increase the gradient through some of the rapids by a factor of 1.8. The major constraint on fluvial transport is structural control. Structural control by canyon walls is indirectly important in providing the sources of alluvial fan debris. The overall river gradient is primarily determined by the balance between addition and removal of coarse debris, as most of the drop in the river occurs in rapids, where debris is contributed by tributaries and rockfalls. The equilibrium between addition and remov-

al of sedimentation is constantly changing, since both processes occur sporadically during times of flood. The morphological context of the debris-fan rapids along with the structurally controlled channel width constitute the major constraints on transport and deposition of cobbles. Some changes have been noted since the completion of Glen Canyon Dam. Post-dam tributary flooding debris deposits are stable at steeper gradients and with a narrower channel. Alluvial fans along the canyon have been noticeably enlarged between 1964 and 1973. The steeper, narrower rapids as well as formation of new rapids will probably continue throughout the lifetime of the Dam. The sand bed will probably readjust, aggrading above the rapids and scouring below. (Baker-FRC)
W82-01338

EROSIVITY 'R' FOR INDIVIDUAL DESIGN STORMS,
Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
K. R. Cooley.
In: CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems, Conservation Research Report Number 26, May, 1980. p 386-397, 4 Fig, 5 Tab, 11 Ref.

Descriptors: *Nonpoint pollution sources, *Soil erosion, *Design storms, *Rainfall intensity, Pollution load, Agricultural runoff, Model studies, Sediments, Computer models.

In assessing nonpoint source pollution, it is necessary to estimate erosion for individual storms since sediments themselves are pollutants and carry other chemical pollutants. The pollution hazard of many chemicals applied to agricultural lands is restricted to a short period immediately after application because most chemicals deteriorate rapidly. The first few runoff-producing storms after chemical applications are therefore much more important for assessing possible pollution damage than are later storms. Annual runoff calculations are almost meaningless for chemical pollutants. A method was developed which provides R values for individual storm events of any selected standard design frequency and duration for any of the four types of storms defined by the Soil Conservation Services, types I, IA, II, and IIA. A general equation was developed which relates maximum 30 minute intensity for storms of any duration and volume of total precipitation for each type of storm. A computer program incorporating the relationships allows one to quickly and easily determine the erosivity factor R for any type and design storm selected. The effects of types of storms on the erosion potential of any given site can also be easily determined. The method allows designers of conservation measures to determine the range of R values that might be encountered and the most critical combination of storm type and soil conditions. Managers in some areas may use the distribution of erosivity with time to minimize soil loss by proper adjustment of harvesting schedules. (See also W82-01401) (Moore-SRC)
W82-01403

SELECTING A FORMULA TO ESTIMATE SEDIMENT TRANSPORT CAPACITY IN NON-VEGETATED CHANNELS,
Science and Education Administration, Oxford, MS. Sedimentation Lab.
C. V. Alonso.
In: CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems, Conservation Research Report Number 25, May, 1980, p 426-439, 3 Tab, 39 Ref, 1 Append.

Descriptors: *Sediment transport, *Sediment-carrying capacity, *Mathematical studies, Forecasting, Hydraulic properties, Computer models, Channel flow.

Sediment transport formulas were investigated in order to select one or more to predict transport capacity of flows in nonvegetated graded channels. The selected formula should: be framed so that it is easy to apply in computer simulation; give the total load of bed material, knowing the hydraulic and geometric properties of the flow; and provide reliable estimates when applied to channels of any size in which sediment particles are transported by the fluid. Eight sediment transport theories were examined with reference to flume and field data. This comparison was based on 40 field measurements and 225 flume experiments. Characteristics of the data were analyzed in terms of four basic dimensionless parameters. The Yang formula was the most reliable over the entire data range. The formulas developed by Ackers and White, Engelund and Hansen, and Laursen, also were found reliable but gave relatively higher errors. Of all the tested formulas, therefore, only the Yang Formula can be used with confidence to predict sand-transport capacity over the range of flow conditions usually encountered in nonvegetated channels. (See also W82-01401) (Moore-SRC)
W82-01405

MODELING EROSION AND SEDIMENT YIELD FROM FLATLAND WATERSHEDS,
Science and Education Administration, Oxford, MS. Sedimentation Lab.
C. K. Mutchler, and C. E. Murphree.
In: CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems, Conservation Research Report Number 26, May, 1980. p 446-454, 13 Ref.

Descriptors: *Sediment yield, *Erosion rates, *Model studies, *Slopes, Soil erosion, Soil water, Outlets, Drainage, *Agricultural runoff, Storage, Surface water.

The differences in erosion between flatlands and the more sloping lands are dominated by the amount of protective water cover during storm events. This is caused by greater surface storage due to low slope, the bedding type of tillage required for seedbed drainage, higher water tables, generally restricted outlets, and low runoff gradients. The generally higher soil water content and high local slopes of bedding make soil detachment higher and more available for transport, however. A larger part of the sediment probably will originate from the field surface, and fines may be enriched because of lower runoff velocities. Factors of the USLE (Universal Soil Loss Equation) generally were derived using data from slopes exceeding 3% steepness. Few K-factor determinations have been made for flatland soils whose erodibility is affected by their higher soil moistures. Research has lowered the exponent of the slope-length factor for slopes of 0.2% to 0.15% and determined the probable validity of the slope steepness relationship. A few C-factor values have been determined that reflect the wetter flatland conditions and the unique tillage required for drainage. The depositional features of flatlands could be evaluated as sediment delivery ratios to reduce USLE soil loss estimates to sediment yield. Determining soil particle sizes in the USLE-predicted soil loss for determining sediment yield from flatlands is important because of high enrichment of the finer soil fractions in the sediment. (See also W82-01401) (Moore-SRC)
W82-01406

GULLY EROSION,
Science and Education Administration, Columbia, MO.
R. F. Piest, and E. H. Grissinger.
In: CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems, Conservation Research Report Number 26, May, 1980. p 455-462, 1 Fig, 17 Ref.

Descriptors: *Gully erosion, *Sediment erosion, *Water polluton sources, *Soil properties, Nonpoint pollution sources, surface runoff, Drainage area, Agricultural runoff.

Types and causes of gullying vary from region to region and are ill-defined in the quantitative sense. Therefore, gully erosion rates will not be estimated in the short-term erosion/sedimentation model. If gullying is significant in the sediment accounting of a drainage basin, the gully erosion rate is estimated. Typically, gully erosion rates are highly variable, and have been related to factors both intrinsic to the watershed, and super imposed thereon. Intrinsic factors can include profile adjustments in a drainageway and depth and erodibility of soils and subsoils along the flow boundary. Extrinsic factors include climatic and manmade disturbances. Quantitative information on gully erosion rates has resulted in some empirical prediction procedures, but the state of the art is presently inadequate to define causative processes. Beginning gully length and distance from gully heads to divide are dominant indicators of gully growth. Gully erosion is also related strongly to the size of the drainage basin. Various inadequately defined factors which influence the headward advance of gullies may be accounted for by using past gullying rates calculated from maps or aerial photos. A knowledge of the overall gully erosion problem of a region can help evaluate a given erosion hazard. (See also W82-01401) (Moore-SRC)
W82-01407

SEDIMENT TRANSPORT CAPACITY OF OVERLAND FLOW,
Science and Education Administration, Lafayette, IN.
W. H. Neibling, and G. R. Foster.
In: CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems, Conservation Research Report Number 26, May, 1980. p 463-473, 5 Fig, 4 Tab, 9 Ref.

Descriptors: *Overland flow, *Sediment transport, *Agricultural runoff, Model studies, Sediment yield, Slopes, Mathematical studies.

Sediment yield from many farm fields is limited by deposition on concave slopes. Deposition occurs when the sediment available for transport exceeds the transport capacity of the flow. Therefore, a relationship for sediment transport capacity of overland flow is a key component of a model designed to estimate sediment yield from agricultural fields. No widely accepted transport equations have been developed for overland flow, but streamflow sediment transport equations often are used. Several streamflow sediment transport equations were examined to determine how well each fit observed overland flow sediment transport data when the equations and their parameters were used directly, without modification or calibration. The equations considered in this analysis were Ackers-White, England-Hansen, Yang, Yalin, Meyer-Peter and Muller, and Bagnold. The Yalin equation can be used without modification to compute sediment transport capacities for overland flow. This equation gives reasonable results for the range of sediment sizes and densities characteristic of agricultural fields, in contrast to some equations that 'blow up' when extended to overland flow conditions. The Yalin equation is recommended for computing sediment transport capacity for both overland flow and concentration flow in channels and waterways on agricultural fields. (See also W82-01401) (Moore-SRC)
W82-01408

CONCENTRATED FLOW RELATIONSHIPS,
Science and Education Administration, Tucson, AZ. Southwest Rangeland Watershed Research Center.
L. J. Lane, and G. R. Foster.
In: CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems, Conservation Research Report Number 26, May, 1980. p 474-485, 4 Fig, 1 Tab, 4 Ref.

Descriptors: *Agricultural runoff, *Channel flow, *Shear stress, *Model studies, *Sediment transport, Channel erosion, flow rate, Temporal distribution, Mathematical studies, Rill erosion.

The concentrated flow relationships are limited to upland areas typical of farm-field situations. Representative situations include: erosion channel development in areas of fields where flow is concentrated; small channels as permanent features which normally are tilled over during cultivation; and temporary channels developing when rows or ter-

races overtop and flow proceeds cross-contour to the field edge. In this analysis, it is assumed that the peak rate is a characteristic discharge, and that the temporal distribution of shear stress in the channel is triangular. A series of regression equations was developed to estimate friction slope, and thus shear stress for spatially varied flow in triangular channels. These equations gave accurate approximations to friction slopes computed under a wide range of conditions. Once the friction slope is computed, the Yalin sediment transport equation and a critical shear stress equation are used to compute sediment transport, deposition, and detachment for open channel flow in field situations. These equations then are used to route sediment in erodible channels. A simplified channel morphology-sediment yield model was developed to estimate sediment yields and channel widths for channels in soil with a nonerodible boundary below the surface of the soil. In a rill erosion study, the simplified model produced excellent estimates of sediment yield with time, total sediment yield, and final width of the developed rills. (See also W82-01401) (Moore-SRC)
W82-01409

ENRICHMENT RATIOS FOR WATER QUALITY MODELING,
Science and Education Administration, Durant, OK. Water Quality Management Lab.
R. G. Menzel.
In: CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems, Conservation Research Report Number 26, May, 1980. p 486-492, 1 Fig, 2 Tab, 11 Ref.

Descriptors: *Soil erosion, *Soil chemistry, *Water pollution sources, *Nutrients, Agricultural runoff, Water quality, Nitrogen, Phosphorus, Model studies.

Eroded soil is usually richer in nutrients than the surface soil of the watershed from which the soil comes. This enrichment results from selective erosion of fine soil particles and organic residues. The degree of enrichment must be known to predict effects of soil erosion and erosion control on water quality. Degree of enrichment is expressed as an enrichment ratio, which is the concentration of nutrient in the eroded material divided by its concentration in the soil. Data from different soil and climatic areas were examined to detect possible effects of such factors as soil texture, cropping pattern, or runoff amount on the relationship between enrichment ratios and the amount of soil eroded. With few exceptions, the enrichment ratios for nitrogen and phosphorus in eroded soil decreased markedly with amount of soil eroded. A logarithmic relationship, ln (ER)=2-0.2 in (sed) where (sed) is kilograms per hectare of eroded soil in indvidual runoff events, appears to hold for a wide range of soil and vegetative conditions. Under these conditions, the enrichment ratio probably could be predicted within a factor of 2 for an annual average, and within a factor of 5 for individual runoff events. Terraced fields and sandy soils may not follow this relationship. Nitrogen enrichment changes more rapidly with sediment discharge than phosphorus enrichment. (See also W82-01401) (Moore-SRC)
W82-01410

UNSTEADY ONE-DIMENSIONAL SETTLING OF SUSPENDED SEDIMENT,
Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
S. Dhamotharan, J. S. Gulliver, and H. G. Stefan.
Water Resources Research, Vol 17, No 4, p 1125-1132, August, 1981. 9 Fig, 17 Ref.

Descriptors: *Suspended sediments, *Sediment deposition, *Settling velocity, Settling basins, Sediment transport, Reservoir silting, Lake sediments, Sedimentation, Turbulent flow, Sediment concentration, Model studies, Mathematical models, Trap efficiency.

To determine how sensitive vertical suspended sediment distributions are to other physical parameters, a numerical model to solve the one-dimensional, unsteady convective-diffusive transport equation was developed. It uses a fully implicit, exponential finite difference scheme and is unconditionally stable regardless of vertical diffusivities and particle fall velocities. A generic study of vertical suspended sediment profiles and sediment trap efficiencies produced results which cover Peclet numbers from zero to infinity. Peclet numbers may be represented by Vh/D, where V is the particle fall velocity, h is the water depth, and D is the mean vertical exchange coefficient. Since particle fall velocity and vertical exchange coefficient are frequently difficult to measure, this model provides a means of simulating the effects of varying these parameters on suspended sediment concentrations and trap efficiences. Where the Peclet numbers are greater than or equal to 20, sediment deposition occurs through downward frontal movement; when less than or equal to 0.2, through columnar precipitation. Residence time is a more important factor than turbulence in determining sediment deposition rate. The generic curves may be useful in design of settling basins and predicting storage loss and reduced water quality in lakes and reservoirs. (Cassar-FRC)
W82-01463

SEDIMENT AND NUTRIENT TRAP EFFICIENCY OF A SMALL FLOOD-DETENTION RESERVOIR,
Scientific and Education Administration, Columbia, MO. Watershed Research Unit.
For primary bibliographic entry see Field 4A.
W82-01471

MANAGEMENT CONCERNS FOR SWIMMING, TUBING, AND WADING IN THE GREAT SMOKY MOUNTAINS NATIONAL PARK,
Great Smoky Mountains National Park, Gatlinburg, TN. Uplands Field Research Lab.
For primary bibliographic entry see Field 6A.
W82-01475

RIVER BED AGGRADATION DUE TO OVERLOADING,
Iowa Univ., Iowa City. Div. of Energy.
S. C. Jain.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY1, p 120-124, January, 1981. 3 Fig, 4 Ref.

Descriptors: *Sediment transport, *Aggradation, *River beds, Degradation, Mathematical equations, Sediment load, *Missouri River.

Reliable quantitative estimates of the future rate and extent of long-term degradation and aggradation would be invaluable to river-management planning, especially along some reaches of the Missouri River. An analytical solution of the aggradation problem was developed, using a boundary condition which was more appropriate than the condition used in a recent analytical model. The boundary condition was based on the observation that the volume of sediment between the initial bed profile (t = 0) and the bed profile at time t must be equal to the volume of additional sediment supplied during this time. Use of the more appropriate boundary condition produces good agreement with experimental data. (Cassar-FRC)
W82-01486

THE EFFECT OF CHANGING SEDIMENT SUPPLY ON SEDIMENTATION IN A GLACIER-FED LAKE,
Illinois Univ. at Chicago Circle, Chicago. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2H.
W82-01510

SUSPENDED SEDIMENT PRODUCTION FROM FORESTED WATERSHEDS ON OAHU, HAWAII,
Pacific Southwest Forest and Range Experiment Station, Berkeley, CA.
R. D. Doty, H. B. Wood, and R. A. Merriam.
Water Resources Bulletin, Vol 17, No 3, p 399-405, June, 1981. 4 Fig, 4 Tab, 12 Ref.

Descriptors: *Watersheds, *Sediment discharge, *Suspended sediments, Water quality standards, Forested watersheds, Agricultural watersheds, Oahu, *Hawaii, Storm runoff, Standards.

Suspended sediments from four forested and two agricultural watersheds on Oahu were sampled for at least 5 years under a variety of storm conditions. Sediment loads were extremely variable among watersheds and within watersheds. Values of suspended sediment discharge in kg per sq km per year were: Kaliki, 20,000-123,000; Kipap, 124,000-617,000; Waikele, 15,000-443,000; Moanalua, 8,400-135,000; Kamoalil (first station), 2,900-721,000; and Kamoalii (second station), 31,900-112,400. Generally, more than 80% of the total suspended sediment was produced in 2% of the time. In a given storm the sediment levels rose rapidly and fell rapidly with time; peak levels were often reached within 2 hours. The great variability makes it difficult to establish effective water quality standards. (Cassar-FRC)
W82-01531

CHANGES IN SEDIMENT STORAGE IN THE COON CREEK BASIN, DRIFTLESS AREA, WISCONSIN, 1853 TO 1975,
California Univ., Los Angeles. Dept. of Geography.
S. W. Trimble.
Science, Vol 214, No 4517, p 181-183, October 9, 1981. 2 Fig, 12 Ref.

Descriptors: *Sediment yield, *Erosion, *Soil erosion, *Coon Creek, *Wisconsin, Sediment distribution, Sediment erosion, River basins, Flood plains, Alluvial plains.

A sediment budget for Coon Creek, Wisconsin, was determined for two periods, 1853-1938 and 1938-1975. The most significant pattern that has emerged from this study is that sediment yield has been small, changing little over the years, compared with either erosion or changes in sediment storage. Upland erosion was severely curtailed in the 1930's, and present sediments are coming from the stored alluvial deposits. Data suggests that sediment yield per unit area may begin to increase with basin size in agriculturally disturbed basins in humid regions, contrary to the widely held concept that sediment yield per unit area decreases with basin size. There are also strong suggestions that yield per unit area at a point in the system can change with time as a result of changes in sediment storage. The mobilization of stored sediment is significant because of pollutants adsorbed onto sediment particles.
W82-01563

2K. Chemical Processes

A COMBINED SALT TRANSPORT-CHEMICAL EQUILIBRIUM MODEL FOR CALCAREOUS AND CYPSIFEROUS SOILS,
Science and Education Administration, Kimberley, ID. Snake River Research Center.
For primary bibliographic entry see Field 5B.
W82-01230

FACTORS AFFECTING THE CHEMISTRY OF PRECIPITATION AND RIVER WATER IN AN UPLAND CATCHMENT,
Aberdeen Univ. (Scotland). Dept. of Soil Science.
J. M. Reid, D. A. MacLeod, and M. S. Cresser.
Journal of Hydrology, Vol 50, No 1/3, p 129-145, March, 1981. 6 Fig, 4 Tab, 21 Ref.

Descriptors: *Precipitation, *Rivers, *Water quality, *Chemical reactions, Water pollution sources, Rainfall, Chemical properties, Soil chemistry, Organic carbon, Glendye, *Scotland, Dye River, Factor analysis, Weathering, Nitrogen compounds, Air pollution, Mineralization, Calcium, Magnesium, Sodium, Potassium, Hydrogen ion concentration, Bicarbonates, Chlorides, Sulfates, Ammonium, Nitrates, Phosphates, Silicon, Iron, Manganese, Aluminum, *Chemistry of precipitation.

The chemistry of precipitation and river water was studied during October 1977 to September 1978 in a 41 sq km moorland catchment at Glendye, Scotland. Precipitation was very dilute (total mean ionic and organic matter, 10.43 mg per liter), weakly acidic (pH 4.33), and highly variable in composition. Compared to the precipitation, Dye River water contained more ionic and organic substances (mean total 39.456 mg per liter), was neutral (pH 6.45), and varied less in composition. Factor analysis suggested that three main processes controlled chemical composition of precipitation: aerosols of oceanic water (Na, Mg, Cl, and total organic carbon), emissions from industries and fossil fuel burning (pH), and windblown terrestrial dust. River water composition was affected by different processes: cation exchange and weathering in the soil (Ca, Mg, Na, bicarbonate, and Si), translocation of elements down the soil profile and into the river during high discharge (Fe, Mn, Al, and total organic carbon), and N demand and mineralization in the soil (ammonium and nitrate). K, Cl, sulfate, and phosphate all showed independent patterns of variation; ammonium and nitrate showed little correlation with discharge but marked seasonal variation. Analysis of river water during two storm events supported the results of the factor analysis, that is, the chemistry of river water is affected by soil processes, suggesting that nearly all the river water originates within the soil, with a minor amount from direct surface runoff. (Cassar-FRC)
W82-01322

RIVER BASIN HYDROSALINITY MODELING,
California Univ., Davis. Dept. of Land, Air and Water Resources.
K. K. Tanji.
Agricultural Water Management, Vol 4, No 1/3, p 207-225, 1981. 3 Fig, 1 Tab, 34 Ref.

Descriptors: *River basins, *Salinity, *Model studies, Australia, United States, Stream discharge, Salts, Solute transport, Groundwater movement, Salt balance, Pollution, Water quality, Computers, Irrigation pratices, Farming, Irrigation effects.

Representative hydrosalinity modeling efforts are reviewed as employed over the past two decades in the Western United States. The potential application of these efforts to the land-stream salinity problem facing Western Australia is investigated. One of the first model systems was the Woods and Orlob Lost River System Model, which combined water-quality data with computer-based modeling efforts. This first model dealt with pesticide residues that appeared to be killing water fowl. This model was followed by a second, which was designed to study low flow conditions in the Sacramento River system. The third major modeling effort was used to evaluate conditions of deteriorating water quality in the lower reaches of the San Joaquin River and their potential salinity impacts on irrigated agriculture. Model 4 was focused on salt balance in the groundwaters of the Upper Santa Ana River Basin, with some consideration on several surface water subsystems. Other models were developed to study the hydrology and total dissolved solids in the Upper Colorado River Basin, the simultaneous simulation of hydrology and salinity, simulation of flow and salinity in a stream/aquifer system in the Arkansas River system in Colorado, the total dissolved solids and nitrogen waste loadings from irrigated agriculture, and the environmental impact of irrigation projects. None of these models has strengths in modeling both water and salts for all three subsystems, soil, groundwater, and stream. It is suggested that, for Western Australia, a first-cut approximation be initially made with more simple models to obtain a fix on probable flow pathways and salt loading. (Baker-FRC)
W82-01469

OXIDATION OF SO2 IN AQUEOUS DROPLETS: MASS TRANSPORT LIMITATION IN LABORATORY STUDIES AND THE AMBIENT ATMOSPHERE,
Brookhaven National Lab., Upton, NY. Dept. of Energy and Environment.
J. E. Freiberg, and S. E. Schwartz.
Atmospheric Environment, Vol 15, No 7, p 1145-1154, 1981. 1 Fig, 2 Tab, 45 Ref.

Descriptors: *Sulfur compounds, *Oxidation, Water, Fluid drops, Water pollution sources, Chemical reactions, Clouds, Fog, *Atmosphere.

The influence of mass-transport limitation on the rate of oxidation of sulfur dioxide to sulfate in aqueous solutions is considered. The aqueous-phase oxidation of sulfur dioxide involves competition between mass transport and chemical reaction. Using the conceptual framework of Schwartz and Freiberg, treating mass transport limitation to the rate of oxidation of sulfur dioxide in aqueous droplets, two laboratory studies were undertaken. As a consequence of aqueous phase mass-transport limitation the reaction reported by Barrie and Georgii, in which the rate of sulfur uptake by suspended aqueous droplets of radius 0.105 cm was determined, may be from 20% to an order of magnitude smaller than the intrinsic rates. Significant gas-phase limitation may have been present as well. Since the high solubility of S (IV) in the presence of ammonia is evident, the contact times employed in the experiments of van den Heuvel and Mason were found to be insufficient for the equilibrium reagent concentration to have been established. Thus the rates derived by Scott and Hobbs from the data of that study are considerably smaller than the intrinsic rates. In a study of the mass transport limitation in relation to fogs and clouds, it appeared that this limitation is not appreciable under ordinary ambient conditions, but may be appreciable at very high oxidation rates, such as high ozone or hydrogen peroxide concentrations. (Baker-FRC)
W82-01470

THE RELEASE OF SOIL PHOSPHOROUS TO RUNOFF IN RELATION TO THE KINETICS OF DESORPTION,
Scientific and Educational Administration, Durant, OK. Southern Plains Watershed and Water Quality Lab.
For primary bibliographic entry see Field 5B.
W82-01477

HYDROCHEMICAL FACIES IN A TERTIARY BASIN IN THE MILLIGAN CANYON AREA, SOUTHWEST MONTANA,
Indiana Univ. at Bloomington. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W82-01481

GASEOUS NITROGEN AS EVIDENCE FOR DENITRIFICATION IN GROUNDWATER,
National Physical Research Lab., Pretoria (South Africa).
J. C. Vogel, A. S. Talma, and T. H. E. Heaton.
Journal of Hydrology, Vol 50, No 1/3, p 191-200, March, 1981. 4 Fig, 1 Tab, 25 Ref.

Descriptors: *Denitrification, *Nitrogen, *Confined aquifers, Groundwater, Nitrates, Argon, Dissolved oxygen, Oxygen, Anaerobic conditions, Aquifers, Microorganisms, Bacteria, *Kalahari Desert.

Very slow denitrification in a confined aquifer was demonstrated by measuring the nitrate, oxygen, and argon concentrations and the N15/N14 ratios in artesian groundwater. The study was conducted in the sparsely populated western Kalahari Desert, which has high concentrations of nitrate from natural sources (rain or bacterial nitrogen-fixing). The ages of the water samples, measured by C14 dating, range from 1300 years to 27,000 years, increasing progressively in a southeasterly direction. Both dissolved oxygen and nitrate decrease with increasing age of groundwater, the nitrate starting to decrease only after all oxygen has disappeared at about 13,000 years. The amount of excess N increases with age and with the decrease in nitrate. The calculated N isotope fractionation factor is comparable to that reported for bacterial cultures. (Cassar-FRC)
W82-01485

2L. Estuaries

LINEARIZED SOLUTION TO INLET EQUATION WITH INERTIA,
Coastal Engineering Research Center, Fort Belvoir, VA.
T. L. Walton, Jr., and F. F. Escoffier.
Journal of the Waterway, Port, Coastal and Ocean Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WW3, p 191-195, August, 1981. 2 Fig, 7 Ref.

Descriptors: *Estimating equations, *Tides, *Inlets, Tidal waters, Flow, Mathematical studies, Friction, Hydrologic aspects, Estuaries.

A solution method is described which employs a linearization technique of equating friction-work over the tidal cycle in a nonlinear approach to friction-work in a linear approach. It avoids the a priori assumptions of the form of bay tide. The method was first used in tidal computations of the Dutch delta works by Lorentz (1926) and was recently applied to inlet-bay problems by Van de Kreeke (1967). The equations are presented for the proposed solution to the hydraulic flow through inlets for simplified inlet-bay type systems. Graphical solutions of some equations are included. (Small-FRC)
W82-01183

EFFECT OF KEPONE ON ESTUARINE MICROBIAL ACTIVITY,
Maryland Univ., College Park. Dept. of Microbiology.
For primary bibliographic entry see Field 5C.
W82-01231

HOLLAND'S EASTERN SCHELDT ESTUARY BARRIER SCHEME: SOME ECOLOGICAL CONSIDERATIONS,
Shell Internationale Research Maatshcappij N.V., The Hague (Netherlands). Group Toxicology Div.
M. Smies, and A. H. L. Huiskes.
Ambio, Vol 10, No 4, p 158-165, 1981. 7 Fig, 35 Ref.

Descriptors: *Barriers, *Environmental effects, *Estuaries, *Flood protection, Planning, Flood control, Dams, Water properties, Sedimentation, Oxygen, Nutrients, *Netherlands, Zeeland.

The possible environmental consequences of construction and use of the Eastern Scheldt Barrier which is being built to protect Zeeland, The Netherlands, from flood waters, are discussed. The project includes the construction of a storm-surge barrier across the mouth of the estuary along with two secondary dams to separate the tidal basin of the Eastern Scheldt from the brackish-fresh water of the Rhine Scheldt shipping route. Turbulence and turbidity will decrease with decreasing mean tidal current velocities, and mean water residence time will increase. Chlorinity and nutrient concentrations depend on water residence time, so these values will be changing. There will probably be increases in net particulate carbon, which may result in increased sedimentation and resulting changes in depth. None of the effects of the barrier will be extreme. If the barrier should be completely closed for over a week, for example, to protect the estuaries from a tanker spill, problems may occur. The estuary may become anoxic, and severe ecological damage could result from lack of oxygen and flooding of the intertidal zone. (Small-FRC)
W82-01375

THE DISTRIBUTION OF MERCURY IN THE SEDIMENTS OF THE PLYM ESTUARY,
Plymouth Polytechnic (England). Dept. of Marine Science.
For primary bibliographic entry see Field 5B.
W82-01390

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

PERIODIC OPERATION FOR DESALINATION WITH THERMALLY REGENERABLE ION-EXCHANGE RESIN. DYNAMIC STUDIES,
Nagoya Univ. (Japan). Dept. of Chemical Engineering.
H. Matsuda, T. Yamamoto, S. Goto, and H. Teshima.
Separation Science and Technology, Vol 16, No 1, p 31-41, 1981. 8 Fig, 4 Ref.

Descriptors: *Desalination, *Ion exchange resins, Water treatment, Sirotherm process, Adsorption, Temperature effects.

A desalination process which uses a thermally regenerable ion exchange resin, Sirotherm TR-20, was studied to improve efficiency, i.e., to decrease the salt concentration in the cold reservoir as fast as possible. In this process, the resin in a basket is alternatively immersed in cold and hot reservoirs. It offers an inexpensive method of desalting low-salinity water where hot water is available in effluents from heat exchangers. A new periodic operation was suggested, on the basis of the observed dynamic behaviors, for the use of this resin. Adsorption isotherms at 10 and 70 C were of the Freundlich type. Surface diffusivity was dependent on the concentration of the liquid phase. Optimal adsorption time was 8 min when desorption time was 10 min. The cost of moving the basket must also be considered in relation to industrial application. (Cassar-FRC)
W82-01341

3B. Water Yield Improvement

MULTIFREQUENCY RADIOMETER DETECTION OF SUBMARINE FRESHWATER SOURCES ALONG THE PUERTO RICAN COASTLINE,
National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
H. J. C. Blume, B. M. Kendall, and J. C. Fedors.
Journal of Geophysical Research, Vol 86, No C6, p 5283-5291, June, 1981. 8 Fig, 4 Tab, 11 Ref.

Descriptors: *Radiometry, *Submarine springs, *Water supply, *Remote sensing, Microwaves, Springs, *Puerto Rico, Coastal aquifers, Coastal waters.

Submarine freshwater springs were detected along the Puertom Rican coast by remote sensing using the NASA Langley dual-frequency microwave radiometer system in conjunction with an infrared radiometer. The surface above fresh water is about 4 C cooler and 5% cooler in salinity than the surrounding sea water. The first flight on February 4, 1978, investigated 3/4 of the coastal area around the island, not including a portion of the northern coast. The February 6, 1978, flight concentrated on the northwestern coast where several submarine springs had been reported. Springs detected by the radiometer correlated well with reported spring locations. After separating runoff from rivers, lagoons, marshes, and bays, 44 submarine freshwater springs were located. More springs were found than had earlier been estimated. Most of the springs were in the northwest and southeast portions of the coastline. There was a 39% chance of success of finding the same springs on both missions. It is believed that a three-frequency system would reduce the effects of intervals between missions, tides, and winds, which could change locations and intensities of salinity and temperature and of the footprint fill factor. (Cassar-FRC)
W82-01349

3C. Use Of Water Of Impaired Quality

IRRIGATION MANAGEMENT OF COLORADO RIVER WATER WITH INCREASE IN SALINITY,
California Univ., Davis. Dept. of Land, Air and Water Resources.
F. E. Robinson, K. K. Tanji, J. N. Luthin, W. F. Lehman, and K. S. Mayberry.
Transactions of the ASAE, Vol 23, No 4, p 859-865, July/August, 1980. 1 Fig, 7 Tab, 25 Ref. OWRT-A-052-CAL(3).

Descriptors: *Sprinkler irrigation, *Irrigation effects, *Salinity, *Colorado River, Crop production, Crop yield, Agriculture, Saline soils, Leaching.

Steady increases in the salt concentration of the Colorado River at the Imperial Dam have raised concerns about the effects of increased salinity on agricultural productivity on lands irrigated with Colorado River water. Field studies designed to evaluate the effects of salinity increases on crop yields and soil salination involved application of artificially salinated water to crops on a clay and a sandy clay loam by sprinkler irrigation. Significantly lower yields of snap beans, carrots, and onions were produced on plots treated with water having a level of total dissolved solids (TDS) raised to 1,350 milligrams TDS per liter than on plots treated with Colorado River water, which has 875 milligrams TDS per liter. Alfalfa crops receiving the driest irrigation treatment (a ratio of irrigation to pan evaporation of 0.57) suffered significant production yield reductions after 2 years, during which salt accumulated faster than it was applied in the irrigation water. Similar increases in soil salinity were found with the intermediate irrigation treatment (ratio 0.67), but no significant reduction in alfalfa yield was experienced after 32 months. The wettest irrigation treatment (ratio 0.78) resulted in the highest yields and in less salt accumulation in the soil than was applied in the irrigation water, indicating partial leaching. These results indicate that a 50 percent increase in the salinity of the Colorado River system would have only minor effects on most crop yields. Use of the driest irrigation treatment with a 2-year leaching cycle would result in a savings of 34 centimeters of water per year in an alfalfa crop during a time of drought. The wettest irrigation treatment would be preferable when water supplies are adequate. (Carroll-FRC)
W82-01226

WATER RECLAMATION AND REUSE,
Alberta Univ., Edmonton.
S. E. Hrudev.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 751-767, June, 1981. 334 Ref.

Descriptors: *Water reuse, *Water renovation, *Literature review, Bibliographies, Irrigation, Agriculture, Industrial water, Health aspects.

A literature review is presented of publications on water reclamation and reuse published during 1980. Several reviews of current and recent water reclamation and reuse practices in the US, Japan, the Netherlands, and South Africa became available. Papers on water reuse planning and allocation considerations included an evaluation of a series of computer models for water reuse planning. On the topic of agriculture and irrigation, several NTIS bibliographies were published, and studies dealt with such topics as salinity problems associated with municipal and industrial effluent reuse. Several publications reported investigations of the long-term effects of land irrigation with municipal wastewater. Aquaculture and wetland systems received attention in publications including an engineering assessment of aquaculture wastewater systems. Water reuse for groundwater recharge was the topic of a California symposium and other papers. The reuse of industrial water was explored for the pulp and paper industry, the textile industry, and organic chemicals processing; petroleum, coal, and synthetic fuels processing; inorganic chemicals processing, steel mills, metal processing and finishing, recirculating cooling systems and power generation, and other miscellaneous processes. Domestic reuse remained controversial, and health aspects of reclamation and reuse were considered in papers dealing primarily with bacteria and viral pathogens. (Small-FRC)
W82-01252

LAND APPLICATION OF MUNICIPAL WASTEWATER,
Nielson, Maxwell and Wangsgard, Salt Lake City, UT.
For primary bibliographic entry see Field 5D.
W82-01253

A LOOK AT SOME WATER RECLAMATION PLANTS IN SOUTHERN AFRICA,
National Institute for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 5D.
W82-01352

EFFECT OF DIFFERENT LEVELS OF WATER SALINITY ON THE DECOMPOSITION OF ORGANIC MANURES IN A BRACKISH WATER FISH POND SOIL,
Central Inland Fisheries Research Inst., Barrackpore (India).
G. N. Chattopadhyay, and L. N. Mandal.
Hydrobiologia, Vol 72, No 3, p 287-292, July, 1980. 2 Fig, 4 Tab, 14 Ref.

Descriptors: *Salinity, *Fish ponds, *Manure, *Decomposition, Organic matter, Brackish water, Saline water, Nutrients, Nitrogen compounds, Nitrates, Dissolved oxygen, Carbon dioxide, Water quality, Animal wastes, Aquaculture, Organic carbon, Soils.

The rate of decomposition of cow dung (at 5% in soil samples) and poultry manure (at 1% in soil samples) was studied in waters of different salinities (0, 10, 20, and 30 ppt) under laboratory conditions. Application of the manures increased the free CO2 content in the water from 0 in the controls (water containing no manure) to 10.2-11.2 ppm with cow dung and 6.2-7.2 ppm with poultry manure. Dissolved oxygen levels in the control averaged 8.2 ppm; in the manured waters, 5.3-6.1 ppm. The pH values of soil and water declined slightly, about 0.05 to 0.2 units. The amount of nitrogen released from the organic manures to water and soil phases increased gradually with the period of incubation (100 days total) but decreased with increases in water salinity levels. Ammonium levels were always higher than nitrate levels because of anaerobic conditions. As decomposition proceeded, the amount of added organic carbon remaining in the soil decreased, but it increased slightly with increases in water salinity levels. These results suggest that in manuring of fish ponds consideration should be given to the salinity of the water, using well-decomposed manure for ponds with higher salinities. (Cassar-FRC)
W82-01363

NITROGEN BALANCES FOR AN EFFLUENT IRRIGATION AREA,
California Univ., Riverside. Dept. of Soil and Environmental Science.
L. J. Lund, A. L. Page, C. O. Nelson, and R. A. Elliott.
Journal of Environmental Quality, Vol 10, No 3, p 349-352, July-September, 1981. 4 Tab, 12 Ref.

Descriptors: *Nitrogen, *Land disposal, *Irrigation, Wastewater disposal, Impaired water use, Denitrification, Leaching, Ammonium Nitrates, Chlorides, Soil water, Soil solution, Soil-water-plant relationships.

The use of sewage effluent for irrigation in arid regions may result in substantial losses of nitrogen through the leaching of nitrate-nitrogen. Nitrate-nitrogen leaching and nitrogen balances for secondary sewage effluent irrigation systems in California were evaluated and compared with leaching

and nitrogen balances in surrounding plots irrigated with well water. Sampling of soils of the carralitos series (Typic Xeropsamment) at nine effluent irrigation plots showed that field water contents in the unsaturated zone below the root zone varied in space but not in time. Mean nitrate-nitrogen concentrations in the soil solution ranged from 15.4 to 32.4 milligrams per liter and varied significantly in both space and time, as did the mean concentrations of chlorides. Although leaching was found to be a significant process in the effluent irrigation system, it did not differ greatly from leaching in some of the surrounding agricultural fields. Calculation of nitrogen inputs and leaching volumes in conjunction with gaseous nitrogen losses for three of the nine plots studied showed that leaching was the dominant sink, accounting for between 51 and 76% of the applied nitrogen. Crop removal accounted for between about 20 and 40% of the applied nitrogen, while gaseous losses accounted for between 7 and 9% of the nitrogen. Denitrification losses were lower in the effluent-irrigated fields than in nearby agricultural fields. It is suggested that consideration be given to reducing the nitrogen loading rate as a means of reducing leaching losses of nitrogen. (Carroll-FRC)
W82-01478

VEGETATION SELECTION AND MANAGEMENT FOR OVERLAND FLOW SYSTEMS,
Cold Regions Research and Engineering Laboratory, Hanover, NH.
For primary bibliographic entry see Field 5E.
W82-01500

UTILIZATION EFFICIENCY OF NITROGEN FROM SEWAGE EFFLUENT AND FERTILIZER APPLIED TO CORN PLANTS GROWING IN A CLAY SOIL,
Volcani Inst. of Agricultural Research, Bet-Dagen (Israel).
A. Feigin, S. Feigenbaum, and H. Limoni.
Journal of Environmental Quality, Vol 10, No 3, p 284-287, July-September, 1981. 6 Tab, 18 Ref.

Descriptors: *Nitrogen, *Land disposal, *Wastewater treatment, Clays, Corn, Fertilizers, Comparison studies, Mineral water, Ammonium compounds, Nitrogen cycle, Nitrogen compounds, Impaired water use, Agriculture.

In order to achieve the efficient use of nitrogen in sewage effluents by crops, it is first necessary to have a basic understanding of nitrogen transformation in fields irrigated with this effluent. This study investigated the effect of irrigation with sewage effluent on the utilization by plants of the nitrogen in fertilizers and on nitrogen losses from the soil as well as the fate of ammonium nitrogen applied in the sewage effluent and its uptake by plants. Greenhouse experiments using nitrogen-15 as a tracer were used in this study. Ammonium-nitrogen was applied to corn grown in a clay soil in the form of a solid fertilizer, in sewage effluent, and in a mineral solution prepared to simulate the sewage effluent composition. There were no significant differences in the uptake of the ammonium sulfate-nitrogen applied as a solid fertilizer resulting from the type of irrigation water used (demineralized, sewage effluent or mineral solution). About 61 percent of the tagged ammonium-nitrogen applied as sewage effluent was taken up by the corn plants, while 14 percent was immobilized in the organic fraction of the soil. Losses of the tagged ammonium-nitrogen were about 24 percent for the sewage effluent and about 17 percent for the mineral solution. The availability of nitrogen from fertilizer incorporated into the soil prior to seeding or planting appears to be slightly greater than that of ammonium nitrogen applied in sewage effluents used for irrigation. Irrigation with sewage effluent did not affect the recovery of nitrogen applied as solid fertilizer. (Carroll-FRC)
W82-01515

TREATMENT OF SEWAGE PLANT EFFLUENT FOR USE AS MAKEUP WATER,
Burbank, CA.
W. Westbury, E. T. Allen, and J. E. Zoski.
Power Engineering, Vol 85, No 7, p 80-83, 1981. 7 Fig.

Descriptors: *Cooling towers, *Corrosion, Calcium, Phosphates, Wastewater, Water reuse, Fouling, Water treatment facilities, Burbank, California, Wastewater disposal, Effluents, Impaired water use.

A new water treatment system was used to solve the problem of deposits and corrosion in an electric powerplant cooling tower which had been caused by the sewage treatment plant effluent used in the cooling tower. The original plan to use sewage treatment plant effluent for cooling tower water in 1968 was economically motivated. The city paid a disposal fee to the city of Los Angeles for its sewage discharge, and Burbank also paid a fee for city water used as cooling tower makeup. Therefore, Burbank was able to save money on both aspects by using treatment plant effluent for cooling tower makeup. The savings amounted to $500 per million gallons of reused effluent. Over a period of time it was noticed that the efficiency of heat removal in the power plant condensers deteriorated, as indicated by an increasing difference between the condensate temperature and the condenser cooling water outlet temperature. Attempts to control condenser deposition were only partially successful. When the condensers were cleaned in June of 1979 a sample of the deposit was analyzed and shown to be primarily calcium phosphate, which came from the sewage effluent. During this time the plant used the terminal temperature difference (TTD) to monitor condenser efficiency. During the condensor fouling problems, the TTD twice reached 15 F. After the addition of a new agent to control calcium phosphate deposition, the TTD did not rise above 9 F, and the cooling system suffered no condenser fouling, even though the calcium concentration of the cooling water reached a maximum of 440 ppm and the phosphate reached 64 ppm. (Baker-FRC)
W82-01585

3D. Conservation In Domestic and Municipal Use

MANDATORY OR VOLUNTARY WATER CONSERVATION: A CASE STUDY OF IOWA COMMUNITIES DURING DROUGHT,
Iowa State Univ., Ames. Dept. of Sociology and Anthropology.
M. Y. Lee.
Journal of Soil and Water Conservation, Vol 36, No 4, p 231-234, July/August, 1981. 1 Tab, 1 Ref.

Descriptors: *Water conservation, *Water use efficiency, *Water shortage, Drought, Water distribution, User charges, *Iowa, Water policy, Policy making.

The effect of the drought of 1977 on 12 Iowa communities was evaluated by comparing mandatory and voluntary water conservation policies, the types of policy-making bodies involved, the rationales on which the water policies were based, and the effectiveness of the water conservation efforts. The communities all had severe water shortages, and all had the mayor-council form of government. Conservation policies were of two types: four communities adopted mandatory policies, while eight communities stayed with voluntary policies throughout the drought. Most communities adopted qualitative restrictions, mainly dealing with the outdoor use of water; the most widely adopted penalty was a high price for water use beyond the allowed quantity. Communities with mandatory policies rated their policies as more effective than did those with voluntary policies. An objective analysis also found these policies more effective. Policies with a quantitative restriction on a per capita basis achieved the highest degree of conservation. (Small-FRC)
W82-01553

3E. Conservation In Industry

OPTIMUM RECYCLE AND REUSE COOLING SYSTEM DESIGNS USING THE BCT PROCESS,
Tower Systems Inc., Tacoma, WA.
W. C. Sanderson, and R. L. Lancaster.
Industrial Water Engineering, Vol 18, No 3, p 24-30, May/June, 1981. 8 Fig, 7 Ref.

Descriptors: *Cooling towers, *Design criteria, Water treatment facilities, Wastewater treatment, Fouling, *Water reuse, *Industrial water.

Use of the Binary Cooling Tower (BCT) and the process associated with it serves to overcome the limitations on recycling of cooling water available in conventional cooling systems. BCT integrated cooling systems are able to concentrate cooling water wastes up to 150,000 mg/liter total dissolved solids. The plant cooling water is maintained at a solids level which is consistent with conventional cooling systems. The most common form of the BCT cooling process is a cooling system with a BCT and a conventional cooling tower operating in parallel. Blowdown from the conventional system is discharged offsite or to other disposal. This same blowdown in the BCT/tandem system flows into water treatment hardware similar to the raw water treatment system. Tandem cooling systems with a BCT and a conventional cooling tower will operate at a single steady state point with respect to water chemistry, providing the BCT makeup water is cooling tower blowdown. Cooling is shared between the primary cooling water loop and the BCT secondary loop. In cases where the BCT is integrated into cooling systems for the evaporative reduction of wastewater streams in addition to or in place of blowdown, the BCT design must be specified on the basis of annual water flows and evaporation characteristics. When the BCT is being considered for a total wet cooling application, it is designed to exactly the same parameters as a wet cooling tower. In total cooling applications the BCT has the additional operational flexibility of operating wet or dry. BCT integrated systems are also effective in reducing scaling, fouling, and corrosion in the circulating cooling water loop. Some costing information is provided. (Baker-FRC)
W82-01503

3F. Conservation In Agriculture

THE EFFECT OF SNOW TRAPPING AND CROPPING SEQUENCE ON MOISTURE CONSERVATION AND UTILIZATION IN WEST-CENTRAL SASKATCHEWAN,
Department of Agriculture, Swift Current (Saskatchewan). Experimental Farm.
K. J. Kirkland, and C. H. Keys.
Canadian Journal of Plant Science, Vol 61, No 2, p 241-246, April, 1981. 4 Tab, 10 Ref.

Descriptors: *Soil moisture, *Crop yield, *Saskatchewan, Soil moisture retention, Soil absorption capacity, Corn, Wheat, Moisture availability, Available water, Water conservation, Snow, *Snow traps.

The effectiveness of snow trapping methods for conserving moisture for wheat production was investigated. The efficiency of fallow-wheat, fallow-wheat-wheat and continuous wheat in converting annual precipitation into grain production was compared. The results demonstrated that the most effective means of retaining snow for soil moisture storage was to leave standing stubble as in the fallow-wheat-wheat rotation and continuous wheat. Snow ridging on fallow and sunflower trap strips did not significantly increase moisture reserves as compared to bare fallow. Widely spaced corn rows in rotation did increase moisture reserves to levels comparable to those achieved by standing stubble in the continuous wheat rotations. All rotations containing a fallow treatment, with the exception of row-crop fallow, had significantly higher moisture reserves available for the crop seeded on fallow than was available for those crops seeded on stubble in the more extended rotations. Continuous wheat produced higher grain yields and used the available soil moisture to produce more per year than either the fallow-wheat or the fallow-wheat-wheat rotations. (Baker-FRC)
W82-01117

A COMPARISON OF CHEMICAL AND CULTURAL CONTROL OF WEEDS IN IRRIGATION DITCHBANKS,
Regina Research Station (Saskatchewan).
For primary bibliographic entry see Field 4A.
W82-01120

IRRIGATION MANAGEMENT OF COLORADO RIVER WATER WITH INCREASE IN SALINITY,
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 3C.
W82-01226

IRRIGATION NEEDS AND YIELD OF RICE ON A SANDY-LOAM SOIL AS AFFECTED BY CONTINUOUS AND INTERMITTENT SUBMERGENCE,
Punjab Agricultural Univ., Ludhiana (India).
B. S. Sandhu, K. L. Khera, S.S. Prihar, and B. Singh.
Indian Journal of Agricultural Sciences, Vol 50, No 6, p 494-496, June, 1980. 4 Tab.

Descriptors: *Irrigation efficiency, *Rice, *Crop yield, Crop production, Irrigation practices, Irrigation requirements, Agriculture, Loam, *India, Seepage loss, *Soil-water-plant relationships.

A practical irrigation schedule was developed for rice that would reduce the irrigation requirement but not the yield. Continuous submergence and irrigation at 1, 3, 5, and 7 days was practiced on rice on a sandy loam. Continuous submergence and irrigations a day after infiltration of ponded water gave comparable grain yields. As the interval between infiltration and irrigation increased, the yield declined. Water requirements were highest with continuous submergence (170 to 204 cm), and percolation losses were large (301 to 483% of evapotranspiration). With 1-day drainage the percolation losses decreased by 32 to 57 cm and with 5-day drainage by 80 to 108 cm. Thus, once transplanted seedlings are established, irrigation can be delayed for some period after infiltration of ponded water. The safe limit of the drainage period depends on the weather. There is a potential savings of 20 to 50% in irrigation water, primarily because of the reduction in seepage losses due to the rapid decline in soil permeability with increasing saturation. (Small-FRC)
W82-01382

INPUT AND OUTPUT CONSTRAINTS AFFECTING IRRIGATION DEVELOPMENT,
Michigan Univ., Ann Arbor. School of Natural Resources.
For primary bibliographic entry see Field 6B.
W82-01476

TRICKLE IRRIGATION LATERAL DESIGN ON SLOPING FIELDS,
Louisiana State Univ., Baton Rouge. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 8C.
W82-01537

CHARACTERIZING SPRINKLER DISTRIBUTION PATTERNS WITH A CLUSTERING ALGORITHM,
Rain Bird Western Sales Corp., Glendora, CA.
K. Solomon, and J. C. Bezdek.
Transactions of the ASAE, Vol 23, No 4, p 899-902, 906, July/August, 1980. 2 Fig, 2 Tab, 7 Ref.

Descriptors: *Sprinklers, *Mathematical studies, *Distribution patterns, Algorithms, *Irrigation efficiency, Performance evaluation.

The distribution pattern for a sprinkler, which is affected by the nozzle combination, operating pressure, and the sprinkler model, gives the water application rate as a function of radial distance from the sprinkler. Prior experience or test data may be used to estimate the distribution pattern shape of a given sprinkler, nozzle, and pressure combination. A method for determining the characteristic curve shapes representative of a sprinkler's performance was developed and applied to test data for the Rain Bird 103 Rain Gun sprinkler. The three stages comprising this method are: normalization of the distribution pattern test data, application of the K-Means clustering algorithm to the normalized pattern shapes, and analysis of the resulting cluster membership lists to determine the nozzle size and pressure situations for which each of the prototypical pattern shapes is found valid. The application rate and distance aspects of the distribution test data are converted to dimensionless forms by the distribution pattern normalization process. The resulting vectors, therefore, are quantitative expressions of pattern shape alone. Application of the K-Means clustering algorithm to analysis of a typical gun-type sprinkler indicates that it is an effective and easily implemented method for determining appropriate sprinkler pattern shapes to represent the performance of a sprinkler. This analysis resulted in the identification of three prototype pattern shapes which summarized 42 tests covering 38 combinations of nozzle size, pressure, and trajectory angle. Use of the algorithm reduces the amount of information needed to indicate a sprinkler's performance and permits estimation of distribution pattern data for untested conditions. (Carroll-FRC)
W82-01575

SIGNIFICANT FEATURES OF EMITTER FLUSHING MODE CHARACTERISTICS,
Rain Bird Western Sales Corp., Glendora, CA.
K. Solomon, and J. C. Bezdek.
Transactions of the ASAE, Vol 23, No 4, p 903-906, July/August, 1980. 6 Fig, 1 Tab, 4 Ref.

Descriptors: *Simulation analysis, *Trickle irrigation, *Flushing, *Irrigation engineering, Irrigation design, Simulation, Mathematical studies, Flow channels, Water pressure, Energy, Hydraulics, Flow discharge, Flow control, Fluid mechanics.

Many trickle irrigation systems include automatic flushing emission devices. These emitters have flow channels which allow maximum flow at some pressure which is less than normal operating pressure in order to flush the emitter once during startup and once during shutdown. A simulation model is used to investigate the influence of the shape of an automatic flushing emitter's pressure-discharge curve on the hydraulic behavior of trickle laterals using such emitters. The proposed quantitative formulation of the pressure-discharge relation for typical automatic flushing emitters uses easily obtainable parameters with obvious physical significance. The significant features of flushing emitter pressure-discharge relationships are identified using trickle lateral line simulations based on hypothetical emitter curves. The height and shape of the flushing peak are important features. Lateral line hydraulic requirements were not affected by shifting the pressure at which peak emitter flushing flow occurred, but were negatively affected by increasing the pressure at which the emitters entered the normal emission mode. A trade-off must be made in the selection or design of flushing trickle emitters between the effectiveness of an emitter's flushing action and the potentially excessive flow rate requirements caused by the flushing mode for the system as a whole. While a large, wide flushing spike on an emitter's pressure discharge curve improves flushing effectiveness, it also increases the system flow rate and horsepower requirements. (Carroll-FRC)
W82-01576

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

A COMPARISON OF CHEMICAL AND CULTURAL CONTROL OF WEEDS IN IRRIGATION DITCHBANKS,
Regina Research Station (Saskatchewan).
R. Grover, A. E. Smith, and H. C. Korven.
Canadian Journal of Plant Science, Vol 60, No 1, p 185-195, January, a980. 2 Fig, 6 Tab, 13 Ref.

Descriptors: *Agricultural chemicals, *Irrigation canals, Irrigation design, Irrigation ditches, Leaching, Percolation, Paraquat, Herbicides, Amitrole, Dalapon, *Weed control, Water pollution sources.

Weed control in a series of irrigation ditches was attempted by the use of various herbicidal treatments and cultural methods. The ditches were similar in design to farmer head ditches. Atrazine (22.4 kg/ha), bromacil (15.2 kg/ha), monuron (38.5 kg/ha) and simazine (22.4 kg/ha) were applied during September of 1970 and reapplied during September of 1973. Paraquat (2.2 kg/ha), dalapon plus amitrole-T (11.2 + 2.2 kg/ha), paraquat plus diquat (1.1 + 1.1 kg/ha) as well as chlorflurenol (3.6 kg/ha) were applied annually each June from 1971 through 1976. Sowing was undertaken in 1971 on ditch bottoms and sides with streambank wheatgrass, sheep fescue, Russian wild ryegrass and dwart timothy. Good control of ditch weeds was obtained from 1973-76, with simazine and atrazine giving superior results to monuron and bromacil. The transport of these herbicides in the initial water flush and their leaching into the soil profile were demonstrated to be real hazards for contamination. Trace amounts of amitrole and dalapon were noted in the irrigation water immediately after herbicidal treatment. Maximum hazards from chemical contamination of the irrigation waters, both from the sterilants and the selected foliar herbicides, were found in the initial ponding of the treated ditches. In subsequent irrigations, the residue levels decreased rapidly, confirming that chemical treatments, especially with soil sterilants, may be dependent on the disposal of the initial flush as waste water, either to selected sites as catchment areas or its diversionary disposal into a drain or waste canal to be dissipated by further dilution. (Baker-FRC)
W82-01120

COMBINATION SURFACE-SUBSURFACE DRAINAGE SYSTEMS FOR HUMID REGIONS,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
R. W. Skaggs.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 106, No IR4, p 265-283, December, 1980. 13 Fig, 5 Tab, 22 Ref. OWRT-A-086-NC(6), 14-34-0001-7070.

Descriptors: *Crop production, *Drainage systems, Surface drainage, Subsurface drainage, Corn, *Humid areas, Mathematical models, Water management.

Alternative combinations of surface-subsurface drainage systems were evaluated for corn production at three locations: Columbus, Ohio; Wilmington, North Carolina; and Jacksonville, Florida. Evaluations were conducted for 60 combinations of drain depth and spacing on four separate soils at each location, and attempts were made to relate the results to simpler methods for drainage design. A water management model, DRAINMOD, was used to simulate corn production over a period of at least 25 years. The number of working days during the one-month period before seedbed preparation and SEW30 values during the growing season were predicted. Relationships were determined between the number of working days and the time required for water table drawdown from the surface to a 0.5 m depth, and between SEW30 and the time required for the water table drawdown to a 0.2 m depth. These may provide useful guidelines for first estimates of drainage designs. (Small-FRC)
W82-01228

SEDIMENT OXYGEN DEMAND AND ITS EFFECT ON DISSOLVED OXYGEN IN A CUTOFF MEANDER OF THE KASKASKIA RIVER,
Bradley Univ., Peoria, IL. Dept. of Biology.
B. J. Mathis, and T. A. Butts.

Water Resources Center, University of Illinois, Urbana. Research Report No 162, July, 1981. 40 p, 15 Tab, 8 Fig, 59 Ref, 4 Append. S-072-ILL.

Descriptors: *Dissolved oxygen, *Oxygen demand, *Channeling, Cutoffs, Meanders, *Lotic environment, Fluvial sediments, Oxygen depletion, *Sediments, Oxbow Lakes, Rivers, Channel improvement, Stagnant water, *Kaskaskia River, Illinois.

When a river or stream is channelized, channel modification not only destroys habitat and changes numerous environmental parameters but also alters meanders that have been left behind. In the Kaskaskia River, initial expectations were that cutoff meanders remaining after channelization could provide nurseries for fish and other aquatic organisms. The objectives of this investigation were to (1) evaluate the effects of channelization on dissolved oxygen and sediment oxygen demand in a cutoff meander of a major river; (2) assess habitat potential for fish in relationship to dissolved oxygen during summer months; and (3) evaluate and propose, if feasible, an alternative method of connecting cutoff meanders to the main stream of a river in future channelization projects. When stagnant or no-flow conditions prevailed, anoxic conditions created by sediment oxygen demand were observed in a significant part of the water in the meander. When no-flow conditions prevailed during the summer months, as much as 25 percent of the water in the meander became anoxic, while 65 percent fell below 5.0 mg/l. Sediment oxygen demand rates were more closely related to temperature than to sediment consistency or benthic macroinvertebrate numbers. Ambient sediment oxygen demand measured during the summer was almost three times greater than demand measured during the fall. While sediment oxygen demand in the channelized portion of the river was higher than in some stations in the meander, reaeration resulting from flowing water in the channel was sufficient to prevent anoxic conditions from developing. (Garrison-Omniplan)
W82-01448

SEDIMENT AND NUTRIENT TRAP EFFICIENCY OF A SMALL FLOOD-DETENTION RESERVOIR,
Scientific and Education Administration, Columbia, MO. Watershed Research Unit.
D. L. Rausch, and J. D. Schreiber.
Journal of Environmental Quality, Vol 10, No 3, p 288-293, July-September, 1981. 3 Fig, 2 Tab, 23 Ref.

Descriptors: *Detention reservoirs, *Nutrients, *Sedimentation, Suspended solids, Reservoirs, Flood-control storage, Storm runoff, *Trap efficiency, Sediment yield, Phosphorus, Nitrogen, *Callahan Reservoir, Missouri.

The Callahan Reservoir, a small flood-detention reservoir in central Missouri, was studied over a three year period to determine the sediment and nutrient trap efficiency and to identify factors affecting trap efficiencies. The Callahan Reservoir, which stores 1 centimeter of runoff from its 1,460 hectare drainage area, was found to remove significant amounts of sediment and nutrients from the runoff. The reservoir trapped an average of 85 percent of the incoming sediment, 77 percent of the total sediment phosphorus, and 37 percent of the inorganic nitrogen. Most of the sediment leaving the reservoir was clay. The trapping of sediment and sediment phosphorus during individual storms was related to the concentration of sediment in the runoff. The trapping of phosphorus was influenced by the concentrations of solution and sediment phosphorus. The average trap efficiency was slightly less for nitrate (40 percent) than for orthophosphorus (43 percent). Trap efficiencies for these two nutrients were not related to sediment deposition and could not be predicted on a storm basis by using hydrologic variables. Dissolved organic and hydrolyzable phosphorus had greater outflow than inflow concentrations, which could have been due to biological activity in the reservoir. These results indicate that detention reservoirs can be used as a 'best management practice' to improve water quality downstream from an agricultural watershed. However, the trap efficiencies of these reservoirs may decrease as the reservoirs fill with sediment. (Carroll-FRC)
W82-01471

WATER MANAGEMENT MODEL EVALUATION FOR NORTH CENTRAL OHIO,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
R. W. Skaggs, N. R. Fausey, and B. H. Nolte.
Transactions of the ASAE, Vol 24, No 4, p 922-928, July/August, 1981. 12 Fig, 5 Tab, 17 Ref.

Descriptors: *Water management, *Model studies, DRAINMOD, Resources management, Groundwater management, Water supply, Drainage patterns, Drainage, Drainage water, Artificial drainage, Soil water, *Ohio.

The application of the water management model, DRAINMOD, for an artificially drained soil in North Central Ohio was investigated. DRAINMOD is a computer simulation model for describing the performance of a drainage system on a continuous basis. The model predicts on a day-to-day, hour-to-hour basis the water table position, soil water content, drainage, evapotranspiration and surface runoff in terms of given climatological data, soil and crop properties and design parameters for the water management system to be used. The predominant soil type at the experimental site is Toledo silty clay. Tile and surface flow data were recorded continuously for the growing season each year of the study. Excess irrigation water was applied twice each year in May, June, or July to provide a repeatable 10-year return period storm. Drain flow data for the 8 years were used in this analysis, as the same crop, corn, was grown during these years. Predicted surface runoff and subsurface drainage volumes using DRAINMOD were in good agreement with measured values for all three drainage treatments. Comparisons of measured and predicted relationships showed that the times of occurrence of surface runoff and subsurface drainage events were predicted accurately in almost all cases. While there were some deviations in the magnitude of predicted and measured volumes for individual drainage events, they were usually small and, in most cases, were about the same magnitude as the differences between replications. (Baker-FRC)
W82-01536

IMPACT OF MANAGEMENT PRACTICES ON THE TALLGRASS PRAIRIE,
Colorado State Univ., Fort Collins. Natural Resource Ecology Lab.
W. J. Parton, and P. G. Risser.
Oecologia, Vol 46, No 2, p 223-234, 1980. 5 Fig, 3 Tab, 43 Ref.

Descriptors: *Mathematical models, *Prairies, *Range management, Grasslands, Farm management, Irrigation effects, Nitrogen, Phosphorus, Cattle, Agriculture, Ecology.

The ELM model, which simulates the flow of water, heat, nitrogen, and phosphorus through an ecosystem and the biomass dynamics of plants, consumers, and decomposers, was adapted to a tallgrass prairie site. Range management practices were evaluated, including: altering the grazing intensity, grazing system, and grazing time; addition of nitrogen and phosphorus to the grassland; effects of irrigation; and the effects of spring burning of the prairie. The simulations matched observed data fairly well. The model successfully represented the effects of range manipulations upon primary production, water flow variables, and nutrient cycling, but was less accurate in representing the impact of some range manipulations upon cattle weight gains. A moderately-stocked year-round cow-calf grazing system was more beneficial to the grassland than a highly stocked seasonal steer grazing system, as the cow-calf scheme increased above ground and below ground primary production and plant nutrient uptake. The addition of fertilizer was the best way to increase cattle weight gain. (Small-FRC)
W82-01580

HYDROPOWER--AN OLD TECHNOLOGY FOR A NEW ERA,
Worldwatch Inst., Washington, DC.
D. Deudney.
Environment, Vol 23, No 7 p 16-20, 37-45, September, 1981. 1 Fig, 1 Tab, 77 Ref.

Descriptors: *Hydroelectric power, *Water resources development, *Dams, Reservoirs, Environmental effects, Rural areas, Ecological effects, Energy sources, River basin development, Aluminum, International agreements, *Developing countries, *China, Social aspects, Economic aspects, Political aspects, Irrigation, Erosion, Agriculture, Fisheries, Public health.

Hydropower technology has been available since Roman times. Political and social conditions have affected its use, which decreased in periods of plentiful, cheap labor and increased with the industrial revolution and the 1973 oil shock. Many of the small dams abandoned in the era of cheap oil are being retrofitted, and the Middle Ages technique of fastening waterwheels to floating river barges is being resurrected. Total world hydropower, currently 3,207 trillion watt-hours per year, could realistically expand to 4 to 6 times that amount, considering environmental and economic constraints. Africa taps only 5% of its hydropower potential, while Norway receives 99% of its electricity and 50% of its energy from water. Switzerland exports electricity, and Nepal and Peru have this potential. The largest existing dam, Itiapu, in Brazil-Paraguay, has a 12,600 MW capacity, but this is dwarfed by proposed dams on the Yangtze River, China (25,000 MW) and the Amazon River, Brazil (66,000 MW). Ecological damage can occur--waterborne disease transmission, silting, erosion, inundation of prime agricultural land, soil salinization, soil waterlogging, fisheries destruction, and loss of unique plant and animal species. For undeveloped countries small projects can often provide needed power without the disruptions produced by the large dams. China's policy of building small projects to complement large dams is a model for developing nations. Since the untapped water resources are largely in uninhabited areas, an eventual shift of wealth, population, power, and employment to areas with abundant hydropower production can be expected. (Cassar-FRC)
W82-01593

4B. Groundwater Management

ARTIFICIAL GROUNDWATER RECHARGE,
Water Research Centre, Marlow (England).
J. B. Joseph.
Water Services, Vol 85, No 1024, p 303-304, 307-308, June, 1981. 5 Fig.

Descriptors: *Groundwater recharge, *Artificial recharge, *Underground waste disposal, *Land disposal, Wastewater treatment, Injection wells, Wastewater disposal, Water quality, *Great Britain.

Artificial groundwater recharge is used in Britain for the disposal and reclamation of wastewater. Surface spreading or injection through wells and boreholes can be used. A typical surface spreading scheme capable of recharging 45 M liters/day will require 1.5 to 2 ha of land. While boreholes require less land, they require large scale drilling equipment and complex technology and operation. Chemical as well as physical problems can occur during recharge. Reaction can lead to a deterioration in water quality and clogging or collapse of the aquifer. One advantage of artificial recharge is that a system for resource augmentation can be constructed in phases whose financing and size can be adjusted to meet changes in the demand growth pattern. For example, phase I of the Lea Valley scheme has a yield of 60 M liters/day and was designed and constructed in three years. Water is available for recharge at a marginal cost, typically 25 British Pounds Sterling/M liter. The standard cost for treated water is about 130 British Pounds Sterling. Artificial recharge can also be used for the prevention or reversal of saline intrusion. (Small-FRC)
W82-01110

COST EFFECTIVE GROUND WATER MONITORING,
R. L. Zook.
Ground Water Age, Vol 15, No 9, p 29-31, May, 1981. 3 Fig.

Descriptors: *Groundwater management, *Monitoring, *Costs, Economic aspects, Design criteria, Water management, Management decisions.

Ground Water monitoring systems can be adequate in size and still be cost effective. Cost effective ground water monitoring systems can be designed through low overhead rates, minimum field and laboratory programs to gain maximum data at the lowest possible cost without sacrificing quality, practical designs and solutions, sound management, and adequate communications with the client. Innovations in design and system size should be accompanied by innovation in material types and installation methods and extensive knowledge of materials, technologies, and methods for evaluating an adequate number of alternatives. The major factor that determines which type of multiple setup is installed is how the well system is installed. It is critical to the success of the multiple setup that leakage does not occur between the monitors in the system. Another important factor affecting the cost of multiple setups is whether the aquifer is in bedrock or soil. To obtain overall cost effectiveness, it is necessary that the initial site investigation be cost effective. It is also necessary that an adequate amount of time as well as money be spent in developing the system. (Baker-FRC)
W82-01113

RESULTS OF ACIDIZING WATER WELLS IN ARIZONA,
Hargis and Montgomery, Inc., Tucson, AZ.
D. R. Hargis, and C. A. McCauley.
Water Resources Bulletin, Vol 17, No 3, p 494-497, June, 1981. 2 Fig, 3 Tab, 4 Ref.

Descriptors: *Acidizing, *Well yield, *Water yield, Hydrochloric acid, Aquifers, Confined aquifers, Unconfined aquifers, Carbonate aquifers, Well capacity, Pumping tests, Costs, Groundwater mining, Drawdown, Arizona, Water harvesting, *Arizona, *Groundwater management.

Acidizing is a procedure used to increase production from water wells, and generally consists of placing a nontoxic acid solution in contact with the water bearing formation to dissolve out part of the stratum. Acidizing of sample wells in Arizona was beneficial for wells producing more than 500 gallons per min and marginal for those producing less than that amount. Sample wells for Wellfield No. 1, penetrating the unconfined Coconino Sandstone aquifer, and Wellfield No. 2, penetrating the confined composite Kaibab Limestone-Coconino Sandstone aquifer, were used to collect drawdown data before and after acidizing. Each well was acidized with different amounts of 15% hydrochloric acid according to borehole size and aquifer thickness. Acidizing improved the specific capacity of the Wellfield No. 1 well by 50% at pumping rates of 200-500 gallons per min and of the Wellfield No. 2 well by 100% at pumping rates of 1250-2200 gallons per min. Acidizing reduced the pumping costs in Wellfield No. 1 by 1% at 195 gallons per min to 11% at 500 gallons per min, and in Wellfield No. 2, by 6% at 1250 gallons per min to 11% at 2200 gallons per min. (Cassar-FRC)
W82-01199

POTENTIAL USE OF A STREAM-AQUIFER MODEL FOR MANAGEMENT OF A RIVER BASIN: CASE OF THE SOUTH PLATTE RIVER IN COLORADO,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W82-01301

THERMAL ENERGY STORAGE IN A CONFINED AQUIFER: SECOND CYCLE,
Auburn Univ., AL. Dept. of Civil Engineering.
F. J. Molz, A. D. Parr, and P. F. Andersen.
Water Resources Research, Vol 17, No 3, p 641-645, June, 1981. 10 Fig, 10 Ref.

Descriptors: *Geothermal studies, *Aquifer management, *Energy storage, Subsidence, Groundwater management, Auburn University, *Thermal water, *Injection wells, Wells, Confined aquifers, Water storage.

The second 6-month injection-storage-production cycle of the Auburn University Aquifer Thermal Energy Storage Project, beginning with injection on September 23, 1978, was performed in a similar manner to the first cycle which started March 18, 1978. Water, pumped from an upper supply aquifer and heated to 55 C with an oil-fired boiler, was injected into a deeper storage aquifer, ambient temperature 20 C. By November 25, 1978, 58,010 cu meters of water had been injected. After a 63 day storage period ending January 27, 1979, hot water production began with a initial temperature of 54 C. By March 23 the temperature had dropped to 33 C, and 66,400 cu meters of water and 76% of the injected thermal energy had been recovered. Production ended April 20, at which time 100,100 cu meters of water and 89% of the injected thermal energy had been recovered; the final temperature was 27.5 C. The second cycle differed from the first in the following aspects: (1) well clogging experienced during the first cycle was reduced by regular backwashing (8 times), and the average injection rate increased by 24%, (2) longer production period, 64 days vs. 41 days, and (3) 76% of energy was recovered vs. 66% at the same drop in production temperature to 33 C. During injection the surface elevation near the well rose 4 mm, fell during storage, and continued to fall during production to 0-2 mm above the initial elevation. This movement was caused by thermal expansion and contraction and not by head changes in the storage aquifer. (Cassar-FRC)
W82-01473

EXTRACTION TIMING AND ECONOMIC INCENTIVES FOR GEOTHERMAL RESERVOIR MANAGEMENT,
Woodward-Clyde Consultants, San Francisco, CA.
K. Golabi.
Journal of Environmental Economics and Management, Vol 8, No 2, p 156-174, June, 1981. 3 Fig, 2 Tab, 11 Ref.

Descriptors: *Geothermal resources, *Conservation, Water conservation, Resources development, Natural resources, *Cost analysis, Economic aspects, Costs.

A model is presented to consider various methods of extraction for a hot water geothermal reservoir, with emphasis on the optimal time to begin extraction. One major objective was to demonstrate how a profit-maximizing firm can determine an optimal extraction plan for a liquid-dominated reservoir, including an investigation of the sensitivity of the decision variables to such parameters as the perceived rate of growth of the value of energy, discount rate, royalties, and the penalties that can be imposed by regulatory agencies for delaying extraction. Of equal importance is the objective of providing public sector resource trustees and regulatory agencies with a model of entrepreneurial activity that can be used to study the effect of various incentives and penalties on the timing and extraction rate of geothermal resources. In the model presented, the economic life of the reservoir can go beyond breakthrough time, with the production of steam continuing until either it is not economical or it is not technically feasible to do so. It is assumed that the brine is extracted from the aquifer, and cycled through heat exchangers where the heat energy is extracted to generate steam, and the cooled brine is reinjected into the aquifer. The economic inducements studied include pre-exploitation rents and penalties and royalties. The substantial variation of starting time with penalty and royalty suggest that these kinds of economic incentives could motivate a profit-maximizing entrepreneur to accelerate or postpone production. However, if the entrepreneur's alternative rate of return is high enough, these inducements will have little effect. The optimal pumping rate decreases as royalty increases. Thus royalty can be considered an effective means for conservation. As royalty is increased, exploitation time is deferred and, when production begins, it is undertaken at a slower rate. (Baker-FRC)
W82-01504

DISCUSSION-ENGINEERING GEOLOGY OF ARID AREAS,
Water and Power Resources Service, Sacramento, CA.
N. P. Prokopovich.
Bulletin of the Association of Engineering Geologists, Vol 17, No 2, p 95-99, Spring, 1980. 1 Fig.

Descriptors: *Arid-zone hydrology, *Water resources development, Deserts, Arid lands, Arid zone, Semiarid lands, Arid climates, *Groundwater, Irrigation, Leaching, Capillarity, Water supply development.

It is anticipated that areas presently viewed as deserts will, in the future, be valuable as agricultural areas, dependable source areas for solar energy, and mining and recreational-residence areas. Imported water will be a necessary item. Extensive pumpage of local ground water for irrigation can create an overdraft of groundwaters in any climatic zone, but is most likely to do so in arid or semiarid climates. Such overdrafts will lead in some cases to land subsidence, which could interfere with deliveries of surface water to areas of demand by canals. Groundwater development is generally less expensive than construction of a long conveyance import system, and probably will precede such construction. Another cause of subsidence is an increase in weight of dry sediments due to wetting with irrigation water, and corresponding compaction of unconsolidated underlying sediments. Irrigation can also lead to a buildup of shallow groundwater bodies, resulting in slope instability and a change in chemistry of groundwaters and soils. Leaching of salts would be an obvious result of importing relatively pure water into a desert. Leaching may cause loss of strength of originally hard-cemented rocks and may lead to slope failures and land sliding. The salts may eventually move and accumulate in depressions, resulting in local concentrations of salts. Drainage problems and disposal of drain water are critical in arid regions. There are no standard patterns for geologic investigations in deserts. Each project must be treated individually. (Baker-FRC)
W82-01568

4C. Effects On Water Of Man's Non-Water Activities

WATER QUALITY FROM TWO SMALL FORESTED WATERSHEDS IN SOUTHERN ILLINOIS,
Illinois Univ. at Urbana-Champaign. Dept. of Forestry.
R. J. Brozka, G. L. Rolfe, and L. E. Arnold.
Water Resources Bulletin, Vol 17, No 3, p 443-447, June, 1981. 1 Fig, 4 Tab, 25 Ref.

Descriptors: *Water quality, *Forest watersheds, *Nutrient removal, Forest hydrology, Intermittent streams, Watersheds, Streamflow, *Illinois, Nitrates, Phosphorus, Water yield, Logging.

Intermittent streams in two similar, forested watersheds in Illinois were monitored for flow volume and water quality during 1977-79 to establish a baseline prior to clearcutting one watershed in November 1979. Dominant species in both stands were oak and hickory. Annual flow varied widely between years and between watersheds. Although water quality was high in both watersheds there were significant differences between watersheds in Na+, Mg(2+), K+, Ca(2+), and nitrate; P showed no difference between watersheds. The most pronounced seasonal trend was in nitrate levels, which rose during the dormant season, peaked in February-March, and declined during the growing season. (Cassar-FRC)
W82-01140

EFFECTS OF LOGGING ON MACROINVERTEBRATES IN STREAMS WITH AND WITHOUT BUFFER STRIPS,
California Univ., Berkeley. Dept. of Forestry and Conservation.
For primary bibliographic entry see Field 5C.
W82-01227

STORM FLOW RESPONSE TO ROAD BUILDING AND PARTIAL CUTTING IN SMALL STREAMS OF NORTHERN CALIFORNIA,
Pacific Southwest Forest and Range Experiment Station, Arcata, CA.
R. R. Ziemer.
Water Resources Research, Vol 17, No 4, p 907-917, August, 1981. 7 Fig, 7 Tab, 19 Ref.

Descriptors: Flood peak, *Logging, *Road construction, Streamflow, Forest management, *Casper Creek, *California, Runoff, Evapotranspiration, Forest watersheds, *Storm runoff, Hydrographs, Peak discharge.

A total of 174 paired storm hydrographs from two sections of the Casper Creek watershed in northern California were analyzed. Selective cutting (67% removal) and tractor yarding (15% of land surface for roads, etc.) of a 85-year-old second growth redwood and Douglas fir forest in the South Fork of the watershed did not significantly change large peak streamflows as compared with the North Fork control area. The South Fork mean peak discharge was only 4% larger than that of the North Fork. However, early fall storms produced a 300% increase in peak discharge because evapotranspiration had ceased at the end of the growing season. These storms were all small and produced minor peaks. During the late fall and winter after recharge of soil moisture, both parts of the watershed had similar peak discharges. The most significant variable explaining the difference between the logged and unlogged watersheds was the annual storm number divided by the amount of watershed logged. (Cassar-FRC)
W82-01295

ESTIMATION OF IMPERVIOUS-AREA WASHOFF PARAMETERS,
Geological Survey, Reston, VA.
W. M. Alley.
Water Resources Research, Vol. 17, No 4, p 1161-1166, August, 1981. 4 Fig, 1 Tab, 12 Ref.

Descriptors: *Impervious surfaces, *Urban runoff, *Water quality, Florida, Rainfall-runoff relationships, Model studies, Urban watersheds, Rainfall intensity, Runoff, Water pollution sources.

The exponential washoff equation, commonly used in models for rainfall runoff water quality in urban areas, is often modified by an availability factor to account for the effects of runoff intensity on pollutant washoff. This study showed that, overall, the inclusion of the availability factor did not significantly improve results. However, techniques for determining the optimum values of coefficients used in these equations have been demonstrated. These procedures were applied to a 6 ha urban watershed in south Florida, where the optimized parameter values vary widely between different storms and between different constituents. (Cassar-FRC)
W82-01465

ANOMALOUS SNOWFALL CAUSED BY NATURAL-DRAFT COOLING TOWERS,
Rand Corp., Santa Monica, CA.
For primary bibliographic entry see Field 2B.
W82-01512

4D. Watershed Protection

ECONOMIC IMPACTS OF EROSION AND SEDIMENTATION CONTROL PLANS: CASE STUDIES OF PENNSYLVANIA DAIRY FARMS,
Cornell Univ., Ithaca, NY. Dept. of Agricultural Economics.
G. B. White, and E. J. Partenheimer.
Journal of Soil and Water Conservation, Vol 35, No 2, p 76-78, March/April, 1980. 4 Tab, 8 Ref.

Descriptors: *Soil conservation, *Farming, *Erosion control, Conservation, *Dairy industry, Pennsylvania, Economic aspects, Profit, Income, Sedimentation, Soil management, Legal aspects, Regulations, *Case studies.

Analyses of 12 Pennsylvania dairy farms using linear programming models showed that implementation of the state's Clean Streams Law, which requires erosion and sedimentation control, would reduce net income on 10 of the farms. The greatest anticipated income reduction was 29%. Six farms had income reductions of 6-29%. Average costs for implementing the plans were $6,420 (range $705-$14,128) without cost sharing and an average of $2,522 with cost sharing. Greatest damage to income was produced by unprofitable crop rotation (any reduction in corn silage decreased farm income). The most efficient conservation practice for all 12 farms was no-till corn. Other helpful measures were rotation changes and cover crops. This analysis suggests a flexible approach with respect to soil loss limits. Present maximum allowable soil losses, 2-4 tons per acre, may be too restrictive in some cases. The goal should be a significant reduction in soil loss rather than an absolute limit. (Cassar-FRC)
W82-01134

ANALYSIS OF NATIONAL WATER POLLUTION CONTROL POLICIES 2. AGRICULTURAL SEDIMENT CONTROL,
Resources for the Future, Inc., Washington, DC.
For primary bibliographic entry see Field 6A.
W82-01293

RESIDUE AND TILLAGE EFFECTS ON SCS RUNOFF CURVE NUMBERS,
Science and Education Administration, Beltsville, MD.
W. J. Rawls, C. A. Onstad, and H. H. Richardson.
In: CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems, Conservation Research Report Number 26, May 1980, p. 405-425, 5 Fig, 7 Tab, 21 Ref, 1 Append.

Descriptors: *Conservation tillage, *Agricultural runoff, *Runoff rates, Rainfall-runoff relationships, Model studies, *Erosion control.

The effects of conservation tillage on reducing direct runoff ranges from slight to substantial. Soil Conservation Service (SCS) procedures used today for estimating runoff do not consider the effects of conservation tillage and no-till practices on runoff. To develop the SCS runoff curve numbers for these practices, tillage and crop data were assembled from small watersheds and plots under natural and simulated rainfall from many locations across the country. The residue left on the ground was chosen as the independent variable to represent the effects of conservation tillage practices. These data were studied to determine runoff curve numbers for single and double cropping systems under various conservation tillage practices. There are not enough data to derive an equation for predicting how conservation tillage affects runoff. Data compiled from plots and small watersheds under simulated and natural rainfall for 531 events were used, however, to develop graphs that can be used as practical guides to estimate the decrease in SCS runoff curve numbers due to a certain amount of residue on the ground or a certain percentage of the surface covered with residue. Separate guides were developed for corn and for such medium-residue crops as wheat, oats, sorghum, and soybeans. (See also W82-01401) (Moore-SRC)
W82-01404

SOIL CONSERVATION PROBLEMS AND PRACTICES: A FARMER VIEW.
Journal of Soil and Water Conservation, Vol 36, No 4, p 186-193, July/August, 1981.

Descriptors: *Soil erosion, *Erosion control, *Farming, Agriculture, Soil erosion, Salinity, Soil compaction, Wind erosion, Agricultural engineering, Farm management.

Seven prominent farmers and ranchers discussed the severity of soil erosion, voluntary vs. mandatory erosion control programs, and the prospects for the adoption of conservation tillage. Problems the farmers were experiencing included water and wind erosion, soil compaction, salinity, and absentee landlords. Changes noted during these farmers' careers included trends toward more machines and less help, more sophisticated irrigation practices, and the extensive use of chemical fertilizers. Conservation practices in use included terracing, minimum tillage, sprinklers and drip irrigation, residue management, and chisel plowing. Conservation tillage, including stubble-mulch tillage and chemical weed control were being practiced in most areas. Government action to require conservation tillage was viewed as a controversial topic. The benefits of conservation tillage were agreed upon by all farmers interviewed. (Small-FRC)
W82-01551

EROSION AND SEDIMENTATION CONTROL IN REGIONAL AND SITE PLANNING,
Pennsylvania State Univ., University Park. Dept. of Landscape Architecture.
B. K. Ferguson.
Journal of Soil and Water Conservation, Vol 36, No 4, p 199-204, July/August, 1981. 13 Fig, 1 Tab, 40 Ref.

Descriptors: *Erosion control, *Sediment control, *Regional development, Planning, Site selection, Environmental effects, Construction, Land use, Vegetation, Land management, Land cover.

Methods available to regional and site planners for minimizing erosion and sedimentation on construction sites are summarized. Illustrations of small hypothetical sites are included. The methods include: land use compression, or getting the same amount of development within a smaller land area; land use distribution, which involves putting the compressed development on the most suitable portion of the site; and facility orientation and adaptation, which involves fitting roads and buildings into a site by shaping and orientation. Also, land grading can be used, which involves shaping the land around the developed facilities, and vegetation and land cover can be used to control erosion. After construction, diversions and chutes can help divert water flows, and land covers can be useful. Preconstruction planning is the most effective means of controlling erosion and sedimentation. (Small-FRC)
W82-01552

SOIL EROSION CONTROL IN IDAHO'S COW CREEK WATERSHED: AN ECONOMIC ANALYSIS,
Idaho Wheat Growers Association, Boise.
S. H. Berglund, and E. L. Michalson.
Journal of Soil and Water Conservation, Vol 36, No 3, p 158-161, May/June, 1981. 4 Tab, 12 Ref.

Descriptors: *Erosion control, *Soil erosion, *Economic aspects, *Farm management, Watershed management, Cost analysis, Fallowing, Precipitation, Sedimentation, Soil management, Crop yield, Crop production.

Precipitation, topography and soil treatment factors make erosion a persistent problem on agricultural land in northern Idaho's Cow Creek watershed. A five point program involving cross-slope farming divided slope farming, minimum tillage, treating critical erosion areas, and restricting summer fallow was proposed to control the erosion problems of this watershed and was evaluated economically. Average costs of the program would range from $5 to $9/acre, depending on the crop rotation system used. High costs occur when income is foregone by planting less profitable crops, higher production costs are incurred and/or yields are reduced. Of the five points proposed to control erosion, treating critical areas would be the most costly, amounting to over 50% of the total program's projected expense. The rest of the costs are divided nearly equally among divided-slope

and contour farming and minimum tillage, with negligible costs being incurred by restricted summer fallow. Since continuous cropping rotation is more profitable to Cow Creek farmers, summer fallow is only used in cases of severe drought or weed infestation. (Geiger-FRC)
W82-01556

MANAGING LAND TO MEET WATER QUALITY GOALS,
Economics and Statistics Service, Washington, DC. Natural Resource Economics Div.
C. Osteen, W. D. Seitz, and J. B. Stall.
Journal of Soil and Water Conservation, Vol 36, No 3, p 138-141, May/June, 1981. 18 Ref.

Descriptors: *Water management, *Water resources development, *Watershed models, *Erosion control, *Management planning, Land management, Watershed management, Water use, Water quality management, Soil conservation, Soil erosion, Model studies.

Under Section 208 of Public Law 92-500, provisions are made for land management to control soil erosion by traditional methods. This approach is termed source control. A second approach, water-based land management (WBLM), relates the choice of land management practices and their locations to water use and water quality goals. The applications of the WBLM are discussed. The implementation of WBLM may be more difficult on the institutional level than 208 plans in agricultural areas. Under a WBLM plan, nonlandowners may be excluded from decisions in which they feel they have an interest. To allow nonlandowners to vote on WBLM motions, changes may have to be made in state soil conservation district laws. The availability of analytical tools and information will affect the WBLM planning process. Physical process models should estimate water quality parameters in conjunction with land management plans. The use of WBLM for controlling washloads and bedlods in agricultural watersheds is considered. Three sediment movement models, ANSWERS, ARM and CREAMS, which may be used in WBLM programs are described. Linear prgramming models used to manage land used for agricultural activities in a watershed should not be impossible to integrate into a WBLM plan. Other factors in integrating models into WBLM systems are discussed. The long range benefits of WBLM planning should justify the extra costs and efforts involved in its implementation. (Geiger-FRC)
W82-01557

DEBRIS FLOWS IN SMALL MOUNTAIN STREAM CHANNELS OF COLORADO AND THEIR HYDROLOGIC IMPLICATIONS,
Denver Univ., CO. Dept., of Geography.
For primary bibliographic entry see Field 2E.
W82-01597

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

A SIMPLE LOW COST APPARATUS FOR CONDITIONING LARGE VOLUMES OF WATER FOR VIROLOGICAL ANALYSIS,
Institut Armand-Frappier, Laval (Quebec). Centre de Recherche en Virologie.
P. Payment, and M. Trudel.
Canadian Journal of Microbiology, Vol 26, No 4, p 548-550, 1980. 1 Fig, 1 Tab, 5 Ref.

Descriptors: *Viruses, *Water analysis, *Sampling, Measuring instruments, Microbiological studies, Filtration, Adsorption, Separation techniques, Laboratory equipment.

A Simple low cost proportioning injector is described which can effectively add chemicals such as aluminum chloride, hydrochloric acid, and sodium thiosulfate, to condition large volumes of water to detect viruses by adsorption to selected filters. This system can function at about one-tenth the cost of the bulky hydraulic proportioner. Its use should simplify the virological analysis of water, particularly for laboratories with limited funds and facilities. When drinking water is to be conditioned, two injectors are connected in-line, one for hydrochloric acid and aluminum chloride, and a second one to add sodium thiosulfate to neutralize residual chlorine. (Baker-FRC)
W82-01123

PERSISTENCE OF PSEUDOMONAS AERUGINOSA IN CHLORINATED SWIMMING POOLS,
Toronto Univ. (Ontario). Dept. of Microbiology and Parasitology.
P. L. Seyfried, and D. J. Fraser.
Canadian Journal of Microbiology, Vol 26, No 3, p 350-355, 1980. 1 Fig, 4 Tab, 22 Ref.

Descriptors: *Swimming pools, *Bacteria, *Chlorination, Chlorine, Recreation facilities, Disinfection, Acidity, Water treatment, Pseudomonas aeruginosa, Coliforms.

A study was conducted to determine the effect of the pool bather load, free chlorine residual, and pH on the incidence of Pseudomonas aeruginosa in swimming pools and to investigate the survival of specific P. aeruginosa serotypes and phage types in a chlorinated pool environment. A total of 179 Toronto and Peterborough swimming pools were sampled between May and September of 1974. The pool types included 18 above and below ground private pools as well as 59 public outdoor and 102 public indoor pools. Surface and subsurface samples were collected. Out of 266 water samples taken in 1974, P. aeruginosa was detected in 8 (21%) of the 38 private pool samples, 4 (3%) of the 124 public indoor pool samples, and 7 (7%) of the 104 public outdoor pool samples. A 36% increase in surface water counts was found compared with subsurface levels. The pH of samples ranged from 6.9 to 7.8 and the water temperature was between 22 and 32.5 degrees C. Bather load at time of sampling ranged from 0 to 25 swimmers, with the exception of one day when 120 bathers were present. The highest P. aeruginosa estimate of 2400 CFU/ml was recorded in a pool water with a bather load of 10, a temperature of 31 degrees C, and a free chlorine residual of 0.0 mg/liter. P. aeruginosa was not found in 146 samples from pools with a free chlorine level greater than 0.4 mg/liter. This study confirms other reports suggesting that single strains predominate when high counts of P. aeruginosa occur in pool waters. (Baker-FRC)
W82-01124

USE OF EXCISED ROOT CULTURES AS BIOINDICATORS OF WATER POLLUTION (UTILISATION DES CULTURES DE RACINES ISOLEES COMME TEST BIOLOGIQUE DE POLLUTION DES EAUX),
Paris Univ. (France).
M. Richez, A. Kovoor, and R. Heller.
Environmental Pollution (Series A), Vol 22, No 1, p 1-10, May, 1980. 1 Fig, 7 Tab, 4 Ref.

Descriptors: *Water analysis, *Plant tissues, *Bioindicators, *Pollutant identification, Water pollution effects, Rivers, Tomatoes, Root development, Cultures, Sein River, Marne River, *France.

Excised roots from the tomato, Lycopersicon esculentum, or other plants highly sensitive to pollutants and capable of rapid growth in vitro, can be used as bioindicators for early detection of freshwater pollution. The test consists of 2 parts: (1) 10 days of in vitro culture in the water sample with added nutrients, and (2) 48 hours exposure in sterilized dialysis bags in the river itself, followed by 8 days immersion in running water in the laboratory. Root growth is compared with controls at the end of the test period. In one test, length of tomato roots was 78 mm in distilled water, 96 mm in 2.5% river water (Marne), and 44 mm in 80% river water. In similar tests with water from the River Seine, the control roots were 87 mm long; in 25-100% river water roots were 26-30 mm. (Cassar-FRC)
W82-01133

PETROLEUM HYDROCARBONS IN SEDIMENTS OF SAGINAW BAY, LAKE HURON,
Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
P. A. Meyers, N. Takeuchi, and J. A. Robbins.
Journal of Great Lakes Research, Vol 6, No 4, p 315-320, 1980. 3 Fig, 20 Ref.

Descriptors: *Oil pollution, *Lake sediments, Pollutant identification, Lakes, Sediments, Organic compounds, Hydrocarbons, *Saginaw Bay, *Lake Huron.

A 60 cm sediment core from Saginaw Bay was analyzed to produce a profile of petroleum contamination over the last 200 years. Aliphatic hydrocarbons averaged 385 micrograms per g in modern sediments and gradually decreased to 30 micrograms per g in sediments deposited before 1976. An unresolved complex mixture of hydrocarbons indicative of petroleum comprised 90% of the total concentration in all core sections deposited over the last 100 years. Although some of these nonbiogenic hydrocarbons may originate from natural sources, such as forest fires and erosion of ancient sediments, it is conservatively estimated that 20,000 to 40,000 tons of petroleum have been deposited in Saginaw Bay in the last 100 years. (Cassar-FRC)
W82-01141

ABUNDANCE OF ORGANIC COMPOUNDS IN WATER,
Illinois Environmental Protection Agency, Springfield.
D. J. Schaeffer, and K. G. Janardan.
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 2, p 211-216, 1980. 1 Tab, 8 Ref.

Descriptors: *Organic compounds, *Water pollution, *Toxicity, *Industrial wastes, *Waste identification, Statistical methods, Pollution load, Pollutants, Environmental effects, Probabilistic process, Mathematical studies, Probability distribution, Frequency distribution, Marking techniques.

A data base for organic compounds in water was established by Shackelford and Keith. In this data base 1,258 compounds appearing in 5,720 observations on 33 water types were tabulated. A total of 175 lists which give the identities and frequencies of occurrence of organic compounds were compiled. Such data constitute the type of information which will be obtained by broad-based monitoring programs. A theoretical model was developed for analyzing the data to provide information applicable to specific compounds. The probability function governing the appearance of a compound on merged lists is identical to the Generalized Geometrical Distribution. According to this calculation, there is only a 14% chance of a specific compound being found in a given list. The maximum number of times a given compound could be expected to appear on several lists is 6. If a given compound appears more frequently than this, it suggests that its absolute rate of occurrence and detection is greater than anticipated. The low frequency of occurrence makes it unlikely that inferential procedures will be developed based on decreased frequencies of observation. The data bases may be analyzed in subsets such as finished drinking waters or specific industrial categories, and relevant estimates may be obtained to guide the collection and interpretation of new data. (Titus-FRC)
W82-01162

ALTERATIONS IN THE BOD PROCEDURE FOR THE 15TH EDITION OF 'STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER',
Iowa State Univ., Ames. Dept. of Civil Engineering.
J. C. Young, G. N. McDermott, and D. Jenkins.
Journal of the Water Pollution Control Federation, Vol 53, No 7, p 1253-1259, July, 1981. 12 Ref.

Descriptors: *Biochemical oxygen demand, *Standards, *Water quality, Sample preparation, Water analysis, Dissolved oxygen, Nitrification, Wastewater.

Additions to and changes in the biochemical oxygen demand test procedure in the 15th edition of Standard Methods are described. The major changes are in sections dealing with immediate dissolved oxygen demand, sample storage, dilution water quality check, nitrification inhibition, seeding, and use of standards as a check on technique. The reasons for the modifications are also discussed. The changes will improve the utility and understanding of BOD analysis. In this edition, no provision for the separate measurement of immediate dissolved oxygen demand is made, and the maximum storage time for a sample was reset to six hours. On the topic of dilution water quality, the dilution water dissolved oxygen uptake after 5 days of incubation at 20 deg C must not exceed 0.2 mg/liter and should not exceed 0.1 mg/liter. A test for nitrification inhibitions was included because of the problems that nitrification in BOD test causes in interpreting plant performance and stream load impact. (Small-FRC)
W82-01186

ORGANOCHLORINE INSECTICIDES AND PCB IN SURFICIAL SEDIMENTS OF LAKE MICHIGAN (1975),
Ontario Ministry of Agriculture and Food, Guelph. Pesticide Residue Lab.
R. Frank, R. L. Thomas, H. E. Braun, D. L. Gross, and T. T. Davies.
Journal of Great Lakes Research, Vol 7, No 1, p 42-50, 1981. 6 Fig, 3 Tab, 18 Ref.

Descriptors: *Chemical wastes, Lakes, *Lake Michigan, *Insecticides, DDT, Chlordane, Endrin, Heptachlor epoxide, HEOD, Mirex, Polychlorinated biphenyls, Sediments, Lake sediments, Great Lakes.

Attempts were made to map the concentration of organochlorine insecticides and PCBs in the upper 3 cm of the bottom sediments in Lake Michigan in order to establish base levels and identify sources to enable future trends to be assessed. Samples of Lake Michigan sediment were collected using a Shipek bottom sampler. Analyses of 286 surficial sediments revealed the presence of DDT, its metabolites DDE and TDE, HEOD, chlordane, heptachlor epoxide (HE), and polychlorinated biphenysl (PCB), but no detectable residues of endrin, endosulfan, methoxychlor or mirex. The mean residue of total DDT for bottom sediments of the whole lake was 11.9 mg/g. The highest mean residue of total DDT occurred in the Milwaukee basin, at 40.79 ng/g, with the metabolites representing about 80% of the total DDT concentration. HEOD was identified and measured in 48.3% of sediments taken from the lake bottom, with 42.0% having residues between 0.1 and 1.0 ng/g. The highest mean residue occurred in the Waukegan basin. Chlordane was identified in 21.6% of the samples, with a calculated mean residue for the whole lake of about 0.37 ng/g. Highest residues occurred in the Grand Haven and Sarian basins. Heptachlor epoxide was identified in 53.9% of the samples, with the mean residue level being 0.67 ng/g. Ninety of the 286 samples (31.5%) contained no residues of the three cyclodienes, HEOD, chlordane, or heptachlor epoxide. PCBs were found in 79.6% of samples, with 67.4% of them containing 2 to 20 ng/g levels. Sixty-two sediments were analyzed for mirex, with no residues being found to a level of 0.2 ng/g. No residues of endosulfan, its sulfate, endrin, or methoxychlor were detected to a limit of 0.2 ng/g. (Baker-FRC)
W82-01190

MONITORING LEACHATE IN GROUND WATER BY CORRECTED RESISTIVITY METHODS,
Wisconsin-Milwaukee Univ. Dept. of Geological Sciences.
W. F. Kean, and R. B. Rogers.
Bulletin of the Association of Engineering Geologists, Vol 18, No 1, p 101-107, 1981. 7 Fig, 1 Tab, 10 Ref. OWRT-A-077-WISC(3).

Descriptors: *Resistivity, *Leachates, *Monitoring, Fly ash, *Path of pollutants, Leacing, Contamination, Groundwater pollution, Sampling, Electrical properties, Water quality, Waste disposal, Landfills, Measuring instruments, *Pollutant identification.

Seasonal variations in temperature from 2 to 18 C affected surface electrical resistivity readings at a landfill site, where fly ash leachate movement was monitored. Therefore, laboratory determinations were made of resistivity of samples from well borings in the study area as a function of temperature, saturation, and salinity. A Wenner electrode configuration with 1 inch electrode spacing was used to measure resistivity. After correction, the surface resistivity measurements positively identified the leachate movement. (Cassar-FRC)
W82-01219

GEOLOGIC AND HYDROLOGIC FACTORS CONTROLLING RADON-222 IN GROUND WATER IN MAINE,
Maine Univ. at Orono. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W82-01222

DETERMINATION OF LABILITIES OF SOLUBLE TRACE METAL SPECIES IN AQUEOUS ENVIRONMENTAL SAMPLES BY ANODIC STRIPPING VOLTAMMETRY AND CHELEX COLUMN AND BATCH METHODS,
State Univ. of New York at Binghamton. Lab. for Trace Methods and Environmental Analysis.
P. Figura, and B. McDuffie.
Analytical Chemistry, Vol 52, No 9, p 1433-1439, August, 1980. 4 Fig, 4 Tab, 29 Ref. OWRT-B-070-NY(2).

Descriptors: *Water analysis, *Trace metals, *Heavy metals, Chemical analysis, Rivers, Pollution load, Chemical properties.

The development and application of a method for differentiating trace metal species on the basis of relative lability is presented. The method developed for solutions of Cd, Cu, Pb, and Zn utilized anodic stripping voltammetry and Ca-Chelex resin in successive column and batch procedures. By using a characteristic time scale for the measuring technique, species were classified as 'very labile', 'moderately labile', 'slowly labile', or 'inert'. For species in each category, a range of dissociation rate constants can be estimated. A precise determination can be made at the ppb and sub-ppb levels using preconcentration of the various fractions. Applications include samples from the St. Lawrence River, Susquehanna River, a Hudson River Estuary, and secondary sewage effluent. In general, Zn and Cd were in the 'very' or 'moderately' fractions, Cu was in the 'moderately' fraction, and Pb was 'slowly labile' or 'inert'. This method can be used to yield detailed information on the various chemical forms of soluble trace metals in polluted or unpolluted waters. (Small-FRC)
W82-01229

TENAX-GC EXTRACTION TECHNIQUE FOR RESIDUAL POLYCHLORINATED BIPHENYL AND POLYAROMATIC HYDROCARBON ANALYSIS IN BIODEGRADATION ASSAYS,
Tennessee Univ., Knoxville. Dept. of Microbiology.
M. P. Shiaris, T. W. Sherrill, and G. S. Sayler.
Applied and Environmental Microbiology, Vol 39, No 1, p 165-171, January, 1980. 1 Fig, 6 Tab, 16 Ref. OWRT-B-040-TENN(2).

Descriptors: *Biodegradation, *Surface water, *Hydrocarbons, Assay, Bioassay, Chlorinated hydrocarbons, Biphenyls, Phenanthrene, Aroclor 1254.

The usefulness of Tenax-GC as an extraction polymer for biodegradation samples was evaluated. The factors affecting the efficient recovery of both PAH and PCB were determined. The method was quantitatively efficient and reproducible for phenanthrene, but variable and not quantitative for Aroclor 1254. Aqueous sample volumes and varying concentrations of organic matter influenced polychlorinated biphenyl and polyaromatic hydrocarbon extraction efficiency. Phenanthrene recovery was decreased by soil extract but unaffected by spent bacteriological culture medium. Both types of organic matter caused significant reduction of Aroclor 1254 recovery. Polyaromatic hydrocarbon and polychlorinated biphenyl biodegradation assays, performed with reservoir samples, supported the laboratory evaluation. This study demonstrated the utility of the Tenax-GC extraction technique for phenanthrene analysis in biodegradation assessment. However, Tenax-GC extraction was not appropriate for Aroclor-1254 biodegradation studies. (Baker-FRC)
W82-01235

INORGANICS,
Pope Scientific, Inc., Menomonee Falls, NI.
D. S. Polcyn.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 620-649, June, 1981. 1 Tab, 1004 Ref.

Descriptors: *Water analysis, *Pollutant identification, *Reviews, Chromatography, Spectroscopy, Potentiometers, Neutron activation analysis, Sample preparation, Heavy metals, Trace elements, Speciation.

This review of 1004 recent papers on analytical methods for inorganic constituents of water samples is basically an index to the references. It is divided into types of methods (gas and ion chromatography, voltammetric methods and their subdivisions, potentiometric methods, pH analysis, selective ion electrodes, atomic absorption spectroscopy and its subdivisions, inductively coupled plasma emission spectroscopy, atomic emission spectroscopy, ultraviolet and visible spectroscopy, fluorescence and chemiluminescence, X-ray flourescence and emission, neutron activation analysis), and analyses for specific constituents such as individual elements, oxygen demand, cyanide, and asbestos. The author also discusses new analytical chemistry books, sampling and sample storage, sample purification and concentration, heavy metal analysis, trace level analysis, instrumentation, speciation, and mass spectrometry. (Cassar-FRC)
W82-01238

ORGANICS,
Washington Univ., Seattle.
F. B. DeWalle, D. Norman, J. Sung, E. S. K. Chian, and M. Giabbai.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 659-674, June, 1981. 8 Tab, 165 Ref.

Descriptors: *Water analysis, *Organic compounds, Detergents, Pesticides, Industrial effluents, Monitoring, Water quality, Pollutant identification, Measuring instruments, Surfactants, Chemical analysis, Reviews, Biochemical oxygen demand, Chemical oxygen demand, *Total organic carbon, Streams.

The biochemical oxygen demand, chemical oxygen demand, and total organic carbon of various industrial wastes were compiled and analyzed using computers. The concentration of TOC (total organic carbon) in a flowing stream was estimated from the time of sampling. Several studies used direct extraction or preconcentration on a resin column to remove detergents from the water phase, followed by high pressure liquid chromatography or gas chromatographic separation and mass spectrometric identification. Analytical methods were also developed to determine hydrocarbons. The use of advanced analytical techniques for determination of pesticides, chlorinated hydrocarbons, and related compounds generally involves capillary GC columns using liquid phases such as OV-101, SE-54 or Carbowax 20 M. Single or multiple stage cleanup was generally required to separate the pesticides from the background organics. Preconcentration was required when the organics were present at low concentrations. Naturally occurring organics were also analyzed in water. Due to their polar nature, derivatization prior to GC was generally required. The most commonly used method was HPLC, with or without derivatization. UV, fluorescence or electrochemical detectors were employed. Low molecular weight compounds were concentrated through steam extrac-

tion or purging of the liquid phase. Numerous compounds such as the priority pollutants have been found in wastewaters, leachate or wastewater effluents. Aerobic and anaerobic degradation was observed for several compounds, whereas adsorption onto solids generally paralleled the octanol/water partition coefficients. Unit processes that were effective in removing the chemicals included activated carbon, wet oxidation, and UV/peroxide. (Baker-FRC)
W82-01239

CONTINUOUS MONITORING, AUTOMATED ANALYSIS, AND SAMPLING PROCEDURES,
Oak Ridge National Lab., TN.
W. W. Pitt Jr.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 675-678, June, 1981. 63 Ref.

Descriptors: *Water analysis, Reviews, *Water quality, Water monitoring, *Monitoring, Wastewater analysis, Computers, *Sampling, Sample preservation, Sample preparation, Biological oxygen demand, *Wastewater analysis.

Recent research advances in the area of monitoring, analysis and sampling for water quality are cited in this review article. Much work has been done on of monitoring strategies and sampling protocols. The need for a well documented quality control system in wastewater monitoring has been recognized and is described; assistance is available from the EPA for establishing such a system. Sampling of effluents from the pulp and paper industry as well as analysis for priority pollutants has received attention. Continuous monitoring systems have been developed, including on-line monitoring and monitoring of receiving waters. An automated system for near-real-time water quality monitoring is undergoing field testing at an experimental wastewater reclamation facility. A computer-automated system for total organic carbon has been installed at two US EPA laboratories in Cincinnati. Biological monitoring systems have included work on a new concept of biological monitoring of industrial effluents using bluegill sunfish as sensors and a small on-line computer to follow the ventilatory rates of fish. Immobilized enzymes and living microorganisms have been used in sensors for wastewater monitoring. Automated analyses continue to be increasingly important in monitoring water quality, as is reflected in several literature reviews. An automated method for the direct determination of microgram levels of organic carbon in potable waters has been developed. Sampling procedures suitable for use with automatic analyzers have been developed and are discussed in relation to the type of samples required, sample storage, and reproducibility of results obtained. New methods of sample preservation have also been developed. (Baker-FRC)
W82-01240

BIOASSAYS - PROCEDURES AND RESULTS,
Ecological Analysts, Inc., Sparks, MD.
A. F. Maciorowski, J. L. Sims, L. W. Little, and E. D. Gerrard.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 974-993, June, 1981. 363 Ref.

Descriptors: *Bioassay, *Toxins, *Reviews, Literature reviews, Bioindicators, Fish, Toxicity, *Ecological effects, Monitoring, Environmental protection, Water quality, Planning, Algae, Invertebrates, Symposium, Conferences.

Various workshops and symposia have been held to deal with the suitability of laboratory methods for predicting ecosystem effects and the future of toxicology as a predictive science. Toxicity testing has proved valuable in the prediction of the environmental impact of chemicals. Regulatory aspects of biological criteria and monitoring have been investigated with special reference to the NPDES permit program. Aquatic research programs conducted and managed by the EPA were outlined, and research dealing with sublethal effects of pollutants in the sea and their effects on the physiology of marine organisms is cited. A compilation was recently published dealing with technical papers on water quality criteria for European freshwater fish. Detailed toxicity test procedures and techniques were provided for finely divided solids, pH, temperature, ammonia, dissolved oxygen, chlorine, zinc, copper and cadmium. Other tests have indicated that zebra fish provide an excellent screening test for potential toxicity. Current research is also cited which deals with the design, interpretation and strategy of bioassays; the use of bacterial bioassay test methods; assays conducted with algae and other plants; the effects of contaminated sediments on marine benthos; pollution effects on fish and amphibians; comparative testing with aquatic organisms from various trophic levels; the impact of pollution on organisms as studied through microcosms and in situ testing; the use of short term bioassays for mutagenicity and cellular toxicity; and additional studies dealing with health effects assays. (Baker-FRC)
W82-01277

MICROBIOLOGY OF WATER,
Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 5B.
W82-01284

MICROBIOLOGY: METHODOLOGY AND QUALITY ASSURANCE,
Environmental Protection Agency, Cincinnati, OH.
R. H. Bordner.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 1098-1107, June, 1981. 120 Ref.

Descriptors: *Microbiological studies, *Quality control, *Literature review, Bibliography, Microorganisms, Bioassays, Water quality.

A literature review is presented of papers published in 1980 on the topic of methodology and quality assurance in microbiology. Research in this area deals with many applications of methodology including sampling, direct test, most probable number, membrane filter, plating, biomass, and identification procedures. Methods to provide more rapid results, to compensate for environment stress, and to screen for toxic materials utilizing bacterial bioassays were emphasized. Rapid method studies included the use of ATP concentrations to show the impact of potential pollutants on aquatic environments, and pyrolysis gas-liquid chromatography for identifying bacteria in sewage treatment effluents. In the area of quality assurance, the adequacy of individual results and accuracy of samples collected for bacteriological analysis of surface waters were evaluated using statistical techniques. The MF technique was evaluated in a polluted beach study, and a standard practice was published for enumerating microorganisms of health and sanitary significance. (Small-FRC)
W82-01285

MICROBIOLOGY: DETECTION, OCCURRENCE, AND REMOVAL OF VIRUSES,
Louisiana State Univ., Baton Rouge.
D. Roy, M. Tittlebaum, and J. Meyer.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 1138-1142, June, 1981. 47 Ref.

Descriptors: *Viruses, *Fate of pollutants, *Water treatment, *Pollutant identification, Microbiological studies, Indicators, Shellfish, Adsorption, Wastewater disposal, Reviews.

Most of the new developments in detection and isolation of viruses in water samples use the adsorption-elution technique on filter media. For example, the tentative standard method recovered 0.7-32% of enteroviruses, but four major groups of enterviruses were inactivated by the glycine-NaOH reagent at pH 11.5. Evaluation of three filter media and three cell lines showed fiberglass filters and BGM cell line to be most desirable for virus recovery procedures. Virus survival was the subject of several studies. In general, seawater completely inactivated viruses within 72-96 hours. Other aspects of virus survival reported are the effects of detergents, thermoinactivation in sediments, and effects of rainfall on land applied wastewater sludge. Factors affecting virus persistence in land irrigated with wastewater treatment plant effluent were mixing time, pH, concentration of virus, and isoelectric points of both virus and adsorbent. Virus removal was 98% on a coal and sand filter bed and 99% with an added sedimentation step. In the soil, most adsorption occurred in the top 20 cm; clays were more efficient than sands and organic soils. An improved detection method for low levels of viruses in oysters, clams, and mussels was reported. Bovine parvovirus was suggested as an indicator for viruses. Fecal coliforms and fecal streptococci were not good indicators. (Cassar-FRC)
W82-01290

METAL ION CONCENTRATIONS ASSOCIATED WITH LATE SUMMER SEDIMENTS OF THE OHIO RIVER,
Louisville Univ., KY. Dept. of Chemical and Environmental Engineering.
H. T. Spencer, C. A. Leuthart, and R. S. Colyer.
Water Resources Research, Vol 17, No 4, p 959-962, August, 1981. 2 Fig, 3 Tab, 7 Ref.

Descriptors: *Metals, *Sediments, *Heavy metals, Fate of pollutants, *Ohio River, Rivers, McAlpine Pool, Pollutant identification, Aquatic life.

The Ohio River, which has been transformed into a series of long flowing lakes by 19 high lift dams for navigation, deposits a fine brown sediment during low flow in late summer. Fine sediment samples collected in McAlpine Pool contained an average of 3% (maximum 4.5%) volatile solids (dry weight). Most of the COD, H, Na, K, Al, Mn, and Pb and a significant amount of C, Cr, Fe, Cu, and Zn were associated with the volatile solids. Only Mg was associated with the nonvolatile solids. Highest concentrations of heavy metals (in micrograms per g) in the 24 samples were as follows: Cr, 87; Mn, 1719; Cu, 30; Zn, 275; Cd, 3.9; and Pb, 67. Analysis of a pooled sediment sample showed 11.0 + or - 0.8 micrograms thorium per g and 1.4 + or - 0.5 micrograms uranium per g. Since the fine sediment collects along the river banks in fish fry feeding areas, the metals contained in the sediment have the potential for entering the food chain. (Cassar-FRC)
W82-01300

PERIPHYTON ANALYSIS FOR THE EVALUATION OF WATER QUALITY IN RUNNING WATERS OF GREECE,
Athens Univ. (Greece) Inst. of Systematic Botany.
A. Economou-Amilli.
Hydrobiologia, Vol 74, No 1, p 39-48, September, 1980. 5 Fig, 2 Tab, 42 Ref.

Descriptors: *Water quality, *Periphyton, *Bioindicators, Streams, Fate of pollutants, Algae, Levadia, *Greece, Diatoms, Springs, Self-purification, Cyanophyta, Species diversity, Saprobity, Water pollution effects.

Periphyton species growing on stones, twigs, and plant life were analyzed according to Kothe's 1962 ecological method of evaluating water quality, combined with Knopp's 1955 and Kadlubowska's 1978 methods of estimating frequency of individuals. The test site was a rapidly running stream, forming cascades, near the sources of springs in Levadia, Greece. Of the 8 sampling stations, 2 were littered by tourists, 1 was marked with large oil spots and tripton, 2 were charged with wastewater influent, and 3 were free of noticeable impurities. Cymbella prostrata (Berkeley) Cleve was established as an obligatory species standard. The indicator species numbers ranged from 26-30 in the three clean sites to 8-13 in the remaining sites. The results are also graphically expressed as the percentage values of the species deficit. There was a remarkable absence of decomposers, showing the lack of heavy pollution even at the sites receiving effluent, probably a result of the turbulence and high oxygen content of the stream. (Cassar-FRC)
W82-01358

FAECAL POLLUTION OF BELGIAN COASTAL WATER,
Institut d'Hygiene et d'Epidemiologie, Brussels (Belgium).
M. Yde, and S. De Maeyer-Cleempoel.
Marine Pollution Bulletin, Vol 11, No 4, p 108-110, April, 1980. 1 Fig, 3 Tab, 8 Ref.

Descriptors: *Coastal waters, *Pollutant identification, *Belgium, *Feces, *Coliforms, Streptococcus, Bacteria, Indicators, Municipal wastewater, Agricultural runoff, Wastewater.

There is a high risk of pollution from domestic and agricultural sewage along the Belgian coast due to discharges from one river, three channels, and five urban sewage outfalls along the 60 kilometer stretch. Coliforms, fecal coliforms, and fecal streptococci were selected as indicators of fecal pollution in the Belgian coastal waters. The density of these organisms was highest on the coastline and decreased with increasing distance from the shore. Significant numbers of the indicator bacteria were found at 5 kilometers from the coastline. The densities of the organisms were similar in surface and deep-sea samples. Fecal bacteria densities appear to be moderated by warm climatological conditions. These results indicate that the Belgian coastal waters are not seriously fecally polluted. None of the samples taken 0.5 kilometers off shore exceeded swimming water standards set by the European Economic Community, and less than 15 percent exceeded standards for coliforms or fecal coliforms. (Carroll-FRC)
W82-01373

ATOMIC ABSORPTION SPECTROPHOTOMETRIC STUDIES OF CADMIUM AND ZINC IN COMMERCIAL FERTILISERS, SOILS AND RIVER WATERS,
Aligarh Muslim Univ. (India). Environmental Research Lab.
For primary bibliographic entry see Field 5B.
W82-01388

RAPID METHODS OF CHEMICAL ANALYSIS USED IN EMERGENCY RESPONSE MOBILE LABORATORY ACTIVITIES,
Municipal Environmental Research Lab., Edison, NJ.
M. Gruenfeld, U. Frank, and D. P. Remeta.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC, Environmental Protection Agency Report (1980). p 165-172, 4 Fig, 2 Tab, 33 Ref.

Descriptors: *Chemical anaysis, *Hazardous materials, *Pollutants, *Gas chromatography, *Infrared spectroscopy, *Fluorescence spectroscopy, Sediments, Water analysis, Quantitative analysis, Quality control, Sample preparation, Soil contamination, Oils, Pollutant identification.

The EPA's Oil and Hazardous Materials Spills Branch (OHMSB) maintains two analytical laboratory facilities: an in-house laboratory and a mobile laboratory. The mobile laboratory provides a prompt on-site chemical analysis facility to support cleanup activities in emergency situations. The in-house laboratory has developed the rapid, direct analytical methods used in the confined space of the mobile laboratory. Gas chromatography using flame ionization detectors and electron capture detectors can be used for quantitative determination of priority pollutants in water, sediments, soils, and abandoned storage tanks and drums. Synchronous exicitation fluorescence spectroscopy has been automated and is used in the quantitative determination of hazardous materials and petroleum oils in water and wet sediments. Infrared spectroscopy is used to identify and quantify petroleum oils following rapid extraction from water and sediments. These methods were used at emergencies at nine sites and supported decisions on response and cleanup. A specialized analysis and safety protocol was developed which eliminates time consuming solvent extraction and concentration procedures. A rapid, simple technique for artificially weathering petroleum oil and a procedure for removing elemental sulfur from sediments are in use. A comprehensive quality assurance/quality control protocol has been implemented to ensure the acquisition and dissemination of high quality data. (Brambley-SRC)
W82-01431

LABORATORY PROCEDURE FOR ESTIMATING RESIDUE DYNAMICS OF XENOBIOTIC CONTAMINANTS IN A FRESHWATER FOOD CHAIN,
Columbia National Fisheries Research Lab., MD.
For primary bibliographic entry see Field 5B.
W82-01443

PRELIMINARY REPORT OF STREAM SAMPLING FOR ACIDIFICATION STUDIES 1980,
New York State Dept. of Environmental Conservation, Albany.
J. R. Colquhoun, J. Symula, M. Pfeiffer, and J. Feurer.
Technical Report No 81-2, September, 1981. 36 p, 14 Fig, 1 Tab, 14 Ref, 2 Append.

Descriptors: *Acid streams, *Fish populations, *Acidic water, *Hydrogen ion concentration, Fisheries, Stream fisheries, Fish stocking, Annual runoff, On-site data collections, *Fish toxins, Fish management, Fish conservation, Adirondack streams, Lakes, Catskills, *New York.

Fish resources in the Adirondack lakes in New York provide a unique opportunity for readily accessible fishing for native and stock salmonids. Loss of this opportunity due to acidification would have serious recreational, economic, and ecosystemic consequences. Depending on the duration and extent of pH depression, fish reproduction may be inhibited, young fish may be killed, or lethal conditions for adult fish may result. During the spring snowmelt runoff, stream pH is inversely related to discharge, with the effect most severe in areas with thin soil on non-calcareous bedrock. Results of a spring 1980 study indicate that some Adirondack streams were affected by depressions of pH and alkalinity. Other streams remained acidified throughout most of the summer, while a large number of streams never reached pH levels potentially lethal to fish (below 5.0) during 1980. None of the sampled streams in the Catskills reached critical pH levels during the survey period; however, snowfall during the 1979-80 winter was abnormally low. Indices of fish populations in Adirondack streams were found to be statistically correlated with spring 1980 pH measurements. These measurements then serve as indications of past effect. Approximately 15 percent of the streams were in a 'critical' classification (a mean equilibrium meter pH reading below 5.0), but this percentage is biased by the selection of streams. It was felt that a larger proportion of all Adirondack streams was probably affected by low pH conditions in 1980, and there would be an even higher proportion after a normal winter. (Garrison-Omniplan)
W82-01453

MERCURY IN THE MUSCLE TISSUE OF FISH FROM THREE NORTHERN MAINE LAKES,
Maine Univ. at Orono; and Columbia National Fisheries Research Lab.
For primary bibliographic entry see Field 5B.
W82-01459

THE APPLICATION OF MUTAGENICITY TESTING TO DRINKING WATER,
Water Research Centre, Stevenage (England).
R. Forster, and I. Wilson.
Journal of the Institution of Water Engineers and Scientists, Vol 35, No 3, p 259-274, May, 1981. 3 Fig, 7 Tab, 46 Ref.

Descriptors: *Mutagens, *Drinking water, *Water analysis, Pollutant identification, Bacteria, Salmonella, Carcinogens, Raw water, Treated water, England.

Twenty-one unconcentrated samples from English raw and treated waters were examined for mutagenic properties using Salmonella tester strains. A chlorinated sewage effluent, which contained histidine, and one treated lowland water produced repeated positive results. Concentration procedures were also evaluated. Partial freeze drying concentrated the organic material most efficiently, having a mean total organic carbon recovery of 101.1% with a concentration rate of 6.3-12 fold. Freeze concentration, which concentrated the sample 6-11 fold, gave a mean total organic carbon recovery of 54.1%. However, samples concentrated by the freezing methods did not produce reliable results in mutagenic testing. A comparison of freeze drying/solvent extraction and XAD-2 resin adsorption/solvent desorption showed that the XAD-2 process was cheaper, less time-consuming, and more selective. High performance liquid chromatography showed promise as a method of fractionating the concentrate to further trace and identify the mutagenic materials. (Cassar-FRC)
W82-01487

RELATIONSHIP OF THE RAW WATER QUALITY TO MUTAGENS DETECTABLE BY THE AMES SALMONELLA/MICROSOME ASSAY IN A DRINKING-WATER SUPPLY,
National Inst. for Water Research, Pretoria (South Africa).
W. O. K. Grabow, P. G. Van Rossum, N. A. Grabow, and R. Denkhaus.
Water Research, Vol 15, No 9, p 1037-1043, September, 1981. 2 Fig, 2 Tab, 33 Ref.

Descriptors: *Mutagens, *Drinking water, *Organic compounds, Pollutant identification, Water quality, Water treatment, Water analysis, Chlorination.

Mutagens detected by the Ames test were related to water quality parameters in the water from the Vaal River, the drinking water supply for Parys, South Africa. The treatment process was conventional: flocculation, sedimentation, sand filtration, and chlorination. Correlations were obtained between mutagenic activity of non-volatile compounds in dichloromethane extracts and volatile halogenated hydrocarbons. Limited correlations were seen between mutagenic activity and total organic carbon contents of raw and treated water. The dry mass of extracts from neither raw nor treated water correlated with these parameters. Mutagenic activity increased in spring, probably because of increased amounts of mutagen precursors washed into the river with the first rains of the season, rising temperature, and increased algal action. With increased flow, mutagenic activity decreased and reached a stable summer level. No activity was detected in raw water, indicating that mutagens in wastewater effluents discharged 40 km upstream had been removed or inactivated. Mutagenic activity in the drinking water was 75-100 induced TA98 revertants per 100 micrograms dry extract in the absence of 89 liver preparation. Values in this range are reported for other potable water supplies. The mutagens consisted mainly of neutral organic compounds, including polycyclic hydrocarbons. The importance of routine mutagenic activity monitoring was emphasized. (Cassar-FRC)
W82-01493

U.V.-DOC CHARACTERIZATION OF PULP AND PAPER BLEACH EFFLUENTS,
Department of Scientific and Industrial Research, Wellington (New Zealand). Industrial Processing Div.
C. N. S. McLachlan.
Water Research, Vol 15, No 8, p 983-988, August, 1981. 10 Fig, 1 Tab, 17 Ref.

Descriptors: *Pulp wastes, *Organic matter *Ultraviolet radiation, Pulp and paper industry, Industrial wastes, Kraft mills, Wastewater treatment, Design criteria, Chemical analysis, Pollutant identification, Flocculation, Separation techniques.

A method for the characterization of pulp and paper bleach effluents was developed, and the aluminum salt flocculation characteristics of the effluent organic components were examined. Ligninsulphonic acid was used as a model substance, and aluminum salts were used as precipitants. U.V.-DOC and U.V.-pH plots were obtained by sequential precipitation of organic material from both

kraft and sulphite bleach effluents and were used to characterize the organic material in the effluent. The plots also provide useful information on the likely degree of purification to be achieved by different treatment processes. The plots of U.V. absorbance versus DOC produce a straight line and permit the accurate estimation of the non-U.V. absorbing DOC in effluent. Thus, DOC loadings can be estimated when designing effluent treatment systems for the highly colored, not readily biodegradable lignin-derived organic material found in pulp and paper bleach effluents. (Small-FRC)
W82-01495

A NOTE ON THE USE OF MEMBRANE FAECAL COLIFORM MEDIUM FOR ENHANCING RESOLUTION AND ACCURACY WHEN ENUMERATING A SMALL PLAQUING COLIPHAGE,
Western Australia Univ., Nedlands. Dept. of Microbiology.
W. F. Parker.
Journal of Applied Bacteriology, Vol 51, No 1, p 81-84, August, 1981. 2 Fig, 7 Ref.

Descriptors: *Culture media, *Viruses, *Bacteriophage, Agars, *Pollutant identification, Coliforms, Microbiological studies, Water analysis.

The resolution and accuracy of bacteriophage M52 plaque enumeration in water samples were improved by modifying a membrane fecal coliform medium (mFC) according to Geldreich, et al. (1965). The host strain was grown overnight in nutrient broth, the plates flooded with the culture, and excess liquid removed by draining and drying. The drop count technique was used to apply the inocula. After incubation, plaques on mFCA (mFC broth base plus agar) were more clearly resolved and more readily enumerated than plaques grown on Trypticase Soy agar. (Cassar-FRC)
W82-01507

THE ESCHERICHIA COLI CONTENT OF MYTILUS EDULIS FROM ANALYSIS OF WHOLE TISSUE OR DIGESTIVE TRACT,
University Coll. of Swansea (Wales). Dept. of Botany and Microbiology.
M. M. Al-Jebouri, and D. R. Trollope.
Journal of Applied Bacteriology, Vol 51, No 1, p 135-142, August, 1981. 3 Tab, 16 Ref.

Descriptors: *Mussels, *Mytilus, *Escherichia coli, *Shellfish, Estuarine fisheries, Microbiological studies, *Bacteria, Sewage bacteria, *Pollutant identification, Water pollution effects.

Sensitivity of bacterial counts in shellfish can be improved by using the digestive tracts, rather than whole tissue, for enumeration. Digestive systems of Mytilus edulis contained 3-6 times the number of E. coli as did whole tissue samples from the same waters. Average mean counts in mussels from Mumbles, Swansea, were: total tissue, 136-183; and digestive tract, 401-572. At Oxwich, Gower, counts were: total tissue, 6-7; and digestive tract, 24-40. Three enumeration methods were used: the 1 x 4 ml plate technique, the 4 x 1 ml pour plate technique, and the 2 x 0.2 ml spread plate technique. The 2 x 0.2 ml spread plate method and the 4 x 1 ml method performed equally well for samples from grossly polluted water, but in samples from cleaner water the 2 x 0.2 ml spread plates failed to detect E. coli in 13 batches where bacteria were detected by other methods. The 4 x 1 ml pour plate method gave no false negatives and gave consistently higher counts than the 1 x 4 ml plate technique. Digestive tract inoculum also produced better results than whole tissue samples in the semiquantitative Percentage Clean method when applied to the cleaner samples. Examination of digestive tracts designated 8 of 10 batches unsatisfactory for consumption; examination of the whole tissue, 2 of 10 batches unsatisfactory, and 6 suspicious. There were no differences in results obtained on grossly polluted samples. (Cassar-FRC)
W82-01508

DETERMINATION OF NANOGRAM QUANTITIES OF MERCURY IN WATER WITH A GOLD-PLATED PIEZOELECTRIC CRYSTAL DETECTOR,
New Orleans Univ., LA. Dept. of Chemistry.
M. H. Ho, G. G. Guilbault, and E. P. Scheide.
Analytics Chimica Acta, Vol 130, No 1, p 141-147, 1981. 4 Fig, 2 Tab, 15 Ref.

Descriptors: *Mercury, *Water analysis, *Pollutant identification, Electrodes, Field tests, On-site investigations.

Mercury in water or biological samples may be determined at the nanogram level (5-100 ng) with a gold-coated piezoelectric crystal, coupled with a direct reduction technique. The method is simple and inexpensive. The detector, free of interferences seen in cold-vapor atomic absorption, is readily portable for field use with batteries. Carrier gas flow rate, configuration of the detector cells, and sample size were critical to sensitivity. Since the detector responds to mass rather than concentration, larger samples increase sensitivity. However, a large sample volume requires a higher flow rate of gas and decreases efficiency of Hg collection on the gold electrode. Of the three configurations tested, the one providing the best contact between gold coating and sample stream is three times more sensitive as another configuration. The detector, with a lifetime of at least 60 cycles, is regenerated by thermal desorption at 170 C in a flow of hot air or nitrogen. (Cassar-FRC)
W82-01509

SOME FACTORS AFFECTING THE DETERMINATION OF PARTICULATE CARBON AND NITROGEN IN RIVER WATER,
Canada Centre for Inland Waters, Burlington (Ontario).
P. H. Whitfield, and J. W. McKinley.
Water Resources Bulletin, Vol 17, No 3, p 381-386, June, 1981. 5 Tab, 4 Ref.

Descriptors: *Sample preservation, *Water sampling, *Nitrogen compounds, *Carbon, Sampling, Rivers, Water analysis, Precision, Particulate matter, Freezing.

Water samples for the determination of particulates nitrogen and carbon should be filtered immediately after collection and the analysis performed as soon as possible. They should not be frozen. Samples collected at 4 rivers in the Vancouver area were subjected to different storage regimes after collection. Samples frozen for 1 week varied from the control by 92-282% in particulate N and 113-338% in particulate C. Samples stored at 5 C varied from the control by 70-139% in particulate N and 87-131% in particulate C. Filtering the samples directly after collection and storing for 1 day (control) or 1 week produced no significant differences between the two groups in most cases. However, for a level or precision greater than 10%, samples should be analyzed immediately. Storage for 1 week at freezing temperatures changed the proportions of the chemical forms of N (nitrate-nitrite, ammonia, dissolved organic N) in 58% of the cases; for storage at 5 C, 42%. (Cassar-FRC)
W82-01532

COMPARISON OF SELECTIVE MEDIA FOR THE ENUMERATION AND IDENTIFICATION OF FECAL STREPTOCOCCI FROM NATURAL SOURCES,
Ontario Ministry of the Environment, Rexdale.
J. E. Pagel, and G. M. Hardy.
Canadian Journal of Microbiology, Vol 26, No 11, p 1320-1327, 1980. 5 Tab, 20 Ref.

Descriptors: *Bacterial analysis, *Streptococcus, *Culture media, *Membrane filters, Agar, *Pollutant identification, Water analysis, Effluents, Wastewater analysis, Filter media, Selective media, Microbiological studies, Bacteria.

The mEnterococcus (mEnt) agar was compared with four other routinely used membrane filtration bacteria selective media and procedures for fecal streptococci recovery on samples of raw sewage, sewage effluent, and combined storm sewer water. Best overall results were obtained with mEnt agar, which gave 92% specificity for enterococci and very good recovery efficiency with low background counts. It was the only media showing appreciable recovery of other fecal streptococci, with 93% of the background colonies being confirmed as fecal streptococci (mostly S. bovis, S. equinus, or S. salivarius). Second in performance was Pfizer selective enterococcus (PSE) agar, with a specificity rate of 96% but lower recovery efficiency and high background counts. The KF agar recovered higher numbers of organisms, but only 81% were fecal streptococci. The Slanetz and Bartley (SB) medium had low specificity. The mE procedure was highly specific but gave low recoveries. A total of 512 colonies was identified from test media. (Cassar-FRC)
W82-01564

AN ESTUARINE AGAR MEDIUM FOR ENUMERATION OF AEROBIC HETEROTROPHIC BACTERIA ASSOCIATED WITH WATER, SEDIMENT, AND SHELLFISH,
Maryland Univ., College Park. Dept. of Microbiology.
R. M. Weiner, D. Hussong, and R. R. Colwell.
Canadian Journal of Microbiology, Vol 26, No 11, p 1366-1369, 1980. 3 Tab, 13 Ref.

Descriptors: *Bacterial analysis, *Agars, *Estuarine environment, Pollutant identification, Bacteria, Aquatic bacteria, Water analysis, Sediment, Oysters, Shellfish, Heterotrophic bacteria, Aerobic bacteria.

An estuarine agar of reduced salt content is recommended for enumerating aerobic, heterotrophic bacteria in samples of water, sediment, and oysters. The final concentration of added salts in the estuarine agar was 9.4% and final pH 7.5, compared with (1) 10.5% and pH 7.2 for estuarine salt water yeast extract agar and (2) no added salts and pH 7.0 for tryptone-glucose-yeast extract agar. Compared with the other agar media, the estuarine agar produced higher bacterial counts and increased taxonomic diversity from all water, sediment, and oyster samples tested. (Cassar-FRC)
W82-01565

EVALUATION OF ULTRAVIOLET SPECTROPHOTOMETRIC DETERMINATION OF NITRATE-NITROGEN IN GLACIAL SNOW, FIRN AND ICE,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
B. C. Parker, W. J. Thompson, and E. J. Zeller.
Analyst, Vol 106, No 1265, p 898-901, August, 1981. 1 Fig, 1 Tab, 10 Ref.

Descriptors: *Nitrates, *Spectrophotometry, *Firn, Pollutant identification, Water analysis, Glaciers, *Antarctic, Ultraviolet radiation, *Snow, Ice.

The direct ultraviolet spectrophotometric method for determining nitrate-N was applied to samples of South Pole firn core. The correlation coefficient was 0.9818, relative standard deviation 2.2%, and relative error, 3.9% at the 12 microgram per liter nitrate-N level. About 40 determinations per hour are possible. No major interferences were found from calcium chloride, potassium chloride, ammonium chloride, ammonium sulfate, sodium chloride, sodium carbonate, or sodium silicate at levels likely to be found in South Pole snow. High levels of Na could depress the ultraviolet absorbance reading for nitrate-N at 210 nm by 1-2 micrograms. Comparisons with the ultraviolet spectrophotometric-standard addition method and the cadmium reduction-diazotization method produced similar values. However, the cadmium method requires at least twice as much time. Surface snow containing particulates or organic matter cannot be reliably analyzed by this method. (Cassar-FRC)
W82-01572

APPLICATION OF CAPILLARY GAS CHROMATOGRAPHY MASS SPECTROMETRY/COMPUTER TECHNIQUES TO SYNOPTIC SURVEY OF ORGANIC MATERIAL IN BED SEDIMENT,

Geological Survey, Denver, CO.
T. R. Steinheimer, W. E. Pereira, and S. M. Johnson.
Analytica Chimica Acta, Vol 129, p 57-67, August, 1981. 7 Fig, 1 Tab, 20 Ref.

Descriptors: *Organic compounds, *Sediments, Industrial wastes, Monitoring, Water pollution sources, River beds, Streambeds, *Chemical analysis, Gas chromatography.

A synoptic survey is presented so that an overview might be realized of the environmental chemistry active in an area impacted by heavy industrial activity. Organic compounds were sought in a bed sediment sample. Extraction was performed on a Soxhlet apparatus using a freeze-dried sample. The Soxhlet extract was fractionated by silica gel micro-column adsorption chromatography. Separation and identification of the organic compounds was accomplished by capillary gas chromatography/mass spectrometry. Over 50 compounds were identified including saturated hydrocarbons, olefins, aromatic hydrocarbons, alkylated polycyclic aromatic hydrocarbons, and oxygenated compounds such as aldehydes and ketones. These were present as a complex mixture resulting from natural products and pollutants from waste discharges. The deposition and concentration of these materials on the bed sediment was determined by river hydrology and other general river conditions. Many of the pollutants identified are susceptible to bioaccumulation. The redistribution of some of these contaminants into the water column during periods of high flow or other kinds of perturbation argues persuasively for synoptic-survey bed sediment analysis as an indicator of water quality. Additional refinements in the capillary column gas chromatographic portion of the analysis may reveal further organic pollutants of significance to the environment. (Baker-FRC)
W82-01573

PRECONCENTRATION FOR TRACE ELEMENT DETERMINATION IN AQUEOUS SAMPLES,
Denver Univ., CO. Dept. of Chemistry.
D. E. Leyden, and W. Wegscheider.
Analytical Chemistry, Vol 53, No 9, p 1059A-1065A, August, 1981. 55 Ref.

Descriptors: *Sample preparation, *Trace elements, *Separation techniques, Water analysis, Preconcentration, Seawater, Ion exchange, Solvent extraction, Electrodeposition, Evaporation, Adsorption, Chemical precipitation, Reviews, *Pollutant identification.

Methods for preconcentrating trace elements in water are discussed as supplements, rather than alternatives, to modern instrumentation. The simplest method of preconcentrating ions is evaporation from solution. This technique, frequently used with X-ray spectrometry, is not suitable where one ion has a high and variable concentration. Electrodeposition, particularly anodic stripping analysis, has been extremely useful. Few reagents are needed and instrumentation is simple, but deposition is very slow. Electrodeposition from seawater has been more promising than that from freshwater. A widely used preconcentration technique is liquid-liquid extraction using a water-immiscible solvent and an aqueous solution containing a chelating agent. Possible improvements in the extraction technique involve continuous extraction, countercurrent flow, combination with gas-liquid chromatography or ICP-AES, and using an organic phase which readily solidifies upon cooling after extraction. Surface adsorption of metal complexes on activated carbon or C18-bonded silica gel attains concentration factors up to 200. Precipitation in the range of interest is not quantitative but may be useful with coprecipitation agents or carrier ions. Larger concentration factors (about 40,000) are obtained with ion exchange methods. The ion may be eluted for analysis in solution or be analyzed directly on the solid matrix. Many resins are available for this purpose: Chelex 100 is widely used. Ion exchange resins may be used to impregnate paper disks or membranes. Other modifications of ion exchange techniques are foams and gels for one-time use and silylation reactions. Several specialized methods are available for specific ions. (Cassar-FRC)
W82-01574

POLYCHLORINATED BIPHENYLS AND OTHER ORGANIC CHEMICAL RESIDUES IN FISH FROM MAJOR UNITED STATES WATERSHEDS NEAR THE GREAT LAKES, 1978,
Environmental Research Lab.-Duluth, MN.
G. D. Veith, D. W. Kuehl, E. N. Leonard, K. Welch, and G. Pratt.
Pesticides Monitoring Journal, Vol 15, No 1, p 1-8 June, 1981. 3 Fig, 2 Tab, 6 Ref.

Descriptors: *Polychlorinated biphenyls, *Fish, *Pesticides, Water pollution sources, Great Lakes, DDT, Chlordane, Environmental effects, Gas chromatography, Halogenated pesticides, Bioindicators.

Exploratory studies of chemicals in fish were performed on specimens obtained from rivers in Minnesota, Wisconsin, Indiana, Michigan, Ohio, and New York. Twenty-six composite fish samples were analyzed for polychlorinated biphenyls (PCBs) and related organic chemicals. In all samples, PCB mixtures resembling Aroclor 1254 were found, and 77% of the samples included mixtures resembling Aroclor 1242. DDT was a minor contaminant, while hexachlorobenzene was determined in 65% of the samples. Chlorine and components of technical chlordane were found in 38% of the samples. Pentachloroanisole was found in 15 samples, and heptachloronorbornadiene and hexachloronorbornadiene were found only in the Wabash River. Mirex was found only in Lake Ontario fish. While PCB's were found in all samples, the predominant forms were tetra-, penta-, and hexachlorobiphenyl homologs. PCBs containing two or three chlorine atoms were found in 19 of the 26 samples. Major improvements are needed in GLC/MS screening before an adequate number of samples can be evaluated. (Small-FRC)
W82-01583

CONCENTRATING ORGANICS IN WATER FOR BIOLOGICAL TESTING,
Oak Ridge National Lab., TN.
R. L. Jolley.
Environmental Science and Technology, Vol 15, No 8, p 874-880, August, 1981. 2 Tab, 111 Ref.

Descriptors: *Water analysis, *Organic compounds, Reverse osmosis, Vacuum filtration, Ultrafiltration, Solvents, Organic solvents, Activated carbon, Resins, Chromatography, Precipitation.

Various methods are described for concentration of organics in water, each having its own advantages and disadvantages. The choice of method or combination of methods to be used depends on such factors as the volatility of the organic constituent to be tested, the degree of concentration required, and the biological test system to be used. Concentration methods may be divided into two basic categories, concentration and isolation. Concentration processes remove water and leave the dissolved substances behind. Isolation processes remove the organic substances from the water. Concentration techniques include freeze concentration, lyophilization (or freeze-drying), vacuum distillation or evaporation processes, reverse osmosis, and ultrafiltration. Isolation techniques include solvent extraction, use of activated carbon, carbonaceous adsorbents, XAD resins, open-pore polyurethane, ion-exchange chromatography, precipitation, centrifugation, and gas stripping. Combination procedures are often used, to achieve as high a recovery of organics as is possible. Reverse osmosis has been combined with Donnan dialysis, solvent extraction and disorption on XAD-2 resin. Silica gel, cation-exchange resin and anion-exchange resin followed by vacuum distillation is another combination. Critical areas include the possible presence of humic materials binding lower molecular weight organic substances, lack of a representative sample, improper sample preservation and improper concentration procedures. (Baker-FRC)
W82-01591

5B. Sources Of Pollution

MASS TRANSPORT OF SOLUTES IN DUAL-POROSITY MEDIA,
Water Research Centre, Marlow (England).
R. Bibby.
Water Resources Research, Vol 17, No 4, p 1075-1081, August, 1981. 7 Fig, 2 Tab, 18 Ref.

Descriptors: *Solute transport, *Aquifers, *Porous media, Path of pollutants, Fate of pollutants, Chalk aquifer, Model studies, Mathematical models, Diffusion, Groundwater movement.

The mechanism for solute mass transport in aquifers with static water (high porosity but low permeability) is controlled by secondary processes such as molcular diffusion, adsorption, and reaction, rather than by primary processes such as convection and dispersion. An analytical solution for diffusion from a constant concentration boundary has been incorporated into a 2-dimensional mass transport model, which uses the Galerkin method of weighted residuals and isoparametric finite elements to solve the flow and transport equations. The method is used to simulate pollutant movement in the Chalk aquifer, East Kent, England, specifically the discharge of saline water (318,000 tons of chloride) from collieries into the aquifer from 1926 to 1974. The model indicates that 13% of the total mass of chloride had been discharged from the aquifer by 1978, and by 2008, 68.6% will have been discharged. An unusually large number of parameters are required to calibrate this model because the transport of solutes is so slow that field tests or tracer studies are impractical. Calibration is very difficult (especially the determination of dispersivities) unless a large amount of historical data is available on a large-scale pollution event. (Cassar-FRC)
W82-01104

FACTORS AFFECTING RADIONUCLIDE AVAILABILITY TO VEGETABLES GROWN AT LOS ALAMOS,
Los Alamos National Lab., NM.
G. C. White, T. E. Hakonson, and A. J. Ahlquist.
Journal of Environmental Quality, Vol 10, No 3, p 294-299, July/September, 1981. 10 Tab, 18 Ref.

Descriptors: *Plutonium radioisotopes, *Vegetable crops, *Land disposal, Plutonium, Radioisotopes, Cesium, Beans, Squash, *Radioactive waste disposal, Soil contamination, Fertilizers, Path of pollutants.

There is a need for information on transuranic element transfer into human food chains. A field study was conducted to investigate the availability of plutonium-238, plutonium-239, and cesium-137 to zucchini squash and to green bush beans grown under home garden conditions in an area of the Los Alamos National Laboratory used for the disposal of treated radioactive liquid wastes. The effects of tissue type, height above soil, fertilization regime, and food cleansing procedures (for squash) on radionuclide concentrations were analyzed using analysis of variance procedures. Ratios of the concentration of a radionuclide in oven-dried vegetables to dry soil ranged from 0.0004 to 0.116 for the plutonium isotopes and from 0.051 to 0.255 for cesium-137. The plutonium concentration ratios were reduced by 30 percent when the fields were fertilized with steer manure, while cesium-137 concentration ratios were reduced by about 50 percent. The reduction due to fertilization was attributed to a stabilization of the soil surface and to increased potassium concentrations (the latter for Cesium-137 only). The finding that vegetative parts within 20 centimeters of the ground surface were about four times as heavily contaminated as plant parts growing further from the surface indicates that a major source of contamination in these plants was soil on the plant surfaces. Washing of the zucchini plants resulted in removal of about 65 percent of the contamination. The 50-year radiation doses to humans consuming these vegetables would be less than 0.05 mrem, and this would be due almost entirely to cesium-137. (Carroll-FRC)
W82-01109

NITRATE REDUCTION IN AN ORGANIC SOIL-WATER SYSTEM,
Agricultural Research and Education Center, Sanford, FL.
K. R. Reddy, P. D. Sacco, and D. A. Graetz.
Journal of Environmental Quality, Vol 9, No 2, p 283-288, April-June, 1980. 5 Fig, 5 Tab, 20 Ref.

Descriptors: *Nitrates, *Denitrification, *Agricultural runoff, *Organic soils, *Floodwater, Fate of pollutants, Nitrogen, Drainage, Farm wastes, Kinetics, Drainage water, Temperature, Soil columns, Nutrient removal, Water pollution control, Water quality control, Oxygen demand, Infiltration.

The ability of flooded organic soil to counteract the effects of soil denitrification by flood water removal of nitrate-N was examined in three laboratory experiments. Nitrate-N reduction rates in agricultural drainage water and in an underlying organic soil column were studied at nitrate-N levels of 10, 25 and 50 micrograms/ml. Energy source and temperature were varied and labeled nitrate-N was used to distinguish between denitrification and reduction to ammonium-N or organic N. Nitrate-N reduction rates at 28 degrees with no excess flood water and flood water nitrate-N removal rates were both described by first order kinetics. In soil columns treated with high oxygen-demand flood water, most of the nitrate-N disappeared before reaching the underlying soil column with rate constants that increased with temperature. At lower temperatures, more of the flood water nitrate-N diffused deeper into the soil column. These findings show that flooded organic soils may serve as a sink for reducing the nitrate-N levels of agricultural drainage waters and should be considered for use in pollution abatement programs. (Geiger-FRC)
W82-01129

A STUDY OF A METHOD FOR DISPLACING SOIL SOLUTION BY CENTRIFUGING WITH AN IMMISCIBLE LIQUID.
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Land Resources Management.
B. R. Whelan, and N. J. Barrow.
Journal of Environmental Quality, Vol 9, No 2, p 315-319, April-June, 1980. 6 Fig, 4 Tab, 12 Ref.

Descriptors: *Path of pollutants, *Soil solution, *Organic solvents, *Separation techniques, Phosphates, Soil filters, Dispersants, Soil dispersants, Water pollution, Membrane filters, Suspended solids, Soil water, Septic tanks, Septic waste water.

The composition of soil solutions in the study of pollutant movements through soils is of interest because the soil is usually the moving phase. A technique using tetrachloroethylene as displacing liquid for soil solutions is described and compared to both 1,1,1-trichloroethylene and carbon tetrachloride systems. After centrifuging a soil solution with tetrachloroethylene at 170,000 m/sec for 30 min, the solution collects at the top of this dense organic liquid and may be separated by pouring through phase-separating paper. After suspended matter is removed by membrane filtration, the solution may be analyzed. The use of tetrachloroethylene as displacent was considered safer than carbon tetrachloride and did not interfere with subsequent tests for nitrate, as did 1,1,1-trichloroethylene. The present method was recommended for investigations on the movement of water-soluble pollutants through soil and was utilized to study phosphate movement below the discharge from a septic tank. (Geiger-FRC)
W82-01131

THE MOVEMENT OF SALTS FROM SOILS FOLLOWING HEAVY APPLICATION OF FEEDLOT WASTES,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
A. Amoozegar-Fard, W. H. Fuller, and A. W. Warrick.
Journal of Environmental Quality, Vol 9, No 2, p 269-273, April-June, 1980. 5 Tab, 16 Ref.

Descriptors: *Salts, *Manure, *Farm wastes, *Fate of pollutants, Trace elements, Heavy metals, Model studies, Soil water, Soil filters, *Fertilizers, Leachates, Leaching, Magnesium, Minerals, Calcium, Potassium, Chlorides, Sodium.

The movement of salts from soils following heavy application of feedlot manure as fertilizers was studied in relation to water management and the aggregate size of the manure. Air-dried manure was formed into three different sizes, mixed with a sandy loam soil and loaded into a plastic cylinder (15 cm diameter) packed with 10 cm of soil. This model system simulated an application rate of 100 metric tons/ha. Deionized water was passed continually or intermittently through the column, and leachates were collected in one-half of a pore volume increments for the determination of electrical conductivity (EC), pH and other factors. Initial EC's of effluent were up to 8-10 mmho/cm, sufficient to affect growth of most field crops. Heavy irrigation could be applied before planting salt-sensitive crops. The movement of sodium and potassium replaced calcium and magnesium on the soil exchange sites; consequently their movement was delayed, and the rate of irrigation water infiltration was reduced. Chloride movement resembled that of leaching manure alone, while movement of trace elements from the system was insignificant. (Geiger-FRC)
W82-01132

TRANSPORTS IN THE DULUTH-SUPERIOR HARBOR,
Minnesota Univ.-Duluth. Dept. of Physics.
K. R. Stortz, and M. Sydor.
Journal of Great Lakes Research, Vol 6, No 3, p 223-231, 1980. 12 Fig, 3 Tab, 14 Ref.

Descriptors: *Sediment transport, *Ships, *Water quality, *Path of pollutants, Water circulation, Lakes, Suspended sediments, Model studies, Hydrodynamics, Solute transport, *Harbors, *Lake Superior, *Duluth, Minnesota, Seiches.

A hydrodynamic model and a water quality model were developed for simulating the transport of particulates and dissolved material in the Duluth-Superior harbor. An average concentration of 10-15 mg per liter suspended solids was observed in the wake of moving ships. It was estimated that 100,000 kg of sediment is resuspended per passage of a ship. The model predicts that 0.1% of this resuspended material flows into Lake Superior, while the remainder settles to the edges of the shipping channels. At the rate of 1000 large ships visiting the harbor annually, the total amount of resuspended material entering the lake from the harbor is about 100 metric tons per year. Simulation of 200 kg of dissolved pollutant added to the water at the coal dock over an 8 hour period shows that peak concentrations (0.05-0.1% of the initial concentration at the spill site) would reach the Duluth entry in 5-8 days and the Superior entry in 9-17 days, depending on seiche amplitude. The residence time of the contaminant in the harbor is on the order of 30-40 days. (Cassar-FRC)
W82-01136

A CLASSIFICATION AND DESCRIPTION OF SOME NORTHEASTERN ONTARIO LAKES INFLUENCED BY ACID PRECIPITATION,
Laurentian Univ., Sudbury (Ontario). Dept. of Geography.
J. R. Pitblado, W. Keller, and N. I. Conroy.
Journal of Great Lakes Research, Vol 6, No 3, p 247-257, 1980. 7 Fig, 3 Tab, 21 Ref.

Descriptors: *Lake classification, *Acid rain, *Air pollution, Sudbury, *Ontario, Water pollution sources, Path of pollutants, Water quality, Nutrients, Urban runoff, Eutrophication, Metals, Smelting industry, Buffering capacity.

Statistical analysis of water chemistry data (23 variables for 187 lakes in the Sudbury, Ontario, area) showed that most of the chemical variability was attributable to 4 components: nutrient status, buffering status, atmospheric deposition status, and sodium chloride status. Seven distinct groups of lakes were obvious. Group 1 lakes, scattered throughout the study area, were high in nutrients and chlorophyll, reflecting cultural eutrophication. Groups 2 and 3, characteristic, dilute lakes of the Precambrian Shield, had an inverse relationship to the atmospheric deposition status and buffering status dimensions, and were low in smelter-produced ions. They differed in nutrient and chlorophyll a status, Group 2 having the higher values. Groups 4, 5, and 6 reflected the impact of airborne pollutants from smelting operations in Sudbury. Group 5 lakes, closest to the smelters, had high acidity, low buffering capcity, and high concentrations of smelter-related metals. Group 6 lakes showed a lesser impact, and Group 4, limited impact, being more buffered and productive. Group 7, a group of anomalous lakes sharing high pH and high ionic strength, were influenced by limestone bedrock or surficial material as well as urban runoff. (Cassar-FRC)
W82-01145

NONPOINT N RUNOFF FROM AGRICULTURAL WATERSHEDS INTO THE GREAT LAKES,
Department of Agriculture, Summerland (British Columbia).
G. H. Neilsen, J. L. Culley, and D. R. Cameron.
Journal of Great Lakes Research, Vol 6, No 3, p 195-202, 1980. 1 Fig, 6 Tab, 28 Ref.

Descriptors: *Agricultural watersheds, Runoff, *Nitrogen compounds, Path of pollutants, Fertilizers, *Agricultural runoff, Watersheds, Ontario, Nitrates, Ammonium, *Inflow, *Great Lakes, Water pollution control, Nutrients, Soil conservation, Nonpoint pollution sources.

Runoff nitrogen and discharge were continuously monitored in 11 agricultural watersheds in southern Ontario during 1975-1977 as part of the International Joint Commission's Pollution from Land Use Activities Reference Group project. The predominant chemical form of N runoff was nitrate-N (flow weighted concentration means, 0.57-5.62 mg per liter), followed by total Kjeldahl nitrogen (TKN) (0.64-2.37 mg per liter) and average soluble ammonium-N (0.03-0.60 mg per liter). Elevated stream dissolved N concentrations were seen in watersheds with increased areas of row crops, especially corn, extensive tile drainage, and high unit area fertilizer N additions. Elevated TKN occurred in watersheds with extensive impermeable soils, high suspended sediment concentrations, and increased surface runoff. Stream nitrate-N loadings ranged from 2.1 + or - 0.2 to 39.0 + or - 7.6 kg per watershed ha. Some watersheds with intense agricultural activity lost up to 30 kg nitrate-N per ha. Watersheds with extensive woodlot, hay, and pasture gained more nitrate-N from precipitation than was lost in runoff. The most important consideration for reducing soluble N runoff in the agricultural areas under study is efficient management of N fertilizers on the extensive areas of tile-drained corn in the lower Great Lakes basin. Total N runoff could be reduced by a fourth or a third using standard erosion control techniques such as grassed waterways and contour planting. (Cassar-FRC)
W82-01148

MERCURY AND ZINC IN THE SEDIMENTS OF SENECA LAKE, SENECA RIVER, AND KEUKA OUTLET, NEW YORK,
Hobart and William Smith Colleges, Geneva, NY.
T. R. Blackburn, J. C. Cornell, and T. R. Fogg.
Journal of Great Lakes Research, Vol 6, No 1, p 68-75, 1980. 9 Fig, 1 Tab, 10 Ref.

Descriptors: *Mercury, *Zinc, *Lake sediments, Sediments, Heavy metals, Metals, Water pollution sources, Path of pollutants, *Seneca Lake, *New York.

Sediments from Seneca Lake, New York, its principal tributary, and its outlfow were sampled from June 1974 to October 1975. Patterns of Hg and Zn concentrations indicated several probable sources of pollution: municipal sewage outfalls, abandoned industrial plants, and a coal-fired power plant. The total Hg content of the upper 2 cm of lake sediments was estimated at 139 kg Hg using an interpolation technique based on the relationship of heavy

metal content to overlying water depth and the increment of Hg above an assumed unperturbed distribution. Sediment Hg concentrations in the Seneca River were 30-480 micrograms per kg; in two heavily polluted lake sites, up to 3000 and 5500 micrograms per kg, respectively; and as high as 1302 micrograms per kg in Keuka Outlet. Zn levels were 59-157 mg per kg in the lake and up to 633 mg per kg in the outlet. Distribution of Zn paralleled that of Hg. The ratio of Zn to Hg was relatively constant at about 650. (Cassar-FRC)
W82-01151

NUTRIENT LOADING OF SOUTHERN LAKE MICHIGAN BY DRY DEPOSITION OF ATMOSPHERIC AEROSOL,
Governors State Univ., Park Forest South, IL. Coll of Environmental and Applied Sciences.
D. A. Dolske, and H. Sievering.
Journal of Great Lakes Research, Vol 6, No 3, p 184-194, 1980. 3 Fig, 6 Tab, 37 Ref.

Descriptors: *Nutrients, *Aerosols, *Air pollution, Water pollution sources, Path of pollutants, Phosphorus, Nitrogen, Nitrates, *Lake Michigan, Lakes.

Dry deposition accounted for 15% or more of all atmospheric nutrient inputs ot total phosphorus and nitrate-nitrite nitrogen and for 3% of total aerosol mass over southern Lake Michigan. High-volume samplers with cellulose fiber filters were used to collect 42 aerosol samples aboard the USEPA's R/V Roger R. Simons at 87 degrees 0 min west and 42 degrees 0 min north during May to September 1977. Micrometeorological data was documented simultaneously. Aerosol deposition velocity was estimated at 0.65 cm per sec using a diabatic drag coefficient method. Dry decomposition loading for this area of the lake was 150,000-180,000 kg per year for P and 3.5 million to 5.1 million kg per year for N. The aerosol P and N was strongly associated with fine particles, less than 1.0 micrometers in diameter. Nutrients deposited in this form are immediately available to the photosynthetically-active regions: overlake, west shore (Milwaukee), Chicago/Gary, Michigan City, and east shore. (Cassar-FRC)
W82-01152

PCB RESIDUES IN BOTTOM SEDIMENTS COLLECTED FROM THE BAY OF QUINTE, LAKE ONTARIO 1972-1973,
Ontario Ministry of Agriculture and Food, Guelph (Ontario). Pesticide Residue Lab.
R. Frank, R. L. Thomas, M. V. H. Holdrinet, and V. Damiani.
Journal of Great Lakes Research, Vol 6, No 4, p 371-376, 1980. 3 Fig, 1 Tab, 9 Ref.

Descriptors: *Polychlorinated biphenyls, *Lake sediments, Organic compounds, Sampling, Chlorinated hydrocarbons, Sediments, Lake basins, Path of pollutants, Pollutant identification, *Lake Ontario, Bay of Quinte, Water pollution sources.

Surface sediments from 214 locations on a 1 km grid were collected in 1972-1973 from the Bay of Quinte, Lake Ontario, and analyzed for polychlorinated biphenyls (PCB) levels. Mean concentration in sediment for the whole lake was 48 plus or minus 43 ng per g (range, < 2-260). Comparing the mean residue in depositional basins (50 ng per g, range < 2-200) and non-depositional zones (47 ng per g, range < 2-260) showed little difference. The six basins studied varied in mean PCB levels from 33 ng per g in Adolphous to 74 ng per g in Trenton. The high concentrations of PCB near the Trent River and the Moira River implicated these rivers as major sources of PCB to the bay. (Cassar-FRC)
W82-01155

TOXICITY AND BIOACCUMULATION OF ENDRIN AND METHOXYCHLOR IN AQUATIC INVERTEBRATES AND FISH,
Environmental Protection Agency, Duluth, MN.
For primary bibliographic entry see Field 5C.
W82-01160

BIOGEOCHEMICAL INVESTIGATION OF BIG CREEK MARSH, LAKE ERIE, ONTARIO,
National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
For primary bibliographic entry see Field 2H.
W82-01163

STUDIES ON UNSATURATED ZONE HYDROLOGY AND RADIONUCLIDE MIGRATION AT A SHALLOW-LAND BURIAL SITE,
California Univ., Berkeley, Dept. of Plant and Soil Biology.
R. K. Schulz, E. B. Fowler, E. H. Essington, and W. L. Polzer.
Soil Science, Vol 132, No 1, p 99-103, July, 1981. 3 Fig, 4 Tab.

Descriptors: *Radioactive waste disposal, *Infiltration, *Tritium, Hazards, Radioactive wastes, Water pollution sources, Runoff, Evapotranspiration, Crop production, Hydrology, Maxey Flats, *Kentucky.

Results of an ongoing field study to determine the migration of radionuclides at a shallow-land burial site at Maxey Flats, Kentucky, are reported. The site was closed due to excessive water entry into the trenches and subsequent migration of the radionuclides. The primary mode of water entry into the trench was by percolation through the trench cap. The movement of 3H through the trench cap was upward from the saturation zone. Tritium moved laterally from the trench, and some movement of 60Co was observed. There was no movement of 137Cs, as it was bound to the soil, and 238Pu moved only a few meters from the trench. The site was a low-level waste burial site, and when it was closed in 1977 it had accumulated about 40% of all the commercially generated low-level radioactive waste in the country. Countermeasures to reduce the present problems at the site could include trench recapping, efforts to increase water runoff from the burial site, and different cropping regimes to increase evapotranspiration. (Small-FRC)
W82-01172

AN ANALYTICAL SOLUTION FOR SOLUTE TRANSPORT THROUGH FRACTURED MEDIA WITH MATRIX DIFFUSION,
National Hydrology Research Inst., Ottawa (Ontario).
For primary bibliographic entry see Field 2F.
W82-01179

PLUME DEVELOPMENT USING LAGRANGIAN MARKER METHOD,
Minnesota Univ.-Duluth. Dept. of Physics.
G. J. Oman, and M. Sydor.
Journal of the Waterway, Port, Coastal and Ocean Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WW3, p 131-148, August, 1981. 14 Fig, 21 Ref.

Descriptors: *Plumes, *Mathematical models, *Turbidity currents, Turbidity, *Clays, Runoff, Erosion, *Lake Superior, Wind, Mathematical studies, Water pollution sources, Sediment transport.

The Lagrangian marker method of plume development was used to study the major sources and sinks of red clay turbidity in extreme Western Lake Superior. Simulations of the development of the Nemadji red clay turbidity plume and the long-range transport of runoff water from the Nemadji and St. Louis Rivers were successful. Results were better than those realized by applying mixing and diffusion in finite difference methods. The numerical simulation revealed several things about the transport of pollutants, including the origin of many distinguishable features of the Nemadji red clay. The relative contributions of runoff, resuspension, shore erosion, and runoff from streams could be estimated, and the distribution of contaminated water under different wind conditions was explained. Easterly winds were shown to generate eddy circulations which tend to trap river effluents in the western part of the lake. (Small-FRC)
W82-01182

MONITORING GROUND-WATER CONTAMINATION AT A FLY ASH DISPOSAL SITE USING SURFACE ELECTRICAL RESISTIVITY METHODS,
Wisconsin-Milwaukee Univ. Dept. of Geological Sciences.
R. B. Rogers, and W. F. Kean.
Ground Water, Vol 18, No 5, p 472-478, September-October, 1980. 10 Fig, 11 Ref. OWRT-A-077-WISC(2).

Descriptors: *Fly ash, *Landfills, *Resistivity, Path of pollutants, Leaching, Leachates, Contamination, *Groundwater pollution, Monitoring, Sampling, Electrical properties, Water quality, Waste disposal.

Surface elctrical resistivity measurements effectively located the horizontal and vertical extent of leachate from a fly ash disposal site used by the Wisconsin Electric Power Co. Water samples were collected simultaneously from 33 wells on the landfill site. Laboratory measurements were made on samples from the well borings to determine the changes in resistivity of each lithology as a function of water saturation and the temperature and conductivity of the pore fluid. Profile data were corrected to a common groundwater temperature, compensating for sampling at different seasons of the year. As resistivity decreased, corresponding water samples showed increased contamination. Sampling from March 1978 to May 1979 indicated that the contamination had progressed in a southeasterly direction. This is depicted on a contour map. (Cassar-FRC)
W82-01218

MONITORING LEACHATE IN GROUND WATER BY CORRECTED RESISTIVITY METHODS,
Wisconsin-Milwaukee Univ. Dept. of Geological Sciences.
For primary bibliographic entry see Field 5A.
W82-01219

THE EFFECT OF FLYASH DISPOSAL ON A SHALLOW GROUND-WATER SYSTEM,
Wisconsin Univ.-Milwaukee. Dept. of Geological Sciences.
D. S. Cherkauer.
Ground Water, Vol 18, No 6, p 544-550, November/December, 1980. 1 Tab, 10 Fig, 6 Ref. OWRT-A-077-WISC(4).

Descriptors: *Groundwater, *Landfills, *Metals, *Contamination, *Fly ash, Waste dumps, Aquifers, Toxicity, Leachates, Infiltration, Percolation, Flow, Surface water, Groundwater recharge, Water level, Drawdown.

At a flyash landfill in Wisconsin, dry ash has been placed in contact with a shallow sand and gravel aquifer. The quality of the ground and surface waters has been monitored on a regular basis for several years following construction. Substantial modification of groundwater quality was noted. Sulfate, calcium, and magnesium concentrations increased. However, after eight years, the contamination has spread less than 200 meters from the site in a permeable aquifer. Toxic metals in the flyash appear immobile in the groundwater. The site is located in alkaline sediment upflow from groundwater discharge in a marsh, which impedes spread of contamination. (Titus-FRC)
W82-01220

RADON-222, IN POTABLE WATER SUPPLIES OF NEW ENGLAND,
Maine Univ. at Orono. Dept. of Physics.
C. T. Hess, S. A. Norton, W. F. Brutsaert, R. E. Casparius, and E. G. Coombs.
Journal of the New England Water Works Association, Vol 94, No 2, p 113-128, June, 1980. 5 Fig, 5 Tab, 15 Ref. OWRT-A-045-ME(3), and B-017-ME(2).

Descriptors: *Potable water, *Carcinogens, *Radon, Public health, *Maine, Pollutant identification, Radioactivity, Diseases, Well water, Granite, New England, Metamorphic rocks, Igneous

rocks, Water supply, Path of pollutants, Water pollution effects.

Samples from private and public water supplies in all the counties of Maine were tested for radon-222. Values from northern Aroostock County water were 1000-2000 pCi per liter; southwestern Maine, up to 100,000 pCi per liter; and public utility water, from 22 pCi per liter in a well aerated lake supply to 11,000 pCi in 40 ft deep wells in gravel over granite. Average values (in pCi per liter) found in different types of rock were: granite, 25,000; sillimanite, 12,000; and chlorite, 1,200. Maximum values in well waters were associated with 100-200 ft deep wells, minimum values with shallow wells. Twenty-minute showers in a closed bathroom produced levels of radon in the air as follows: 20 pCi per liter using water of 620 pCi per liter, and 1600 pCi per liter using water of 70,000 pCi per liter. An average reading over 2-3 days was 9-10 pCi per lier in the air. Statistical studies showed that Maine's cancer rates were 122% of the national average. Significant correlations with radon levels were obtained for lung-tracea-bronchus cancer in women, and for lung and reproductive cancer in men. The highest incidences of total and lung cancers were found in counties with the highest calculated radon in water supplies. (Cassar-FRC)
W82-01221

GROUNDWATER CONTAMINATION BY SANITARY LANDFILL LEACHATE AND DOMESTIC WASTEWATER IN CARBONATE TERRAIN: PRINCIPAL SOURCE DIAGNOSIS, CHEMICAL TRANSPORT CHARACTERISTICS AND DESIGN IMPLICATIONS,
Harvard Univ., Cambridge, MA. Div. of Applied Sciences.
J. P. Murray, J. V. Rouse, and A. B. Carpenter.
Water Research, Vol 15, No 6, p 745-757, 1981. 5 Fig, 9 Tab, 41 Ref. OWRT-B-077-MO(5).

Descriptors: *Landiflls, *Groundwater pollution, *Tracers, Path of pollutants, Water pollution sources, *Kohl Spring, Missouri, Hydrogen sulfide, Sulfides, Lithium bromide, Solute transport, Septic tanks, Wastewater disposal, Leachates.

Procedures for identification of groundwater pollution sources are illustrated in an investigation of severe pollution in Kohl Spring, Missouri, 1.5 km north of a sanitary landfill. Lithium bromide tracer studies, N:P ratios, chemical response to rainfall variation, bacterial counts, correspondence of dilution ratios for conservative pollutants, and the short interval between initiation of the landfill and the appearance of pollutants in the spring indicated that the landfill was the principal source of pollution, not nearby domestic septic tanks and domestic wastewater stabilization ponds. Geologic structure and the karst nature of the subsurface also were favorable to transport of contaminants from landfill to spring. Pollution was characterized by large amounts of hydrogen sulfide and suspended black metal sulfides. Fish and intruding fauna were killed upon exposure. Water quality in the spring improved rapidly after landfill operations were terminated. (Cassar-FRC)
W82-01223

PREDICTION OF DIFFUSION COEFFICIENTS FROM THE ELECTRICAL CONDUCTANCE OF SOIL,
Department of Agriculture, Lethbridge (Alberta). Research Station.
For primary bibliographic entry see Field 2G.
W82-01224

A COMBINED SALT TRANSPORT-CHEMICAL EQUILIBRIUM MODEL FOR CALCAREOUS AND CYPSIFEROUS SOILS,
Science and Education Administration, Kimberley, ID. Snake River Research Center.
C. W. Robbins, R. J. Wagenet, and J. J. Jurinak.
Soil Science Society of America Journal, Vol 44, No 6, p 1191-1194, November/December, 1980. 3 Fig, 2 Tab, 21 Ref. OWRT-B-148-UTAH(3), 14-34-0001-7195.

Descriptors: *Salts, *Gypsum, *Model studies, Salinity, Calcium carbonate, Cations, Mathematical studies, Chemical precipitation, Lime, Calcium sulfate, Electrical conductivity, Conductivity, Solutes, Bicarbonates, *Saline soils, Sulfates, Carbonates, Soil chemical properties, Chemical reactions, Soil water movement, *Ion transport.

An existing water movement-salt transport model was interfaced with two subroutines, chemical precipitation-dissolution and cation exchange, to provide a computer program which successfully predicted electrical conductivity, soil adsorption ratio, and concentrations of Ca, Mg, Na, K, Cl, sulfate and bicarbonate. The transport model is also useful in the study of relative plant growth and water uptake as affected by soil moisture and salinity. Three model options were available for testing the predictions of salt transport and storage: individual ion transport without soil interaction, precipitation and dissolution of lime and gypsum during transport, and cation exchange and precipitation-dissolution reactions. It was necessary to use both subroutines to obtain results agreeing with observed measurements for a gypsiferous and a nongypsiferous soil irrigated with high, medium and low CaSO4 content waters at two leaching fractions. (Cassar-FRC)
W82-01230

PHENANTHRENE BIODEGRADATION IN FRESHWATER ENVIRONMENTS,
Tennessee Univ., Knoxville. Dept. of Microbiology.
T. W. Sherrill, and G. S. Sayler.
Applied and Environmental Microbiology, Vol 39, No 1, p 172-178, January, 1980. 3 Fig, 6 Tab, 20 Ref. OWRT-B-040-TENN(1).

Descriptors: *Biodegradation, *Hydrocarbons, Polycyclic aromatic hydrocarbons, Temperature effects, Phenanthrene, *Microbial degradation, Microorganisms, Reservoirs, Comparison studies.

An evaluation was made of the potential for significant polycyclic aromatic hydrocarbon (PAH) degradation by the indigenous microbial populations in freshwater environments. Phenanthrene was incubated with water samples from various reservoir systems in Tennessee. Biodegradation was assessed by comparison of total polycyclic aromatic hydrocarbon substrate recovery in degradation flasks relative to sterile control flasks. During 1977 field studies, the mean phenanthrene biodegradation was about 80% after a four week incubation. Within a given habitat, 45% of the total variability in phenanthrene biodegradation was attributable to the physical, chemical, and microbiological site characteristics examined. Polycyclic aromatic hydrocarbon degradation was directly related to the historical environmental pollution of the sampling sites examined, the length of biodegradation assessment, temperature, and the molecular size of the polycyclic aromatic hydrocarbon substrate. (Baker-FRC)
W82-01234

URBAN RUNOFF AND COMBINED SEWER OVERFLOW,
Syearns and Wheeler, Cazenovia, NY.
P. E. Moffa, S. D. Freedman, E. M. Owens, R. Field, and C. Cibik.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 770-776, June, 1981. 82 Ref.

Descriptors: *Urban runoff, *Storm water, *Combined sewer overflows, Water pollution sources, Runoff, Model studies, Storm runoff, Storm overflow sewers, Wastewater treatment, Water pollution control, Water quality, Sewer systems, Reviews, Detention reservoirs, *Literature review.

A review of recent literature on urban runoff and combined sewer overflow describes the results of storm water sampling, hydrology, impact on receiving waters, control of pollution, treatment of storm water, watershed management, and rainfall-runoff models. The most polluted storm waters resulted from commercial land use; these were as high in BOD, COD, and solids, but lower in N and P, than secondary effluent. Some sources of pollution were leaves, deicing salts, automobile exhausts, and street debris. The first flush after dry weather was studied by several authors. A study of combined sewer overflows showed that some needed no abatement and others required treatment. Most streams receiving untreated storm waters showed decreased water quality. Pollution control methods include trapping first-flush waters for later treatment, storage in underground reservoirs or detention basins, and porous pavements. Treatment methods emphasize source control (drainage, erosion control, street sweeping, sewer flushing, and storage), sedimentation, swirl grit separators, and ultra-high rate filtration. Models for studying watershed management are reported. (Cassar-FRC)
W82-01254

PULP AND PAPER INDUSTRY EFFLUENT MANAGEMENT,
National Council for Air and Stream Improvement, Inc., Medford, MA.
For primary bibliographic entry see Field 5D.
W82-01260

SYNTHETIC FUEL EFFLUENTS,
Argonne National Lab., IL.
M. F. Torpy, and E. L. Stover.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 828-831, June, 1981. 33 Ref.

Descriptors: *Synthetic fuels, *Coal gasification, *Oil shale, Water pollution sources, Effluents, *Path of pollutants, Effluents, Gasification, Wastewater treatment, Leachates, Industrial wastewater, Coal liquefaction.

Wastewaters produced by synthetic fuel manufacture from coal gasification and liquefaction and oil shale processing were reviewed. Ammonia and phenol, acting synergistically, were the wastewater constituents toxic to fish. High concentrations of mutagens were present in sludges from treated wastewater. Several papers concerned analytical methods for these effluents. Activated sludge treatment effectively removed base-fraction organics, but not some aromatics and polynuclear hydrocarbons. Ammonia concentrations had to be reduced by dilution or stripping prior to biological treatment of coal gasification wastewaters. Treated effluent was used as a cooling medium, according to a patent. Leachates from spent oil shale piles appeared to be biostimulatory to Lake Powell algae. Methods for treating oil shale retort water included anaerobic digestion, steam stripping, biological treatment, activated carbon adsorption, percolation through spent shale, and evaporation. A study showed that chronic, long term groundwater pollution would be likely in areas of future in situ oil shale development. (Cassar-FRC)
W82-01263

POWER INDUSTRY WASTES,
Tennessee Valley Authority, Norris.
T-Y. J. Chu, and H. Olem.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 831-843, June, 1981. 1 Tab, 215 Ref.

Descriptors: *Electric power industry, *Thermal pollution, *Cooling water, Regulations, Thermal water, Powerplants, Nuclear wastes, Reviews, Radioactive wastes, Wastewater treatment, Water pollution sources, Aquatic life, Water reuse, Fly ash, Entrainment, Industrial wastewater.

Many papers concerning the impact of the power industry and its wastes on water resources were included in a review of recent literature. Environmental regulations relating to the power industry and water quality are summarized in a table. Retrofitting small dams for hydroelectric power production may affect the environment in several ways: disturbance of fish passage, fluctuations in water level and flow and water quality, and sedimentation from dredging. Trace metals released into the environment from fossil-fuel burning plants were studied in aquatic ecosystems, rivers, and the

marine environment. Fly ash piles and slurry threatened groundwater and surface water supplies. One case of ground water contamination by heavy metals was reported. Thermal discharge was the subject of many papers, including a state-of-the-art manual, effectiveness of cooling ponds and lakes, models for predicting heat transfer and aquatic life losses, and ecological effects. Evaluation of a cooling lake fishery showed no harmful effects from the thermal enrichment. Entrainment of zooplankton, phytoplankton, and fish at the cooling water intake was studied and methods were developed to assess the effects. Brackish groundwater, municipal wastewater effluent, and agricultural wastewater were all considered as sources for cooling water. Many wastewater treatment processes were described. Excess heated water from steam-electric plants was used in several ways: a municipal water supply, wastewater treatment, open field irrigation, aquatic facilities, greenhouses, and drying grain. Most of the other waste heat utilizations were reported as cogeneration applications. (Cassar-FRC)
W82-01265

RADIOACTIVE WASTES,
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5D.
W82-01268

SOLID WASTES AND WATER QUALITY,
Envirodyne Engineers, Knoxville, TN.
G. R. Brower, and R. Ramkrishnadas.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 896-900, June, 1981. 51 Ref.

Descriptors: *Solid wastes, *Water quality, *Waste disposal, Water pollution sources, Leaching, Monitoring, Fate of pollutants, Regulations, Surface runoff, *Path of pollutants.

The quantity of solid waste, potentially affecting water quality in the United States, estimated at 83.1 million dry metric tons in 1977 and 262.3 million dry metric tons in 1987, has been increased by implementation of environmental legislation such as the Clean Water Act. Contamination or degradation of water supplies has been documented from many sources: septic tank drainfields, rapid infiltration sites, biological treatment wastes discharged into rivers, agricultural and surface runoff, reduced flow from energy development, snow removal dump sites, coal mines, and mercury tailings. Methods of monitoring groundwater and stream pollution from different sources, such as landfills, were reviewed. Treatment and disposal methods and their effects on water quality were described. (Cassar-FRC)
W82-01269

NON-POINT SOURCES,
Browne (F. X.) Associates, Inc., Lansdale, PA.
F. X. Browne.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 901-908, June, 1981. 137 Ref.

Descriptors: *Nonpoint pollution sources, *Literature reviews, Pollution load, Reviews, Nutrients, Runoff, Urban runoff, Sedimentation, Water quality, Watersheds, Model studies, Management planning.

Current research dealing with non-point sources as they affect water pollution treatment is updated in this literature review article. In the area of analysis and characteristics, research has advanced in evaluating the statistical reliability of grab versus composite sampling methods; studies have been conducted of the runoff into undeveloped bays in the Virgin Islands; non-point pollution data were collected on the flat coastal topography of the Maryland eastern slope; and an infiltration-inflow analysis was developed to determine the amount of excess rain and groundwater in a sewer system. Recent studies in the area of water quality effects have included studies of the relationship between precipitation, streamflow and fecal coliform levels in a rural watershed during runoff events; water quality degradation resulting from urban runoff; the spatial and temporal distribution and composition of bacteria in the sediments and overlying waters of the Lynnhaven Estuary in Virginia; and the increasing salinity, turbidity and total hardness of water in the Tigris River resulting from nonpoint source pollution in Baghdad. Watershed research has emphasized the importance of continued management and monitoring for nonpoint pollution in a developing watershed; the impact of urbanization and recreational development on the hydrologic and nutrient budgets of contrasting watershed systems; and the relationship between geology and vegetation of a watershed as predictors of the nutrient and heavy metal-transporting capacity of its suspended sediment. Research also advanced in the areas of model construction for non-point pollution sources, and in methods for managing these pollution problems. (Baker-FRC)
W82-01270

GROUND WATER,
Geraghty and Miller, Inc., Syosset, NY.
For primary bibliographic entry see Field 2F.
W82-01273

BIOACCUMULATION AND TOXICITY OF HEAVY METALS AND RELATED TRACE ELEMENTS,
O'Brien and Gere Engineers, Inc., Syracuse, NY.
For primary bibliographic entry see Field 5C.
W82-01278

AQUATIC SEDIMENTS,
Clarkson Coll. of Technology, Potsdam, NY.
J. V. DePinto, T. C. Young, and S. C. Martin.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 999-1007, June, 1981. 140 Ref.

Descriptors: *Aquatic soils, *Sediments, *Literature review, Sedimentology, Water pollution sources, Bibliographies, Lakes, Aquatic sediments, Sediment transport, *Path of pollutants.

A 1980 literature review is presented on the topic of aquatic sediments which covers the general areas of analytical and sampling methods, heavy metals, nutrients, biological activity, organics, and modeling. Papers referenced include a review of the use of sediment traps by Bloesch and Burns, and a review and comparison of laboratory and in situ techniques for measurement of sediment oxygen demand. Other papers dealt with the importance of sediment material in eutrophication control, and the importance of aquatic sediments as vehicles for the transport of algal nutrients and toxic materials. Sediments in the Great Lakes which originate from land drainage sources are associated with large quantities of phosphorus, industrial organic chemicals, pesticides, and heavy metals. The relationships between sediments and contaminants in aqueous environments were explored in a compilation of papers. (Small-FRC)
W82-01279

MICROBIOLOGY OF WATER,
Environmental Protection Agency, Cincinnati, OH.
E. E. Geldreich.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 1083-1098, June, 1981. 219 Ref.

Descriptors: *Microbiological studies, *Literature review, *Water quality, Bioindicators, Bacteria, Coliforms, Water pollution effects, Path of pollutants.

A review of the literature published during 1980 on the microbiology of water includes sections on microbial indicators of pollution, microbial ecology of water, and the microbiology of river systems, coastal areas and lakes. Studies on indicators defined the characteristics of a good indicator, discussed the coliform standard, and suggested that sulfate-reducing bacteria indicated a fecal origin. The relationships between intestinal microflora and water quality were investigated in cold-blooded animals. Several papers dealt with the natural self-purification processes by which pathogenic and indicator organisms disappear from polluted waters. Microbiology studies of rivers and lakes considered the effects of metabolic activities on the fate of pollutants in aquatic ecosystems. (Small-FRC)
W82-01284

MICROBIOLOGY OF GROUND WATER,
Environmental Protection Agency, Dallas, TX. Region VI.
M. J. Allen.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 1107-1109, June, 1981. 23 Ref.

Descriptors: *Groundwater, *Microbiological studies, *Literature review, Bibliographies, Water quality, Public health, Drinking water, Bacteria, Water pollution sources, Groundwater contamination.

A literature review is presented of papers published during 1980 which concerned the microbiology of groundwater. One study isolated coagulase-positive Staphylococcus aureus from over 6% of rural well water specimens. Another study found more than one third of rural water supplies unsatisfactory. Other studies examined groundwater quality and investigated various tracers including hydrogen-sulfide positive E. coli. One study found that even deep aquifers have been contaminated by septic tank leachate. The virus hazard from wastewater sludge application was investigated, and a literature review was published dealing with viruses in groundwater. The effectiveness of disinfectants and surfactants in the control of iron bacteria was evaluated, and the movement of nitrates and phosphates in septic tank effluent was studied and found to be related to microbial activity in the soil. Another study evaluated the effect of sand-clay types and mixtures in the purification of leachfield effluents. (Small-FRC)
W82-01286

MICROBIOLOGY: DETECTION OF BACTERIAL PATHOGENS AND THEIR OCCURRENCE,
Environmental Protection Agency, Cincinnati, OH.
D. J. Reasoner.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 1112-1134, June, 1981. 7 Tab, 139 Ref.

Descriptors: *Pathogens, *Bacteria, *Literature review, Bibliographies, Human diseases, Water pollution effects, Enteric bacteria, Salmonella, Microbiological studies.

A literature review is presented of 1980 publications dealing with the occurrence and detection of bacterial pathogens. Information from the references is presented in tabular form. These tables include: occurrence of Salmonella serotypes and related enteric pathogens in warm-blooded animals and in cold-blooded animals; Leptospira in animals; miscellaneous bacterial pathogens and opportunistic pathogens in animals; the occurrence and detection of Enterobacteriaceae in water; the occurrence and detection of Vibrio and Campylobacter in water; and miscellaneous bacterial pathogens and opportunistic pathogens in water. Warm-blooded and cold-blooded animals provide a reservoir of salmonellae transmissible to humans. Enteric pathogens including salmonellae, shigellae, yersiniae, and the chlorela and El Tor vibrios are often waterborne. Legionella organisms are also associated with water habitats. (Small-FRC)
W82-01288

ALUMINUM IN PRECIPITATION, STREAMS, AND SHALLOW GROUNDWATER IN THE NEW JERSEY PINE BARRENS,
Pennsylvania Univ., Philadelphia.
W. W. Budd, A. H. Johnson, J. B. Huss, and R. S. Turner.
Water Resources Research, Vol 17, No 4, p 1179-1183, August, 1981. 5 Fig, 1 Tab, 12 Ref.

Descriptors: *Acidic water, *Acid rain, *Aluminum, Water quality, Air pollution, Humic acids, Fulvic acids, Organic matter, Chelation, Precipitation, Fate of pollutants, Water pollution effects, Streams, McDonalds Branch, Pine Barrens, *New Jersey, Groundwater, Hydrogen ion concentration.

Aluminum appears in waters of the New Jersey Pine Barrens at concentrations of 0-200 micrograms per liter (volume weighted average, 105 micrograms per liter) in precipitation; 100-800 micrograms per liter (volume weighted average, 345 micrograms per liter) in streams; and 0-3000 micrograms per liter (volume weighted average, 468 micrograms per liter, and excluding one very acid well, 329 micrograms per liter) in groundwater. These levels are 10 times greater than in most terrestrial waters, except for the acidified waters of New England and New York. The pH of precipitation in this study averaged 4.0; of groundwater, 4.6; and of streams, 4.1. The total (acid reactive) aluminum deposited in the McDonald's Branch basin was 140 mg per sq meter per year over the study period, May 1978 to May 1980. Stream and groundwater outputs were 149 and 110 mg per sq meters per year, respectively. Increased precipitation, streamflow, and decomposing organic matter caused higher Al inputs and outputs in summer. In streams Al may be transported as an organometallic complex with dissolved organic matter, humic and fulvic acids. Groundwater Al concentrations depend on gibbsite solubility in mineral soils and are pH dependent. (Cassar-FRC)
W82-01297

APPORTIONMENT OF NET RECHARGE IN LANDFILL COVERING LAYER INTO SEPARATE COMPONENTS OF VERTICAL LEAKAGE AND HORIZONTAL SEEPAGE,
Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.
For primary bibliographic entry see Field 2G.
W82-01298

WATER CHARACTERISTICS,
Army Construction Engineering Research Lab. (Army), Champaign, IL.
E. D. Smith.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 649-659, June, 1981. 154 Ref.

Descriptors: *Acid precipitation, *Reviews, Water properties, Water analysis, Aquatic plants, Aquatic organisms, *Acid rain, *Environmental effects, Ecological effects.

Recent research on water characteristics is cited in this review article. Acid precipitation has been noted as one of the major environmental problems of the current decade. It poses a serious challenge to national and international bodies to protect water quality. Considerable interest was voiced in 1980 over the causes and effects, prevention and control of acid rain. One study estimated that acid rain was causing an estimated annual $5 billion loss in crop, forest, and aquatic yields, not including the losses due to irreversible damage. Several conferences were held during 1980 on acid rain problems. Groundwater contamination from acid rain was cited as one of the many current and anticipated problems in maintaining a clean and healthful water supply. Acid rain and vegetation interactions were studied in depth, as were the effects of acid precipitation on aquatic organisms. Several researchers reported on analytical techniques. A procedure was developed which may be useful in the quantification of acid rain via isolated precipitation events. The influence of sulfate and soluble metals in summer rains was considered. Natural sources of pollution were shown to affect acid rainfall, as reported for volcanic eruption events. Evaluation of the chemical and physical characteristics of rainfall was reported in the West Indies. Acid precipitation was studied in forest environments. Two efforts assessed the potential for acid rain to leach into the soil. The continuous determination of alkalinity in surface waters, procedures using automated techniques for determining compounds in sea water, techniques for measuring suspended solids, methods for particle analysis, and the development of final effluent monitoring were all investigated. (Baker-FRC)
W82-01305

THE DEPTH OF RAINFALL-RUNOFF-SOIL INTERACTION AS DETERMINED BY P32,
Science and Education Administration, Durant, OK. Southern Plains Watershed and Water Quality Lab.
L. R. Ahuja, A. N. Sharpley, M. Yamamoto, and R. G. Menzel.
Water Resources Research, Vol 17, No 4, p 969-974, August, 1981. 6 Fig, 1 Tab, 16 Ref.

Descriptors: *Phosphorus, *Rainfall-runoff relationships, *Runoff, Fate of pollutants, Tracers, *Soil adsorption capacity, Nutrient removal, Fertilizers, *Agricultural runoff.

The degree of interaction between rainfall, soil, and agricultural chemicals in runoff decreased very rapidly with depth below the surface. P32, a relatively immobile tracer, was applied at the soil surface and at depths of 0.5, 1.0, 1.5, and 2.0 cm in soil boxes. Each box received 6.5 cm per hr of simulated rainfall for 2 separate 30 min periods. Soils were Ruston fine sandy loam Bernow fine sandy loam, and Houston black clay. The average depth of interaction calculated from the data was 0.2-0.3 cm. It was more dependent on the period of rainfall than on the type of soil. The average depths of interaction were used to predict the P concentrations in runoff, which agreed well with observed values. This confirmed that the effective average depth of interaction was valid for P. Transient changes in the effective average depth during a rainfall were then calculated from simultaneous P and P32 concentrations in runoff. The effective average depth increased with time during a rainfall period, more so in the first period than in the second (30 min averages for 3 soil types and 2 storms, 0.207-0.291 cm). (Cassar-FRC)
W82-01318

GEOHYDROLOGIC MODELS OF THE HOUSTON DISTRICT, TEXAS,
Geological Survey, Lawrence, KS.
For primary bibliographic entry see Field 2F.
W82-01335

PHOSPHORUS CONCENTRATION-WATER FLOW INTERACTIONS IN TILE EFFLUENT FROM MANURED LAND,
Cornell Univ., Ithaca, NY. Dept. of Agronomy.
G. W. Hergert, D. R. Bouldin, S. D. Klausner, and P. J. Zwerman.
Journal of Environmental Quality, Vol 10, No 3, p 338-344, July-September, 1981. 10 Fig, 3 Tab, 20 Ref.

Descriptors: *Phosphorus, *Flow characteristics, *Tile drainage, Effluent, *Manure, Fertilizers, Wastewater composition, Flow rates, Nitrate, Chlorides, Perched water table, Water table, Soil solution, Calcium.

During a study of the effects of fertilizing with manure on tile effluent, it was noted that wide variations occurred in the dissolved molybdate reactive phosphorus concentrations both among weekly samples from a given plot and among plots. An irrigation experiment was undertaken to determine the factors causing these variations in phosphorus concentrations in the tile flow. Phosphorus concentrations in tile effluent during drainage events were found to increase with increasing flow, while nitrate and chloride concentrations were inversely related to flow rate. A perched water table was found to exist above high bulk density material with low vertical permeability just below the plow layer. Nitrate/chloride ratios in the tile effluent and in soil samples from various depths indicated that the flow of water to the tile was dominated by downslope movement in the plow layer and by downward movement to the tile in the relatively permeable backfill material above the tile. Phosphorus concentrations were found to be influenced by calcium or salt concentrations in soil solutions and in tile effluent during drainage events. The large increase in phosphorus concentration as the rate of tile flow increases appears to be a consequence of reduced calcium or salt concentration at high flow rates. The impact of manure in these experiments appears to be mainly due to the large amount of phosphorus added, much of which is in inorganic form, which leads to high amounts of labile phosphorus in the soil and which can sustain very high phosphorus concentrations in leaching water. (Carroll-FRC)
W82-01340

FORMATION OF N-NITROSODIMETHYLAMINE DURING TREATMENT OF MUNICIPAL WASTE WATER BY SIMULATED LAND APPLICATION,
Cornell Univ., Ithaca, NY. Dept. of Agronomy.
For primary bibliographic entry see Field 5D.
W82-01343

PREDICTING STREAM SALINITY CHANGES IN SOUTH-WESTERN AUSTRALIA,
Perth Public Works Dept. (Australia).
For primary bibliographic entry see Field 6A.
W82-01350

OBSERVATIONS ON THE HYDROGRAPHY AND INSHORE PLANKTON OF THE BAY OF BENGAL OFF BALASORE,
Ravenshaw Coll., Cuttack (India). Dept. of Zoology.
For primary bibliographic entry see Field 2A.
W82-01362

VOLATILE C1-C7 ORGANIC COMPOUNDS IN SURFACE SEDIMENTS FROM WALVIS BAY,
Woods Hole Oceanographic Institution, MA.
J. K. Whelan, J. M. Hunt, and J. Berman.
Geochimica et Cosmochimica Acta, Vol 44, No 11, p 1767-1785, 1980. 15 Fig, 3 Tab, 51 Ref.

Descriptors: *Organic compounds, *Marine sediments, *Hydrocarbons, Sediments, Sulfur compounds, Organic matter, Volatility, Walvis Bay, Capetown, *South Africa.

Volatile organic compounds were identified in marine sediments collected from Walvis Bay on the African west coast near Capetown, South Africa. Marine organisms, not air transport of material from the adjacent desert or river transport, is believed to be the source of this organic matter. The C1-C7 fraction studied in this work included alkanes (methane, ethane, propane, i- and n-butane, i- and n-pentane, and heptane), alkenes (2-methyl-2-butene, dimethylcyclopentenes, cyclohexene), oxygen containing compounds (2- and 3-methylfuran, 2,5-dimethylfuran, 2- and 3-methylbutanal, and 3-pentanone), sulfur compounds (dimethyl sulfide, thiophene, 2- and 3-methylthiophene) and aromatic compounds (benzene and toluene). Concentrations of most compounds were on the order of a fraction of a nanogram to several nanograms; toluene occurred at the highest levels other than methane. The probable precursors of many of these compounds are marine terpenes, which react in situ at temperatures less than 15 C. The more reactive compounds, furans, keto compounds, and alkenes, were not found in the deeper sections of the 220 cm cores. (Cassar-FRC)
W82-01367

MERCURY AND LEAD CONCENTRATIONS IN SOME SPECIES OF FISH FROM THE TUSCAN COASTS (ITALY),
Pisa Univ. (Italy).
S. S. Buggiani, and C. Vannucchi.
Bulletin of Environmental Contamination and Toxicology, Vol 25, No 1, p 90-92, 1980. 1 Tab, 8 Ref.

Descriptors: *Mercury, *Lead, *Fish populations, Contamination, *Toxicity, Heavy metals, Fish physiology, Tissue analysis, Coastal waters, Estuaries, Environmental effects, Water pollution, Ecosystems, *Tuscan coasts, Italy.

The concentrations of lead and mercury in tissues of marine fish near the Tuscan coasts in 1977 are reported. Composite samples obtained by mixing homogeneous samples from individual fish were analyzed. The data shows that both mercury and lead are consistently present in samples corresponding to the various fishing locations. The maximum absolute values of both metals are found in the same samples. Results suggest potential hazards to human health from small-size fish eaten after only partial removal of the viscera. Seagulls and other components of the food chain should be studied to determine the nature of the source of pollution. The results suggest widespread heavy metal contamination. The fishing areas studied are adjacent to densely populated coasts. (Titus-FRC)
W82-01368

LAND AND STREAM SALINITY IN WESTERN AUSTRALIA,
Perth Public Works Dept. (Australia).
R. M. Hillman.
Agricultural Water Management, Vol 4, No 1-3, p 11-18, 1981. 3 Fig, 3 Ref.

Descriptors: *Saline water, *Salinity, *Catchment areas, Arid lands, Runoff, *Farms, Water quality, Saline soils, Land clearing, Western Australia, *Australia.

Aspects of the problem of dryland salinity and its effects on farmlands and water resources are discussed, with emphasis on Western Australia. Salinity was first recognized as a problem in connection with the supply of boiler water for railway locomotives in 1924. During an agricultural expansion in the 1950's the problem came to the attention of the State and the general public. Today, dryland salinity has resulted in the loss of considerable agricultural land and associated economic losses. Also, only 50% of the divertible surface water remains largely unaffected and still fresh. To arrest and reverse water quality deterioration, clearing controls have been introduced on five important river catchments. Over the past ten years there has been a large research effort aimed at the problem. (Small-FRC)
W82-01374

THE INFLUENCE OF CHEMICAL CONDITIONING AND DEWATERING ON THE DISTRIBUTION OF POLYCHLORINATED BIPHENYLS AND ORGANOCHLORINE INSECTICIDES IN SEWAGE SLUDGES,
Imperial Coll. of Science and Technology, London (England). Dept. of Public Health Engineering.
For primary bibliographic entry see Field 5E.
W82-01387

ATOMIC ABSORPTION SPECTROPHOTOMETRIC STUDIES OF CADMIUM AND ZINC IN COMMERCIAL FERTILISERS, SOILS AND RIVER WATERS,
Aligarh Muslim Univ. (India). Environmental Research Lab.
N. A. Khan, A. Ahmad, A. A. Nomani, and M. Ajmal.
Environmental Pollution, Series B, Vol 2, No 4, p 259-264, 1981. 5 Tab, 18 Ref.

Descriptors: *Fertilizers, *Cadmium, *Zinc, Metals, Heavy metals, Soil analysis, Water analysis, Water pollution sources, Pollutant identification, Rivers, Path of pollutants.

Contamination of soils and waters by cadmium and zinc from commercial fertilizers was determined by atomic absorption spectrometry in soil and water samples collected near Aligarh, India. The concentrations of Cd and Zn, respectively, in fertilizers were 1.2-7.9 and 17-3070 mg per kg; in fertilized productive soils, 0.9-5.9 and 55-95 mg per kg; in barren soils, 0.14-0.06 and 7.5-10 mg per kg; in garden soils, 0.4-0.75 and 7.8-11 mg per kg; and in river water, 0.5-2.3 and 8.5-18.5 mg per liter. (Cassar-FRC)
W82-01388

THE DISTRIBUTION OF MERCURY IN THE SEDIMENTS OF THE PLYM ESTUARY,
Plymouth Polytechnic (England). Dept. of Marine Science.
G. E. Millward, and I. Herbert.
Environmental Pollution, Series B, Vol 2, No 4, p 265-274, 1981. 2 Fig, 5 Tab, 29 Ref.

Descriptors: *Mercury, *Estuaries, *Sediments, Path of pollutants, Plym Estuary, *England, Plymouth Sound, Chemical precipitation, Iron, Manganese, Clay, Organic matter, Rivers, Water pollution sources, Sewage disposal, Metals.

The concentrations of Fe (2800-439,000 micrograms per g), Mn (25-384 micrograms per g), clay (0.03-82.6%), and organic carbon (0.3-8.4%) in surface sediment samples collected in the Plym Estuary, England, correlated well with each other according to statistical analysis. However, Hg concentrations (18-2610 ng per g) were not strongly correlated with any other sediment variables. All data is reported on a dry weight basis. Cluster analysis revealed three geochemical facies. Facies P, upstream with poorly sorted sediments, had higher than expected Hg concentrations (208 ng per g compared with the average for English soils, 60 ng per g) probably as a result of the close proximity to a sewage disposal works outfall. Facies Q, further downstream where water is more saline, had 234 ng Hg per g, only a 16% increase over that of Facies P, suggesting a loss of Hg to Plymouth Sound. Facies R consisted of contaminated sediments (2060 ng per g) associated with sewage effluent disposal. (Cassar-FRC)
W82-01390

CREAMS: A FIELD-SCALE MODEL FOR CHEMICALS, RUNOFF, AND EROSION FROM AGRICULTURAL MANAGEMENT SYSTEMS.
Science and Education Administration, Washington, DC.
Conservation Research Report No 26, May, 1980. 650 p, 147 Fig, 174 Tab, 591 Ref.

Descriptors: *Nonpoint pollution sources, *Model studies, *Erosion, *Agricultural runoff, Agricultural chemicals, Sediment transport, Soil management, Mathematical models, Pesticides, Nutrients.

A mathematical model, CREAMS, was developed to evaluate nonpoint source pollution from field-sized areas under various management practices for selecting Best Management Practices to reduce nonpoint pollution to acceptable levels. CREAMS consists of three components: hydrology, erosion/sedimentation, and chemistry. In order to develop this model quickly, existing physically based models, or those that could readily be modified and improved, were assembled into a package to estimate runoff, sediment, plant nutrient, and pesticide movement in a field. The CREAMS model was developed using units common for the individual components, and therefore, contains mixed or customary units. The purpose of this publication is to provide a complete package for potential users of the model. It is divided into three main divisions. Volume I, model documentation, presents the concepts of model components. Volume II, user manual, provides information on selection of parameter values and model operation. Volume III, supporting documentation, provides the user additional information to obtain parameter values. Results of sensitivity analysis for each component are included in the publication to indicate effects of errors in parameter estimation. (See W82-01402 thru W82-01414) (Moore-SRC)
W82-01401

EROSIVITY 'R' FOR INDIVIDUAL DESIGN STORMS,
Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 2J.
W82-01403

ENRICHMENT RATIOS FOR WATER QUALITY MODELING,
Science and Education Administration, Durant, OK. Water Quality Management Lab.
For primary bibliographic entry see Field 2J.
W82-01410

NITRATE PRODUCTION, UPTAKE, AND LEACHING,
Science and Education Administration, Durant, OK. Southern Plains Watershed and Water Quality Management Lab.
S. J. Smith, D. E. Kissel, and J. R. Williams.
In: CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems, Conservation Research Report Number 26, May, 1980. p 493-508, 5 Fig, 6 Tab, 37 Ref.

Descriptors: *Nitrates, *Soil chemistry, *Leaching, *Mineralization, *Fertilizers, *Nonpoint pollution sources, Agriculture, Soil water, Soil temperature, Watersheds, Return flow.

Nitrate in watershed soils is derived mainly from soil organic matter and applied N fertilizer. The behavior of nitrate in watershed soils is complex, and exact prediction of its fate is neither possible nor practical. A simple, abbreviated way for predicting actual amounts of nitrate produced under field conditions was developed, along with different options for assessing the fate of the nitrate. Prediction is on the basis of the soil nitrogen mineralization potential, N sub o, which may be considered as the quantity of soil organic N that is susceptible to mineralization according to first-order kinetics. N sub o can be determined conveniently based on oxidative release of NH4-N from soil organic matter using acid permanganate. Measurements are made for the plow layer (0-15 cm) and a subsurface layer (15-60 cm). For mineralization intervals longer than a day the integrated expression N = N sub 0 (1 - e super-kt) M may be used where N represents the mineralized N; N sub o, the mineralization potential; K, the temperature-adjusted rate constant; t, the time; and M, the soil water content expressed as a percentage of field capacity. The options for assessing the fate of soil and fertilizer-derived nitrate allow for the use of different types and amounts of available input data. One option is based on a water use/dry matter simulation, while the other option is based on the normal probability curve adjusted for water stress. The amount of nitrate available for leaching represents accumulated soil nitrate production plus fertilizer-derived nitrate, minus that taken up by the crop. Both return flow and vertical leaching losses can be calculated on the basis of the nitrate concentration in the root zone and the amount of water percolating through the zone. (See also W82-01401) (Moore-SRC)
W82-01411

ESTIMATING SOLUBLE (PO4-P) AND LABILE PHOSPHORUS IN RUNOFF FROM CROPLANDS,
Science and Education Administration, Oxford, MS. Sedimentation Lab.
L. L. McDowell, J. D. Schreiber, and H. B. Pionke.
In: CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems, Conservation Research Report Number 26, May, 1980. p 509-533, 7 Fig, 6 Tab, 47 Ref.

Descriptors: *Phosphorus, *Agricultural runoff, *Soil chemistry, *Nutrients, *Nonpoint pollution sources, Mathematical studies, Vegetation, Storm runoff.

Soil P intensity values appear useful for estimating potentially soluble PO4-P in runoff from croplands. Intensity values measured from PO4-P sorption-desorption isotherms and water extracts of soils were used to estimate the annual discharge weighted soluble PO4-P concentrations from plots and watersheds differing greatly in soils, area, fertility, crops, and management. Equilibrium phosphorus concentration (EPC) values better estimated PO4-P in runoff, even when PO4-P from crop residues was an important source. Soil EPC values derived from sorption-desorption isotherms are recommended for estimating the annual discharge weighted PO4-P concentration in runoff. Soil labile P also can be determined from the isotherm, but with a greater uncertainty. simpler tests, such as water-extractable PO4-P and plant available P, can be used to estimate the EPC and the soil labile

P, respectively. They must be tested and verified for application to an area, however. PO4-P concentrations measured in runoff may vary considerably from storm to storm. Crop residues; fertilizers, depending on method of incorporation and time of runoff after application; and possible leaching from green plants can contribute significant and variable quantities of soluble PO4-P. (See also W82-01401) (Moore-SRC)
W82-01412

SOLUBLE N AND P CONCENTRATIONS IN SURFACE RUNOFF WATER,
Science and Education Administration, Morris, MN. North Central Soil Conservation Research Lab.
D. R. Timmons, and R. F. Holt.
In: CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems, Conservation Research Report Number 26, May, 1980. p 534-543, 5 Tab, 20 Ref.

Descriptors: *Surface runoff, *Nutrients, *Nitrogen, *Phosphorus, *Agricultural runoff, Leaching, Vegetation, Fertilizers, Precipitation, Tillage, Erosion control.

The loss of soluble nutrients in surface runoff for a given runoff event is a function of runoff water volume and soluble nutrient concentration. Since existing values for extraction coefficients are limited, flow weighted concentrations were compared to standard treatments for evaluating the effects of various factors on soluble nutrient concentrations. Soluble N and P concentrations in runoff water result from the interactions of factors which include precipitation, vegetation, fertilizer, tillage, plant residue, and soil. Soluble nutrients can be influenced by the type of vegetation, the stage of physiological development, and the climatic factors preceding the runoff event. The leaching of vegetation by precipitation or runoff is a mechanism that contributes nutrients to surface runoff. The concentrations of soluble N and P in surface runoff water will be influenced by: rate of fertilizer application; method of application; form of fertilizer; time of application; and precipitation after fertilization. The different tillage systems have a direct effect on incorporation of fertilizer and on the plant residue remaining on the surface. As plant residues left on the soil surface to decrease soil erosion are subject to leaching by precipitation or runoff water or both, they will tend to increase soluble nutrient concentrations, as compared to conventional tillage. (See also W82-01401) (Moore-SRC)
W82-01413

PESTICIDE CONCENTRATIONS IN AGRICULTURAL RUNOFF: AVAILABLE DATA AND AN APPROXIMATION FORMULA,
Science and Education Administration, Stoneville, MS. Delta States Agricultural Research Center.
R. D. Wauchope, and R. A. Leonard.
In: CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems, Conservation Research Report Number 26, May, 1980. p 544-559, 3 Fig, 2 Tab, 33 Ref.

Descriptors: *Pesticides, *Agricultural runoff, *Pesticide kinetics, *Nonpoint pollution sources, Pesticide residues, Surface runoff, Mathematical studies, Subsoil, Soil surface.

Major factors affecting runoff losses of pesticides include: physical and chemical properties of the formulated pesticide; application rate; location of application residue (foilage, soil surface; soil subsurface); and time elapsed between application and runoff storms. Studies have shown that runoff concentrations are roughly proportional to application rate, all other factors being equal. Regardless of pesticide or site, runoff experiments usually show that runoff concentrations decline drastically as the time elapsed between application and runoff increases. Typically, runoff concentrations decrease by a factor of two for every 2-7 days of delay. When pesticides applied as simple aqueous solutions reach their target and dry, the resultant residue should have properties similar to the pure chemical. Many insoluble pesticides are sprayed adsorbed onto solid granules or in nonpolar solvents or emulsions. This will drastically affect the availability of a pesticide for washoff, even after drying. Application of highly soluble pesticides to foilage results in greater runoff concentrations than applications to bare soil. Some pesticides are applied incorporated into subsurface soil, which leads to low runoff concentrations. All of these factors are combined into a rough mathematical formula containing two empirical constants, which are calibrated using selected data on 373 runoff events from the literature. (See also W82-01401) (Moore-SRC)
W82-01414

THE STRINGFELLOW INDUSTRIAL WASTE DISPOSAL SITE: A TECHNICAL ASSESSMENT OF ENVIRONMENTAL IMPACT,
California Dept. of Health Services, Berkely. Hazardous Materials Lab.
R. D. Stephens.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC, Environmental Protection Agency Report (1980). p 15-20, 1 Fig, 2 Tab, 12 Ref.

Descriptors: *Waste disposal, *Land disposal, *Industrial wastes, *Floodng, *Soil contamination, Storm runoff, Pollutants, Inorganic compounds, Metals, DDT, Leachates, Deposition, Chromium, Environmental effects, Riverside, *California, Stringfellow Quarry.

The Stringfellow Quarry industrial waste site near Riverside, California, was authorized to accept Class I wastes from 1955 to 1972. Other wastes could be accepted only with specific approval of the Regional Water Quality Control Board. Waste disposal records were incomplete, so that, when two incidents of flooding and runoff from heavy storms occurred, it was not known what pollutants may have been washed out. In the second incident approximately 1 million gallons of polluted liquid was discharged into Pyrite Wash. Liquid, surface, shallow subsurface, and vegetation samples were taken within the disposal site, and the surrounding canyon, and along Pyrite Wash for analysis for metals, anions, and organic compounds. The on-site liquid samples were homogeneous for the major inorganic constituents. The off-site samples showed that all the metals except manganese were attenuated from the leachate, with chromium being lost most rapidly. The primary organic constituent was DDT, and most of it remained as a surface layer in the disposal site. Some had migrated away from the site, and levels of 1 ppm were found some distance downstream from the site. (Brambley-SRC)
W82-01415

CASE STUDIES ON THE MIGRATION OF POLLUTANTS IN GROUND WATER,
State Univ. of New York Coll. at Oswego.
R. J. Scrudato, R. Schneider, R. Hinrichs, and P. Goliber.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC., Environmental Protection Agency Report, (1980). p 71-77, 6 Fig, 3 Tab, 6 Ref.

Descriptors: *Groundwater movement, *Groundwater pollution, *Waste disposal, *Land disposal, *Industrial wastes, Hazardous materials, Chemical analysis, Monitoring, *Oswego County, New York, Lake Ontario, Metals, Heavy metals, Bromine, Economic aspects, Case studies.

There are 22 hazardous waste disposal sites in Oswego County, New York, ten of which contain 55 gal barrels of industrial waste distributed by a defunct industrial waste disposal firm. Three of the sites contain more than 75% of the wastes and they also pose the greatest direct threat to surface and groundwater systems. After a preliminary survey of all the sites a drilling program was started. To date 49 auger holes have been completed at 5 sites. Drilling logs are being maintained, ground water migration is being monitored, and organic and inorganic analysis of the water are being conducted. Two sites containing 8,000 and 15,000 barrels of waste, respectively, have been subject to detailed geological and hydrological study. The first site is on the top of a hill, in a ground water recharge area, with ground water movement to the south-southeast, towards residences. The groundwater contains elevated levels of manganese, iron, zinc, and bromine. The second site is situated between two creeks, 1500 ft south of Lake Ontario. Ground and surface waters move toward the lake, and the groundwater contains elevated concentrations of manganese, iron, zinc, nickel, lead, and bromine. Although the threat to the local water resources is recognized, little remedial work has been done, due to lack of planning and funding. Groundwater monitoring and analysis are continuing. (Brambley-SRC)
W82-01424

GEOLOGICAL STUDIES OF INDUSTRIALLY-RELATED CONTAMINATION: SOIL AND GROUND WATER INVESTIGATIONS,
Metcalf and Eddy, Inc., Boston, MA.
D. H. Bruehl, N. K. Chung, and W. F. Diesl.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC, Environmental Protection Agency Report, (1980). p 78-84, 8 Fig, 2 Tab.

Descriptors: *Waste disposal, *Land disposal, *Groundwater pollution, *Paint industry, *Water pollution control, Chromium, Organic solvents, Soil contamination, Leachates, Aquifers, Chlorinated hydrocarbons, Phthalates.

A case history of an actual hazardous waste site investigation is presented to detail the phases leading to closure of a site that is posing a hazard to resources. The dump site is about 1 acre in size in a broad limestone valley, and contains paint wastes and organic solvents. It is poorly defined and covered with dense vegetation. After initial reconnaissance and data collection a baseline was drawn across the suspected site and 51 surface soil samples were taken on a grid pattern. Chromium concentrations in soil samples ranged from 20 - 280,000 mg/kg. Test pits were dug by backhoe to delineate the extent of the wastes. Organic waste, containing trichloroethylene, tetrachloroethane and dibutylphthalate, occurred primarily in a lens within the chromium waste. Laboratory extraction procedures showed that most of the chromium was non-extractable. Ground water analyses showed contamination by chromium, oil and grease, and total organic carbon. Two wells in the contaminated ground water plume contained high concentrations of 5 organic compounds on the EPA Priority Pollutant list. Of the four rehabilitation possibilities - chemical fixation with off-site or on-site disposal, on-site or off-site disposal in an approved hazardous waste landfill - the last was chosen. There was no way to fix the pollutants effectively, and, although more expensive, off-site disposal will afford greater protection to the limestone aquifer and will be quicker to implement. Sampling must be conducted to ensure that all contaminated material is removed, and a clay cap installed on the bedrock to prevent infiltration. (Brambley-SRC).
W82-01425

LOVE CANAL: CHEMICAL CONTAMINATION AND MIGRATION,
New York State Dept. of Health, Albany. Div. of Labs. and Research.
C. S. Kim, R. Narang, A. Richards, K. Aldous, and P. O'Keefe.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC, Environmental Protection Agency Report (1980). p 212-219, 9 Fig, 2 Tab, 8 Ref.

Descriptors: *Love Canal, New York, *Waste dumps, *Chlorinated hydrocarbons, *Dioxin, *Groundwater pollution, Storm sewers, Hazardous materials, Groundwater movement, Leachates, Soil contamination, Outfall, Sumps, Dusts, *Path of pollutants.

A brief history of Love Canal, New York, is presented, from its construction in 1890, its use as a

waste dump from 1942-1953, sale in 1953, construction of residences and a school from 1954 to the early 1970's, to the complaints and fencing of the canal in 1978. The air, soil, water and non-water-soluble liquids were analyzed; all indicated contamination by a large number of organic compounds, including many chlorinated hydrocarbons. Water, leachate, soil and sediment samples contained dioxin at concentratons of 1.4 - 312 ppt. The major swale crossing the canal site and the fill around utility lines were demonstrated not to be the main pollutant pathway, but that the storm sewers were. They received the contaminated water pumped by the sump pumps in the basements of the houses closest to the canal. Two major contaminant entry points were located, and the two outfalls of the storm sewer system were contaminated. Because of the complex mixture of chemicals the hazard posed by any one is difficult to assess. Evidence of through-ground transport of chemical wastes appears to be limited to the first ring of homes, but some canal soils have been moved for use as fill. Windborne dusts and vapors contributed to the wider distribution of chemicals. (Brambley-SRC)
W82-01436

LABORATORY PROCEDURE FOR ESTIMATING RESIDUE DYNAMICS OF XENOBIOTIC CONTAMINANTS IN A FRESHWATER FOOD CHAIN,
Columbia National Fisheries Research Lab., MD.
B. T. Johnson.
Technical Papers of the U.S. Fish and Wildlife Service, No 103, 1980. 18 p, 1 Fig, 16 Ref.

Descriptors: *Model studies, *Food chains, *Bioaccumulation, *Biodegradation, *Pollutants, Microorganisms, Daphnia, Organic compounds, Bluegills, Water pollution, Fish.

A model food chain provides a simple means for estimating, under laboratory conditions, the movement of a synthetic organic chemical contaminant. This laboratory method is designed to investigate the accumulation, transfer, degradation, and elimination (residue dynamics) of xenobiotic chemicals in a simple freshwater food chain representing three aquatic trophic levels: microorganisms (yeast, protozoa, bacteria, or algae); filter-feeder (daphnid); and fish (bluegill). Accumulation data may potentially be drawn from five routes within the model system: water to microorganisms, microorganisms to daphnids, water to daphnids, daphnids to fish, and water to fish. Also, the simultaneous use of different water and food combinations produces a number of possible permutations for the evaluation of residue dynamics. The three trophic levels of the model are never tested together in the same chamber because of the difficulties in controlling natural predator-prey relations between organisms of different trophic levels over extended periods. A flow-through diluter-system, carbon-14 labeled contaminants, gas and thin-layer chromatography, autoradiography, and liquid scintillation spectrometry are used in making residue determinations. Accumulation factors and various index values are developed for measuring and estimating potential accumulation of xenobiotic contaminants by aquatic organisms. The laboratory procedure is economical, simple, reproducible, and ecologically relevant. (Moore-SRC)
W82-01443

MERCURY IN THE MUSCLE TISSUE OF FISH FROM THREE NORTHERN MAINE LAKES,
Maine Univ. at Orono; and Columbia National Fisheries Research Lab.
J. J. Akielaszek, and T. A. Haines.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 2, p 201-208, August, 1981. 1 Fig, 4 Tab, 15 Ref.

Descriptors: *Mercury, *Trout, *Wilderness areas, *Lakes, Fish, Water pollution effects, Air pollution effects, Oligotrophic lakes, Trophic level, *Maine, Chemical analysis, Path of pollutants.

Levels of mercury were measured in the muscle tissue of brook trout (Salvelinus fontinalis) and lake trout (S. namaycush) from three lakes in northern Maine: Eagle Lake, Cliff Lake, and St. Froid Lake. Some researches have reported higher levels of mercury in trout from oligotrophic waters than in trout from eutrophic waters in unpolluted areas. This study also indicated that high mercury concentrations appear to be characteristic of certain fish in certain locations in the Allagash Wilderness Waterway and other areas in northern Maine. Mercury concentrations in lake trout, burbot, and lake whitefish were higher than might be expected. The high mercury content resulted from a combination of factors, including trophic status of the fish, increased uptake of fish mercury under oligotrophic conditions, and some source of mercury input into these aquatic systems. A likely source of mercury in wilderness Maine is contaminated precipitation. (Small-FRC)
W82-01459

A STOCHASTIC APPROACH FOR DESCRIBING CONVECTIVE-DISPERSIVE SOLUTE TRANSPORT IN SATURATED POROUS MEDIA,
Florida Univ., Gainesville, Dept. of Statistics.
P. V. Rao, K. M. Portier, and P. S. C. Rao.
Water Resources Research, Vol 17, No 4, p 963-968, August, 1981. 2 Fig, 14 Ref.

Descriptors: *Solute transport, *Porous media, *Saturated flow, Path of pollutants, Model studies, Mathematical models, Stochastic process.

A stochastic approach is presented for describing convective-dispersive solute transport during steady water flow in homogeneous, water-saturated porous media. The movement of a single solute particle is considered as homogeneous Brownian motion with a positive drift. An integral expression is derived for the form of the expected solute concentration by combining the Brownian motion assumption with the probability density function for the first passage time of a specific solute particle at a given position with the rate of entry of solute particles into the porous medium. This expression leads to known solutions for two cases where analytical solutions exist (instantaneous release and continuous input). The method is also applied to a case of periodic solute input. This method eliminates the need to solve a set of partial differential equations for each set of initial and boundary conditions and allows for estimating the confidence intervals on the drift (velocity) and diffusion (dispersion) coefficients. (Cassar-FRC)
W82-01461

ESTIMATION OF IMPERVIOUS-AREA WASHOFF PARAMETERS,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 4C.
W82-01465

RIVER BASIN HYDROSALINITY MODELING,
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 2K.
W82-01469

NITROGEN LEACHING AS INFLUENCED BY NITROGEN MANAGEMENT AND SUPPLEMENT IRRIGATION LEVEL,
Scientific and Education Administration, Morris, MN. North Central Soil Conservation Research Lab.
D. R. Timmons, and A. S. Dylla.
Journal of Environmental Quality, Vol, 10, No 3, p 421-426, July-September, 1981. 5 Tab, 25 Ref.

Descriptors: *Nitrogen, *Irrigation effects, *Leaching, Nitrogen compounds, Soil types, *Fertilizers, Crop production, Corn, Nitrites, Percolation, Lysimeters, Soil water, Farm management, Nutrients.

The increased use of fertilization and supplemental irrigation on sandy soils in the northwest corn belt area has created a need for information on management practices which can be used to minimize nitrate-nitrogen leaching losses. Nitrogen was applied in droughty Estherville sandy loam soil either as granules broadcast and disked in before planting or in liquid form through the irrigation system four times during the growing season. Supplemental irrigation was applied either as a partial replenishment (2.5 cm) or as a full replenishment (5 cm) irrigation each time the available soil water reached 50% depletion. Annual soil water percolation from spring thaw to autumn freeze averaged about 7.1 cm for nonirrigated corn, 11.2 cm for 2.5-cm irrigated corn, and 18.0 cm for 5-cm irrigated corn during the 5-year period studied. Average annual nitrate-nitrogen losses from the intensely managed corn systems which were both fertilized and irrigated ranged from 17 to 62% higher than such losses from fertilized, nonirrigated corn. The 5-year average nitrate-nitrogen losses for the 5-cm irrigation level were about 31% greater than those for the 2.5-cm irrigation level. The nitrogen application method had no effect on corn yields, but the use of liquid rather than granular nitrogen fertilizer reduced nitrate-nitrogen leaching losses about 11% for the 5-cm irrigation level and not at all for the 2.5-cm irrigation level. A combination of partial replenishment irrigation with period application of fertilizer nitrogen in the irrigation water should sustain high corn yields and help to minimize soil water percolation and nitrate-nitrogen leaching losses. (Carroll-FRC)
W82-01472

THE RELEASE OF SOIL PHOSPHOROUS TO RUNOFF IN RELATION TO THE KINETICS OF DESORPTION,
Scientific and Educational Administration, Durant, OK. Southern Plains Watershed and Water Quality Lab.
A. N. Sharpley, L. R. Ahuja, and R. G. Menzel.
Journal of Environmental Quality, Vol 10, No 3, p 386-391, July-September, 1981. 5 Fig, 4 Tab, 21 Ref.

Descriptors: *Phosphorus, *Surface runoff, *Soil properties, Soil aggregates, Fertilizers, Phosphates, Mathematical models, Pesticide kinetics, *Runoff.

Very little is known about the kinetics of phosphorus release during a rainfall or about the extent and dynamics of the interacting layer of surface soil. This study investigated the release of phosphorus from surface soil to runoff water under simulated rainfall conditions for five soils at several rates of fertilizer phorphorus application. An empirical model had previously been proposed for the description of the kinetics of phosphorus desorption in water as a function of rate of phosphorus addition to soil and of water/soil ratio for five different soils. This model was used to describe the release of phosphorus to runoff water from soil under simulated rainfall. Both the concentration of soluble phosphorus in runoff during an event and mean values for successive events were adequately described by this simplified kinetic model. The logarithm of soluble phosphorus concentration was found to decrease linearly during an event as the logarithm of time increased. Mean soluble phosphorus concentrations of individual runoff events increased linearly with amount of desorbable phosphorus in the surface soil, while a power function related to water/soil ratio could be used to explain the effect of increased rain intensity on concentrations. The average depth of runoff-surface soil interaction calculated from the data using the kinetic model ranged from 1.5 to 3.0 millimeters for the five soils and was significantly related to the degree of soil aggregation. There was close agreement between these depth values and those determined in early earlier studies using phosphorus-32 as a tracer. The depth of interaction increased with increase in soil slope, kinetic energy of the raindrops, and to a lesser extent, rainfall intensity. Modeling of soluble phosphorus loading in runoff could be improved by using this kinetic model. (Carroll-FRC)
W82-01477

EFFECTS OF DAIRY MANURE ON PHOSPHORUS CONCENTRATIONS AND LOSSES IN TILE EFFLUENT,
Cornell Univ., Ithaca, NY. Dept. of Agronomy.
G. W. Hergert, S. D. Klausner, D. R. Bouldin, and P. J. Zwerman.

Journal of Environmental Quality, Vol 10, No 3, p 345-349, July-September, 1981. 2 Fig, 7 Tab, 19 Ref.

Descriptors: *Phosphorus, *Tile drainage, *Manure, Animal wastes, *Dairy industry, Wastewater composition, Fertilizers, Leachage, Drainage, Water quality, Surface runoff.

In the Northeastern United States, large areas of farmland are tile drained due to poor internal drainage. The phosphorus content of tile effluent is an important consideration because a major portion of the phosphorus in these effluents is dissolved and dissolved phosphorus controls phytoplankton activity in lakes in this region. The dissolved phosphorus concentrations and losses in effluent from a tile-drained silt loam during three consecutive years of dairy manure applications were compared with those for the four years prior to manuring. The plots had received fertilizer phosphorus in the years prior to manuring and received applications of either 35 or 200 wet metric tons of manure per hectare per year during manuring. Over 95% of the effluent samples prior to manuring contained dissolved molybdate reactive phosphorus (DMRP) concentrations of less than 30 parts per billion (ppb). During the three years when manure was applied, 92% of the effluent samples from plots receiving 35 ton applications contained less than 30 ppb of phosphorus, while only 53% of the plots receiving 200 ton applications did so. The flow-weighted DMRP concentrations in the tile effluent were 116, 441, and 97 ppb for the 200 ton applications and 22, 10, and 9 ppb for the 35 ton applications, respectively, during the 3 years the manure was applied. Although the tile flow accounted for about 40% of the drainage water lost from the plots, the phosphorus contents of the tile flow amounted to 10% of the total dissolved phosphorus losses in surface runoff. These results demonstrate that annual applications of 200 metric tons of manure per hectare per year have an undesirable effect on dissolved phosphorus in tile drain effluent and provide far more phosphorus and nitrogen than corn crops can use. (Carroll-FRC)
W82-01479

THE ROLE OF ATMOSPHERIC DEPOSITION IN AN EASTERN U.S. DECIDUOUS FOREST,
Oak Ridge National Lab., TN. Environmental Sciences Div.
S. E. Lindberg, and R. C. Harriss.
Water, Air, and Soil Pollution, Vol 16, No 1, p 13-31, July, 1981. 6 Fig, 6 Tab, 59 Ref.

Descriptors: *Heavy metals, *Deposition, *Deciduous forests, *Air pollution effects, Sulfates, Solubility, Toxicity, Rainfall, Environmental effects.

Deposition rates and processes were investigated for Mn, Zn, Cd, Pb, and SO4(2-) in a forest canopy and its underlying soils. The following were determined: aerosol composition and solubility, empirical measurement of dry deposition, precipitation chemistry, and rates and processes of deposition to the forest. Atmospheric deposition supplied from 14% Mn to about 40% Zn, Cd, and SO4(2-), to about 99% Pb to the forest floor. Measured water solubility indicated that these metals may be readily mobilized following deposition. Dry deposition contributed about 20% of Cd and Zn, about 35% of SO(2-), about 55% of Pb and about 90% of Mn. Wet deposition rates for single events were one to four times greater than dry deposition rates. Thus, man's activities which influence the atmosphere may lead to a shift in the exposure of vegetation to certain nutrients and trace contaminants. Heavy metals can cause visible injury to plants, and toxic internal concentrations may exist in plants with no external damage. (Small-FRC)
W82-01491

METHYL BROMIDE AND BROMIDE-ION IN DRAINAGE WATER AFTER LEACHING OF GLASSHOUSE SOILS,
Rijksinstituut voor de Volksgezondheid, Bilthoven (Netherlands).
R. C. C. Wegman, P. A. Greve, H. De Heer, and P. Hamaker.
Water, Air, and Soil Pollution, Vol 16, No 1, p 3-11, July, 1981. 6 Fig, 11 Ref.

Descriptors: *Methyl bromide, *Bromides, *Greenhouses, Drainage water, Leaching, Irrigation water, Fish toxins, Water pollution sources, Agriculture.

The extent of contamination of surface water with methyl bromide and bromide-ion was investigated during the leaching period of two greenhouses treated with methyl bromide. Water samples were analyzed from irrigation water, drainage water, and recipient surface water. Maximum concentrations in drainage water were 9.3 gm/cu m for methyl bromide and 72 g/cu m for bromide ion. During the drainage procedure, fish mortality was observed in the ditches around one of the greenhouses. The rate of decline of methyl bromide was estimated for surface water. The average decline of methyl bromide in the drainage ditch was about 18%. The decline was the result of degradation and volatilization processes. The average half-life for the decline of methyl bromide in the ditch sections was calculated to be 6.6 hr at a water temperature of approximately 11 deg C. Gas chromatography was used to determine concentration levels. (Small-FRC)
W82-01492

GROUNDWATER CONTAMINATION BY TRACE LEVEL ORGANICS FROM A RAPID INFILTRATION SITE,
Rice Univ., Houston, TX. Dept. of Environmental Science and Engineering.
M. B. Tomson, J. Dauchy, S. Hutchins, C. Curran, and C. J. Cook.
Water Research, Vol 15, No 9, p 1109-1116, September, 1981. 3 Fig, 3 Tab, 13 Ref.

Descriptors: *Organic compounds, *Wastewater disposal, *Rapid infiltration, Trace levels, Effluents, Secondary wastewater, Water pollution, Groundwater pollution, Path of pollutants, Infiltration, Chlorinated hydrocarbons, Phenols, Wastewater treatment, Phoenix, Arizona.

An experimental rapid land infiltration site in Phoenix, Arizona, removed about 92% of trace organics from secondary wastewater effluent. A total of 67 organic compounds were monitored in effluent and groundwater. Classes of compounds which were removed at greater than 90% efficiency were chloroaromatics, alkylbenzenes, alkylnaphthalenes, alcohols, ketones, indoles and indenes, and alkoxyaromatics. Compounds with removals of 70-90% were chloroalkanes, alkylphenols, alkanes, and amides. Only 2% of phthalates were removed. Groundwater damped concentration fluctuations, so that there was little variation over a 5-day period. (Cassar-FRC)
W82-01496

THE PHYSICOCHEMICAL SPECIATION OF CD, PB, CU, FE, AND MN IN THE FINAL EFFLUENT OF A SEWAGE TREATMENT WORKS AND ITS IMPACT ON SPECIATION IN THE RECEIVING RIVER,
Lancaster Univ., Bailragg (England). Dept. of Environmental Sciences.
D. P. H. Laxen, and R. M. Harrison.
Water Research, Vol 15, No 9, p 1053-1065, September, 1981. 11 Fig, 7 Tab, 48 Ref.

Descriptors: *Chelation, *Heavy metals, *Cadmium, *Speciation, Path of pollutants, Fate of pollutants, Chemical reactions, Metals, Copper, Lead, Iron, Manganese, Effluents, Rivers, Water quality, Wastewater treatment, Water pollution sources, Particulate matter.

A previously developed scheme for speciation of metals in fresh waters was applied to the analysis of a sewage treatment final effluent and to the river upstream and downstream of the effluent outfall. In this treatment plant Cd levels were high in influent and effluent. Additional metals studied were Pb, Cu, Fe, and Mn. The scheme separates particles into six size fractions. Further analysis determines total non-filterable metal, total filterable metal, ASV-labile metal, Chelex-labile metal and ultraviolet irradiation-ASV-labile metal. In the final effluent, the largest fraction (> 12 micrometers) contained 20% of the Cd, 52% of the Pb, 32% of the Cu, 58% of the Fe, and 13% of the Man. The smallest fraction (< 0.015 micrometers) contained 45% of the Cd, 10% of the Pb, 47% of the Cu, 4% of the Fe, and 83% of the Mn. Intermediate-sized fractions each contained up to 24% of the total amount of each metal. Cd and Cu, but not Pb and Fe, appeared to be complexed with organic matter. Comparing similar analyses of the river upstream and downstream of the outfall showed changes in speciation. A large part of the Cd was added to the smallest size fraction. The major proportions of Pb, Cu, and Fe were added to the colloidal and particulate size fractions, minimizing immediate toxicity to aquatic life. Most of the Mn was present in the smallest fraction. (Cassar-FRC)
W82-01498

RELEASE OF PHOSPHORUS BY CERTAIN BENTHIC INVERTEBRATES,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 2H.
W82-01502

AN ANALYSIS OF ACIDIC PRECIPITATION IN SOUTH-CENTRAL ONTARIO USING AIR PARCEL TRAJECTORIES,
Ontario Ministry of the Environment, Toronto.
J. Kurtz, and W. A. Scheider.
Atmospheric Environment, Vol 15, No 7, p 1111-1116, 1981. 1 Fig, 6 Tab, 26 Ref.

Descriptors: *Acid rain, *Distribution patterns, Distribution, Precipitation, Rainfall, Acidity, Water pollution sources, Spatial distribution, Seasonal distribution, *Ontario, Canada, Sulfates, Nitrates.

An attempt is made to relate the deposition and concentrations of hydrogen, sulfate, and nitrate ions in precipitation collected at Muskoka-Haliburton to the directions of the associated air parcel trajectories. In this manner the relative contributions from the various directions were calculated to assess proposed strategies aimed at controlling and reducing the acidity in Ontario's precipitation. Precipitation collectors were located in central Ontario in an area underlain primarily by Precambrian bedrock with a thin, glacially derived overburden. A mixed deciduous/coniferous forest covers the area, and no large or industrial centers exists within 200 km. The majority of the precipitation collected is in the form of composite samples. The size of the data set for event samples is small. The characterization of acidic precipitation events using a single trajectory may be misleading. Even so, the results of the composite sample analysis show the maximum possible deposition of hydrogen, sulfate, and nitrate ions which could correspond to each octant of trajectory origin. In the case of each of the constituents, and both warm and cold seasons, the South and South-West octants are associated with the greatest maximum possible deposition, and the North octant is associated with the lowest possible deposition. The majority of these acidic deposits at Muskoka-Haliburton was associated with trajectories from the south or southwest. The average concentrations of the individual ions in precipitation for the south, southwest, west and northwest octants are all substantial. Precipitation from the remaining octants was very infrequent. (Baker-FRC)
W82-01513

RECENT ACIDIFICATION OF PRECIPITATION IN NORTH AMERICA,
Cornell University, Ithaca, NY. Section of Ecology and Systematics.
G. E. Likens, and T. J. Butler.
Atmospheric Environment, Vol 15, No 7, p 1103-1109, 1981. 4 Fig, 36 Ref.

Descriptors: *Acid rain, *Temporal distribution, United States, Rainfall, Air pollution, Fallout, *North America, Acidity, Chemical properties.

Analysis of precipitation occurring prior to the industrial revolution, and preserved in glaciers or continental ice sheets, reveals a pH of greater than 5.0. Remote areas such as Greenland and Antarctica have a pH of about 5.5 for precipitation currently falling. However, rain and snow falling over certain regions of the world are currently 5 to 30-40 times more acid than the lowest value expected for unpolluted atmospheres. This phenomenon is observed to be widespread in non-urban as well as urban areas throughout most of eastern North America and western Europe. Annual pH values average about 4.0 to 4.5 in parts of the northeast US and southeast Canada and northwest Europe. Individual storms have been recorded at pH 3.0. During 1959 through 1966 a sampling network was established throughout the conterminous United States. The vast majority of monthly pH readings from stations west of the Mississippi River were consistently above 5.6, with modal values in the high 6's. In contrast, monthly values east of the Mississippi were much more acidic. In the past two decades the southeastern United States has undergone the most rapid decrease in pH. This area has at the same time experienced an increase in atmospheric haze, presumably from increased urban and industrial activity, which would provide a regional source of anthropogenic emissions leading to the increased acidity. The longest continuous comprehensive record of precipitation chemistry in the US was obtained for the White Mountains area of New Hampshire in the Hubbard Brook Ecosystem Study. The pH has varied between 4.03 and 4.21 since the start of record keeping in 1964. Atmospheric deposition of heavy metals and various organic pollutants also occurs, and apparently has increased concurrently with increased acidity of precipitation in eastern North America. (Baker-FRC)
W82-01514

ENVIRONMENTAL RECOVERY IN A MARINE ECOSYSTEM IMPACTED BY A SULFITE PROCESS PULP MILL,
Victoria Univ. (British Columbia).
S. F. Cross, and D. V. Ellis.
Journal of the Water Pollution Control Federation, Vol 53, No 8, p 1339-1346, August, 1981. 8 Fig, 1 Tab, 10 Ref.

Descriptors: *Pulp and paper industry, *Monitoring, *Bioindicators, Aquatic life, *Ecological effects, Water pollution effects, Environmental effects, Fucus, Shores, Oligochaetes, Industrial wastes, Path of pollutants, Indicators, Neroutsos Inlet, *British Columbia, Sulfite mills.

A biological monitoring protocol was developed to assess the environmental recovery of the Neroutsos Inlet and Quatsino Sound, British Columbia, after installation of a sulfite process pulp mill pollution abatement program at the Rayonier Canada Limited plant. Three tests were used: qualitative estimation of enchytraeid/tubificid oligochaete species composition near high tide within the shoreline where obvious pollution impact was evident, Fucus-epifaunal amphipod abundance and diversity, and qualitative surveys of rocky shore fauna and flora. Sampling was done at 10 shoreline stations, representing both east and west sides of the inlet. Lumbricillus lineatus proved to be a good indicator of high concentrations of sulfite mill effluent. Moderate levels of sulfite mill effluent were reflected in the number and diversity of Fucus epifaunal amphipoda, particularly Allorchestes angusta. The point of maximum abundance of this species has moved closer to the outfall each year since 1977, indicating a decrease in pollution. Analysis of the shoreline flora and fauna illustrated the tendency of the effluent to have a greater effect on the east side of the inlet than on the west side. (Cassar-FRC)
W82-01548

RELATIONSHIP BETWEEN INCREASED CROP ACREAGE AND NONPOINT-SOURCE POLLUTION: A GEORGIA CASE STUDY,
Georgia Univ., Athens.
F. C. White, J. R. Hairston, W. N. Musser, H. F. Perkins, and J. F. Reed.
Journal of Soil and Water Conservation, Vol 36, No 3, p 172-177, May/June, 1981. 1 Fig, 7 Tab, 34 Ref.

Descriptors: *Economic aspects, *Agricultural runoff, *Nonpoint pollution sources, Soil erosion, Nutrients, Crop production, Cost analysis, *Cropland, Environmental effects, Pesticides, Nitrogen, Phosphorus, Farm wastes, Pollution load, Sediment load, Case studies, Georgia.

Between 1973 and 1976, 274,000 hectares of new cropland were brought into production in Georgia. On the average, each acre of this new cropland generated environmental loadings of 4.38 tons of sediment, 7.45 pounds of nitrogen, and 1.30 pounds of phosphorus. The impact of these nonpoint sources of pollution must be weighed against the economic benefit from the increased cultivation of land which was formerly woodland, pasture, wildlife areas, idle land, or wetlands. Some environmental impacts of new agricultural production which contribute to water quality deterioration of streams, lakes and rivers were considered. The production of increased loadings of phosphorus, nitrogen, storm runoff, sediments, and pesticides were studied in relation to the area of new cropland cultivated. Aggregate personal income for the state rose an average of $1.41 for each $1.00 increase in net farm income. Methods are recommended for calculating costs to the state for damage to water quality, soil stability, wildlife, and public health and recreation due to the impact of increased land cultivation. (Geiger-FRC)
W82-01550

STREAM NUTRIENT LEVELS AND PROXIMITY OF AGRICULTURAL AND FOREST LAND TO STREAMS: SOME RELATIONSHIPS,
Corvallis Environmental Research Lab., OR.
J. M. Omernik, A. R. Abernathy, and L. M. Male.
Journal of Soil and Water Conservation, Vol 36, No 4, p 227-231, July/August, 1981. 3 Fig, 3 Tab, 32 Ref.

Descriptors: *Nutrients, *Agricultural runoff, *Forests, Mathematical models, Runoff, Stream degradation, Land use.

The effectiveness of forest buffer zones in reducing nutrient levels in streams draining agricultural lands was evaluated by comparing stream nutrient concentrations from sets of 80 and 175 relatively large watersheds with varied patterns of forest and agricultural land use. Two mathematical models were used to test the importance of proximity of general land use types to main streams in affecting mean annual stream nutrient concentrations. Also, land use overlays for each of the 904 NES/NPS study watersheds were studied to detect disproportionate patterns of agriculture or forest proximity to main streams. The proximity of forest and agriculture to main streams did not bear a significant relationship to stream nutrient concentrations beyond that attributable to the proportion of the total watershed that these land uses comprise. It is suggested that over the years, an increasing percentage of nutrients associated with sediment intercepted by the buffer strips should eventually find its way into the streams. Thus, forested buffer strips may be only a temporary solution. (Small-FRC)
W82-01554

CHEMICAL AND BACTERIOLOGICAL QUALITY OF PASTURE RUNOFF,
Science and Education Administration, Lincoln, NE.
J. W. Doran, J. S. Schepers, and N. P. Swanson.
Journal of Soil and Water Conservation, Vol 36, No 3, p 166-171, May/June, 1981. 7 Tab, 27 Ref.

Descriptors: *Fate of pollutants, *Animal wastes, *Feedlot runoff, Feedlot wastes, *Enteric bacteria, Farm wastes, Coliforms, Streptococcus, Feces, Cattle, Bacteria, Agricultural runoff, Water quality standards, Urban runoff, *Pastures, *Nebraska.

Pasture runoff in south central Nebraska is influenced by grazing cattle and natural background characteristics. Chemically, the quality of runoff water from grazed pasture was better than that from unstocked grassland. Pasture runoff, which was of better quality than runoff from urban areas or cultivated cropland, was within recommended water quality standards. Fecal coliforms were increased 5- to 10-fold in runoff from areas grazed by cattle. Levels of fecal coliform were similar in rainfall runoff from both grazed and ungrazed pasture and cropland and urban areas. The fecal coliform counts of the runoff from these four areas exceeded water quality criteria more than 90% of the time. The fecal coliform/fecal streptococci ratio of grazed and ungrazed pasture was similar to wildlife feces, suggesting a large natural background input for these microorganisms. The water quality criteria for bacteriological inputs for runoff from pasturelands should be reevaluated in light of these findings. (Geiger-FRC)
W82-01555

PARAMETERIZATION OF CONTAMINANT TRANSPORT THROUGH AN ANISOTROPIC UNCONFINED AQUIFER,
Canada Centre for Inland Waters, Burlington (Ontario).
A. G. Bobba, and R. P. Bukata.
Nordic Hydrology, Vol 11, No 3/4, p 187-208, 1980. 10 Fig, 17 Ref.

Descriptors: *Groundwater movement, *Aquifers, *Anisotropy, Path of pollutants, Porous media, Unconfined aquifers, Model studies, Adsorption, Solute transport.

A duo two-dimensional deterministic model which considers dispersion, convection, and chemical adsorption processes of contaminant transport in a porous medium was developed and applied to a homogeneous and anisotropic unconfined aquifer. Finite difference techniques were used to consider the effects on contaminant transport of anisotropic groundwater flow (indicated by principal velocity ratios), adsorption coefficient, and dispersivity ratios. Of these parameters the principal velocity ratio (degree of aquifer anisotropy) had a dominant influence on the transport of subsurface contaminants. Contaminant concentration iso-concentration curves were illustrated for a hypothetical waste disposal site on a recharge area. These showed that the contaminant was transported a shorter distance in the lateral direction than in the downstream direction. Some transport was also noticeable in the upstream direction, probably as a result of molecular dispersion. Although this paper considers a simple aquifer, current work, soon to be reported, is directed toward aquifers closer to natural basin conditions. (Cassar-FRC)
W82-01570

EFFECTS OF WATER AND NITROGEN MANAGEMENT ON NITRATE LEACHING LOSS FROM SANDS,
Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
D. G. Watts, and D. L. Martin.
Transactions of the ASAE, Vol 24, No 4, p 911-916, July/August, 1981. 6 Fig, 2 Tab, 12 Ref.

Descriptors: *Nitrates, *Leaching, Irrigation management, Nitrogen, Soil properties, Sand, Permeability, Groundwater, Groundwater pollution, Water quality, Model studies, Great Plains, *Irrigation effects.

The contributions of nitrate to the groundwater system were compared as they might result from the wide range of existing management practices on irrigated sands in the central Great Plains. A mechanistic model of the soil-plant-water-nitrogen system was developed for irrigated corn on sands. It simulates the biological transformation of various nitrogen forms in the soil, nitrogen uptake by the crop, and the loss of water and nitrate from the root zone. Corn having a 105-107 day relative maturity range was simulated. The soil for which the simulations were performed is a Valentine very fine sand, with an available water holding capacity of about nine to ten percent by volume. Two nitrogen amounts, 168 and 253 kg/ha, were used in the studies. The nominal irrigation frequency in the simulations was four days. A maximum system

capacity of 0.94 cm/day was assumed. Four important factors that were seen to affect nitrate leaching loss and were controllable included irrigation amounts, nitrogen source, nitrogen amount, and timing of nitrogen application. For years of normal rainfall, about 30-35 kg/ha of nitrate leaching loss may be expected during the growing season when 168 kg/ha of N is applied to the irrigated corn. When growing season percolation is 12 cm or less, leaching loss of nitrate during the growing season is essentially independent of N source. Nitrate leaching loss increases due to either rain or excess irrigation. Nitrate uptake decreased as leaching loss increased. Nitrate uptake increased when N applications were increased by 50%. Leaching losses during the growing season were slightly increased. Nitrate residual is considerably increased, creating the potential for additional leaching loss during the following spring. (Baker-FRC)
W82-01581

CADMIUM, LEAD, MERCURY, ARSENIC, AND SELENIUM CONCENTRATIONS IN FRESHWATER FISH, 1976-77-NATIONAL PESTICIDE MONITORING PROGRAM,
Columbia National Fisheries Research Lab., MO.
T. W. May, and G. L. McKinney.
Pesticides Monitoring Journal, Vol 15, No 1, p 14-38, June, 1981. 1 Fig, 4 Tab, 91 Ref.

Descriptors: *Heavy metals, *Fish, *Water pollution sources, Industrial wastes, Air pollution effects, Cadmium, Lead, Mercury, Arsenic, Selenium, Monitoring, Rivers, Path of pollutants.

Heavy metal data gathered by the National Pesticides Monitoring Program (NPMP) during 1976-77 are presented and interpreted. Freshwater fish were collected at 98 monitoring stations and analyzed for residues of cadmium, lead, mercury, arsenic, and selenium. Range and geometric mean values in mg/kg wet weight were: Cd. 0.01-1.04, 0.07; Pb, 0.10-4.92, 0.32; Hg, 0.01-0.84, 0.11; As, 0.05-2.92, 0.27; and Se, 0.05-2,87 0.56. Cadmium concentrations have decreased since 1972; the highest concentration was found in carp on the Verdigris River near a zinc plant. There has been no significant change in lead concentrations over the years for which data are available, and the sources of lead are industrial effluents and aerosols. Mercury levels have been declining due to reduced emissions and reduced use. Paper pulping and chlor-alkali operations were common sources. Arsenic levels in fish have increased, possibly because of air pollution, smelter solid wastes, and the use of arsenical pesticides. Selenium contamination is not widespread and is associated with geologic sources and industrial effluents. All five trace elements may undergo biologically mediated transformation reactions that yield organometallic compounds that are routed through the food chain. (Small-FRC)
W82-01584

CHRYSOTILE ASBESTOS FIBERS IN DRINKING WATER FROM ASBESTOS-CEMENT PIPE,
Wisconsin Univ. Madison. Dept. of Preventive Medicine.
M. S. Kanarek, P. M. Conforti, and L. A. Jackson.
Environmental Science and Technology, Vol 15, No 8, p 923-925, August, 1981. 3 Tab. 14 Ref.

Descriptors: *Potable water, *Asbestos, pipes, Asbestos-cement pipe, Water pollution sources, *Pollutant identification, *Drinking water, Water distribution, Corrosion, *San Francisco Bay area.

The water sampling program for the San Francisco Bay epidemiology studies was designed to assess the levels of asbestos in drinking water of the area's different water distribution systems. The asbestos content of distilled water samples was below detectable limits of the analysis. In one major distribution system mean chrysotile counts were 115 times greater in drinking water after flow through the pipe. This demonstration of substantial increases in asbestos fiber counts in nonaggressive drinking water raises questions regarding the validity of aggressiveness indexes for prediction of fiber release from asbestos-cement pipes. A possible explanation of the increase in fiber counts after flow through asbestos-cement pipes is that the fibers already present in the water from natural sources break up, thus yielding higher counts. However, the water samples after flow through asbestos-cement pipe have a larger proportion of longer fibers than the before asbestos-cement pipe samples. Thus the theory of fiber breakup seems to be invalidated. Other factors that might affect the release of fibers from the pipe include size of pipe, flow rate of water, alternate wetting and drying of surfaces, quality of joint materials used, corrosive cleaners in use to flush sections of pipe, and tapping of pipe. Hydrants and other dead ends in a water distribution system often act as a reservoir for fibers released by trapping at other places in the system. (Baker-FRC)
W82-01592

5C. Effects Of Pollution

ACUTE TOXICITY OF LEACHATES FROM COAL GASIFICATION AND LIQUEFACTION SOLID WASTES TO THE FATHEAD MINNOW, PIMEPHALES PROMELAS,
Illinois State Natural History Survey, Urbana. Aquatic Biology Section.
J. J. Suloway, R. M. Schuller, and R. A. Griffin.
Journal of Environmental Science and Health, Part A, Vol 16, No 4, p 419-445, 1981. 2 Fig, 9 Tab, 28 Ref.

Descriptors: *Toxicity, *Leachates, *Coal gasification, *Fathead minnows, Fish, Liquefaction, Bioassay, Effluents, Solid wastes, Industrial wastes, Water pollution effects.

Earlier studies have indicated that coal conversion wastes, which contain relatively large concentrations of accessory elements and which produce acidic leachates, pose a potential hazard to water resources. Surface runoff from exposed piles of solid wastes could enter into streams and lakes, and the percolation of precipitation through wastes deposited in landfills could contaminate groundwater. The acute toxicity of leachates generated from Lurgi gasification ashes, an H-Coal liquefaction residue, and an SRC-1 liquefaction residue was investigated through 96-hour static bioassays using 1 to 6 day old fathead minnow fry. The leachates generated from the Lurgi gasification ash contained concentrations of several chemicals that exceeded recommended water quality standards. Leachates generated from the liquefaction residues in which the pH was not adjusted were acutely toxic. All of the acidic leachates were acutely toxic to the fry, requiring dilutions ranging from 1:10 to as high as 1:2000 to eliminate mortality. Total mortality occurred when the fry were exposed to acidic reconstituted water for 96 hours. Some of the acidic leachates also contained concentrations of aluminum, cadmium, chromium, zinc, copper, and nickel which have been shown to be acutely toxic to fish. Mortality was probably caused by the combined effects of pH and total ionic strength of the leachates. Much of the enormous quantity of solid wastes which will be generated by coal liquefaction and gasification will probably be redeposited on the coal mining site or in landfills, where percolation of acid mine drainage through the wastes could produce highly toxic acidified leachates. (Carroll-FRC)
W82-01108

A QUANTITATIVE STUDY OF SHORELINE MARSH COMMUNITIES ALONG LAKE HURON IN ONTARIO,
University of Western Ontario (London). Dept. of Plant Sciences.
For primary bibliographic entry see Field 2H.
W82-01122

INTERACTIVE EFFECTS OF METALS IN MIXTURES ON BIOMASS PRODUCTION KINETICS OF FRESHWATER COPEPODS,
Canada Centre for Inland Waters, Burlington, (Ontario).
U. Borgmann.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 8, p 1295-1302, August, 1980. 3 Fig, 5 Tab, 12 Ref.

Descriptors: *Copepods, *Metals, *Toxicity, Water quality, Natural waters, Synergistic effects, Productivity, Population dynamics, Water pollution effects.

The concept of additivity of the inverse of growth rates and mortality rates is expanded to provide estimates of the toxicity of metal mixtures to natural assemblages of freshwater copepods. Fourteen binary mixtures of the metals cadmium, copper, mercury, lead, zinc, and arsenic were used. The average observed growth time increase in copepods was 17% larger than the average calculated growth time increases, indicating a slight but sugnificant synergism. Synergism in multimetal mixtures appears to be cumulative. One of the 15 possible binary mixtures, zinc:arsenic, demonstrated a large difference between the calculated and the observed growth rates. For all other mixtures studied, most of the toxicity was accounted for by the summation of noninteractive, single metal effects. The use of the toxic unit concept, which assumes additivity of concentrations rather than effects, would have predicted antagonism in most metal interactions. Although the toxic unit concept may be of use for water quality management if more complete information is not available, it cannot be used to correctly predict synergism or antagonism of metal mixtures. (Baker-FRC)
W82-01125

PHOSPHORUS UPTAKE DYNAMICS AS RELATED TO MATHEMATICAL MODELING OF CLADOPHORA AT A SITE ON LAKE HURON,
Michigan Univ., Ann Arbor.
M. T. Auer, and R. P. Canale.
Journal of Great Lakes Research, Vol 6, No 1, p 1-7, 1980. 6 Fig, 1 Tab, 25 Ref.

Descriptors: *Phosphorus, *Algae, *Cladophora, *Lake Huron, Model studies, Mathematical models, Great Lakes, Lakes, Nutrients, Eutrophication, Fate of pollutants, Water pollution effects.

Cladophora collected near a wastewater treatment plant at Harbor Beach, Michigan, on Lake Huron, had high levels of internal phosphorus (0.25%) and low or negative P uptake rates. Cladophora in water with low levels of dissolved P had low internal P levels (0.01%) and rapid P uptake rates. This research is part of a continuing study directed at understanding and control of nuisance growths of this attached, filamentous green alga in the Great Lakes. A mathematical model was developed to predict the response of Cladophora to management and control alternatives. Preliminary model simulations of Cladophora biomass, internal P, and external P were qualitatively similar to observed field data. (Cassar-FRC)
W82-01149

SOME EFFECTS OF AGRICULTURAL LAND USE ON STREAM INSECT COMMUNITIES,
Waterloo Univ. (Ontario). Dept. of Biology.
K. W. Dance, and H. B. N. Hynes.
Environmental Pollution, (Series A), Vol 22, No 1, p 19-28, May, 1980. 1 Fig, 4 Tab, 14 Ref.

Descriptors: *Land use, *Insects, *Water quality, *Agriculture, Water pollution effects, Macroinvertebrates, Invertebrates, Suspended solids, Soil erosion, Erosion, Species composition, Agricultural runoff, Runoff, Midges, Caddisflies, Aquatic animals, Canagagigue Creek, *Ontario.

Invertebrate community composition was studied in two branches of the Canagagigue Creek, Ontario. Although the two subbasins were similar in 1840, the west branch now is 6.9% forest, 23.7% bank cultivated, and 70% raw soil at the bank. It has 6.6 tons per day of suspended sediment and 964 kg per year of allochthonous organic input (serving as invertebrate food). In the west branch (1976 figures) total coliforms were 2046 per 100 ml; total P, 1.24 mg per liter; nitrites-nitrates, 3.24 mg per liter; suspended solids, 51 mg per liter. Widespread agricultural practices include manure spreading on

fields in winter and on stream banks in summer, wading by cattle in the stream, intensive corn cropping, and uncontrolled barnyard runoff. In contrast, the east branch is 34.1% forest, 13.4% bank cultivated, and 36% raw soil at the bank. It has 3.9 tons per day suspended sediment, and 5103 kg per year allochthonous organic input. In 1976 total coliforms in the last branch were 989 per 100 ml; BOD 1.2, mg per liter; dissolved oxygen, 9.0 mg per liter; total P, 0.079 mg per liter; nitrite-nitrate, 4.07 mg per liter; suspended solids, 114 mg per liter. The east bank is largely forested with little agriculture. Another important difference is the discharge regime. In the west branch flow is 4200-7840 liters per sec in the spring snow melt period with 6 weeks of no flow in summer. In the east branch spring discharges are 2000 liters per sec, summer flow 50-170 liters per sec. The west branch contained 2 species of Plecoptera, 7 species of Trichoptera, 98 taxa (40 chironomids), and no shredders. The east branch contained 8 species of Plecoptera, 15 of Trichoptera, and 110 taxa (36 chronomids). (Cassar-FRC)
W82-01159

TOXICITY AND BIOACCUMULATION OF ENDRIN AND METHOXYCHLOR IN AQUATIC INVERTEBRATES AND FISH,
Environmental Protection Agency, Duluth, MN.
R. L. Anderson, and D. L. DeFoe.
Environmental Pollution, (Series A), Vol 22, No 2, p 111-121, June, 1980. 3 Fig, 3 Tab, 21 Ref.

Descriptors: *Insecticides, *Toxicity, *Bioaccumulation, *Aquatic animals, Methoxychlor, *Endrin, Pesticides, Invertebrates, Accumulation, Stoneflies, Caddisflies, Isopods, Snails, Fish, Bullhead, Water pollution effects.

Endrin was more toxic than methoxychlor to stoneflies, caddisflies, isopods, snails, and bullheads in a 28 day test. Tests were performed in a flowing water system using unfiltered Lake Superior water. Concentrations for endrin were 0.03, 0.07, 0.15, 0.26, and 0.60 micrograms per liter and for methoxychlor, 0.15, 0.42, 1.30, 2.17, and 4.23 micrograms per liter. The isopod Asellus communis was most sensitive to methoxychlor; EC50 (behavior) was 1.78 micrograms per liter at 4 days, and 0.42 at 28 days; LC50 (survival) was 1.75 at 7 days and 0.42 at 28 days. Caddisflies (Hydropsyche sp.) were less sensitive. LC50 was 2.90 micrograms per liter for methoxychlor at 14 days and 1.30 micrograms per liter at 28 days. Stoneflies (Pteronarcys dorsata) and snails (Physa integra) showed no deaths in 28 days in 4.20 micrograms per liter methoxychlor. Endrin toxicities (all in micrograms per liter) were as follows: caddisfly (Brachycentrus americanus) EC50, 0.23 at 4 days, 0.017 at 14 days; LC50, 0.34 at 4 days and greater than 0.34 at 21-28 days; stonefly, EC50, 0.22 at 4 days and 0.05 at 21-28 days, LC50, 0.28 at 7 days, 0.07 at 28 days; bullhead (Ictalurus melas), LC50, 0.45 at 4 days, 0.10 at 28 days. Bioaccumulation factors were: for methoxychlor, stonefly, 348-1130, and snail, 5000-6710; for endrin, stonefly, 610-1033. (Cassar-FRC)
W82-01160

PHYTOPLANKTON PRODUCTIVITY AND STANDING CROP IN THE VICINITY OF THE LAKE HURON-SAGINAW BAY FRONT,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 2H.
W82-01164

POSTSPAWNING MORTALITY OF RAINBOW SMELT IN WESTERN LAKE SUPERIOR,
Brigham Young Univ., Provo, UT. Dept. of Zoology.
W. F. Schaefer, R. A. Heckmann, and W. A. Swenson.
Journal of Great Lakes Research, Vol 7, No 1, p 37-41, 1981. 2 Fig, 3 Tab, 23 Ref.

Descriptors: *Fish populations, *Thermal stress, Heated water, Harbors, Thermal pollution, Smelt, Temperature effects, Fungus, Fish diseases, *Lake Superior, Fish mortality, Rainbow smelt.

Population characteristics and the possible causes of die-offs in rainbow smelt in Lake Superior were investigated. During the springs of 1976 and 1977, 1,958 mature adult rainbow smelt that survived spawning and 1,014 post-spawning dead rainbow smelt were examined. Rainbow smelt were collected during spawning runs at five stations, in the Amnicon River, Burle River and near-shore points off Wisconsin Point. Intensities of the die-offs were determined by counting dead fish along the beach, at 12 stations located east of Superior-Duluth along the north and south shorelines to the Cascade River in Minnesota and Cornucopia Beach in Wisconsin. The die-off of smelt in western Lake Superior reached maximum intensity 3-5 weeks after spawning peaked at each location and lasted about 2 weeks. No dead smelt were found on the beaches prior to or during spawning. The density of dead smelt on beaches decreased with distance from the Superior-Duluth harbor. All dead rainbow smelt were infected with fungus, with the most common locations being the base of the pectoral and pelvic fins and the area around the vent. Fungus was also noted on the dorsal surface of the head and on the caudal peduncle. The fungus was determined to be a non-sexual form of Saprolegnia, probably S. parasitica. The most probable cause of the die-off was temperature stress on spawning smelt in the spawning areas, which increased the susceptibility of smelt to the fungus and may also have produced an osmoregulatory imbalance. The preferred temperature for rainbow smelt is 7 degrees Centigrade. Variation in temperature is considerable between waters in the harbor and the lake, with surface water temperatures in the harbor area of about 15 degrees Centigrade. (Baker-FRC)
W82-01189

EFFECTS OF ATMOSPHERIC PRECIPITATION ADDITIONS ON PHYTOPLANKTON PHOTOSYNTHESIS IN LAKE MICHIGAN WATER SAMPLES,
Argonne National Lab., IL.
For primary bibliographic entry see Field 2H.
W82-01196

RADON-222, IN POTABLE WATER SUPPLIES OF NEW ENGLAND,
Maine Univ. at Orono. Dept. of Physics.
For primary bibliographic entry see Field 5B.
W82-01221

EFFECTS OF LOGGING ON MACROINVERTEBRATES IN STREAMS WITH AND WITHOUT BUFFER STRIPS,
California Univ., Berkeley. Dept. of Forestry and Conservation.
J. D. Newbold, D. C. Erman, and K. B. Roby.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 7, p 1076-1085, July, 1980. 2 Fig, 5 Tab, 49 Ref. OWRT-A-047-CAL(6).

Descriptors: *Water pollution effects, *Macroinvertebrates, *Logging, Stream pollution, Aquatic populations, Species diversity, Mathematical studies, Forest watersheds, Chironomids, Population density, California.

Populations of stream macroinvertebrates in commercial logging and controled watersheds throughout various sample sites of northern California were compared by a nonparametric test of community dissimilarities within matched blocks of two control and one or two treated stations. When Euclidean distance and mutual data were used as dissimilarity indices, significant effects of logging on unprotected streams were observed. Unprotected streams showed higher densities of total macroinvertebrate fauna and certain Chironomidae and lower Shannon diversity values than control waters. Narrow buffer strips (< 30 m) helped to maintain normal Euclidean distance levels but had little effect on population diversity. Streams with wide buffer strips (> 30 m) were similar to control streams in their macroinvertebrate communities and sometimes had a greater amount of diversity, showing effective protection from logging influences. (Geiger-FRC)
W82-01227

EFFECT OF KEPONE ON ESTUARINE MICROBIAL ACTIVITY,
Maryland Univ., College Park. Dept. of Microbiology.
S. A. Orndorff, and R. R. Colwell.
Microbial Ecology, Vol 6, No 4, p 357-368, 1980. 3 Fig, 2 Tab, 20 Ref. OWRT-B-034-MD(3).

Descriptors: *Insecticides, *Estuarine environment, *Microbiological studies, *Kepone, Water pollution effects, Water pollutants, Pesticides, In situ tests, Inhibitors, *Chesapeake Bay.

Natural waters have become contaminated with pesticides, such as Kepone, which may have deleterious effects on microorganisms in the waters which are responsible for mineralization of organic matter and for nutrient regeneration. A method adapted from that of Kogure et al. was used for determination of total numbers of actively metabolizing estuarine bacteria in the presence of the chlorinated insecticide Kepone in the Chesapeake Bay. Observed relationships between results obtained using this method, heterotrophic activity measurements, and a specific activity index are presented. In situ heterotrophic uptake of mixed carbon 14-amino acids and direct viable cell (DVC) count of water samples from the Bay were not significantly affected by concentrations of Kepone not exceeding 0.01 milligrams per liter. Maximum inhibition of heterotrophic uptake (about 85 to 90 percent) and of DVC count (between 45 and 97 percent) was evident when Kepone concentrations exceeded 0.2 milligrams per liter. A specific activity index (either Metabolic Activity/DVC or Kepone-resistant DVC), heterotrophic uptake, and DVC count were found to be statistically correlated to one another, but negatively correlated with concentrations of Kepone. The direct viable cell count proved to be a rapid, simple method for estimating the effect of Kepone on in situ estuarine microbial activity. (Carroll-FRC)
W82-01231

POTENTIAL HEALTH HAZARDS FROM MICROBIAL AEROSOLS IN DENSELY POPULATED URBAN REGIONS,
Louisville Univ., KY. Dept. of Biology.
L. S. Cronholm.
Applied and Environmental Microbiology, Vol 39, No 1, p 6-12, January, 1980. 1 Fig, 5 Tab, 11 Ref. OWRT-A-068-KY(2).

Descriptors: *Bacteria, *Wastewater treatment, Sludge, Human diseases, Water treatment facilities, Microorganisms, Feces, *Coliforms, *Aerosols, Air pollution, Fallout, Sludge, Activated sludge, Bacterial analysis.

This study examined whether the risk of exposure to microbial aerosols in the vicinity of aerobic sewage treatment plants could be determined with sufficient accuracy to assist in public policy decisions regarding the design and location of such plants. Samples of air upwind and downwind of the treatment plants were collected with disposable two-stage Andersen samplers. Three treatment plants were selected for study. Two of these were typical of the small activated sludge plants located in subdivisions; they treat domestic sewage. The third is the largest facility in the area, which is separate from the Louisville, Kentucky, centralized treatment facility and treats a combination of domestic and industrial wastes. Aerosolized bacteria were recovered up to 930 meters downwind of the three plants. Some homes are within this distance. Although the bacterial counts taken on foliage in the area decreased rapidly, at 48 hr after exposure they were significantly higher than the counts on unexposed leaves. The 50% lethal dose of aerosolized Klebsiella pneumoniae was comparable to the 50% lethal dose of a virulent clinical isolate, and enteric bacteria were recovered from the respiratory organs of mice after forced inhalation adjacent to an aerated sludge tank. Coliform density in the effluents of the plants was inversely related to the airborne bacterial load at those plants. This relationship was attributed to the correlation between effluent quality and extent of aeration of activated sludge. Airborne enteric bac-

teria were also isolated near a decorative fountain used by humans for wading. (Baker-FRC)
W82-01232

HEALTH EFFECTS ASSOCIATED WITH WASTEWATER TREATMENT AND DISPOSAL,
Environmental Protection Agency, Cincinnati, OH.
N. E. Kowal, and H. R. Pahren.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 776-786, June, 1981. 133 Ref.

Descriptors: *Wastewater disposal, *Sludge disposal, *Public health, Literature review, *Wastewater treatment, Land disposal, Soil amendments, Pathogens, Bacteria, Viruses, Composting, Aspergillus, Parasites, Water pollution sources, Heavy metals, Cadmium, Zinc, Agriculture, Water reuse.

This literature review discusses health effects associated with wastewater treatment plants, composting of sludge, land application of wastewater and sludge, and use of renovated water. Many cases of plant workers exposed to pathogens and chemicals are reported--chlorinated organics, hydrogen sulfide, bacteria, and endotoxins. Several studies done on risk of bacterial and viral exposures for plant workers and nearby populations failed to show significantly higher illness rates. Several papers discussed the hazards of wastewater discharges with respect to swimming, transmission of antibiotic resistance factors, and viruses. Although exposure to sludge composting did not produce a high incidence of illness, protective measures and regular health examination for workers are recommended. Of particular concern is Aspergillus fumigatus. Studies on land application of wastewater and sludges revealed few ill effects in animals fed sludge, crops grown on sludge amended soils, or exposed humans. However, some potential and actual cases of disease transmission were noted: grazing animals, persons living in kibbutzim practicing wastewater spray irrigation, well water pollution, a cholera outbreak, and leptospirosis incidence. Potential chemical threats from land application are pesticides, polynuclear aromatic hydrocarbons, toxic trace elements (particularly Cd), and nitrates. There is not much information on health effects of treated wastewater reused as part of the potable water supply, but it is preferable to use renovated water for nonpotable uses. Of great concern are pathogens and mutagenic or carcinogenic materials, such as halogenated organics, in reclaimed water. (Cassar-FRC)
W82-01255

MARINE AND ESTUARINE POLLUTION,
California State Univ., Long Beach.
D. J. Reish, G. G. Geesey, P. S. Oshida, F. G. Wilkes, and A. J. Mearns.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 925-949, June, 1981. 6 Tab, 351 Ref.

Descriptors: *Marine environment, *Literature review, *Water pollution sources, Sludge, Ocean dumping, Waste disposal, Bioaccumulation, Toxicity, Pesticides, Organic compounds, Pollutants, Microorganisms, Viruses, Bacteria, Effluents, *Estuarine environment.

Recent advances in the area of marine and estuarine pollution are cited in this literature review. Two international marine pollution symposia were published with topics including heavy metal pollution, radioactive materials, oil and related substances, pesticides, industrial and domestic pollution, environmental evaluation and management, biochemical, physiological, genetic, and behavioral effects, pathobiology, and monitoring. In the area of pesticides, investigations were made concerning the value of various methods of study, the acute effects of certain chemicals, sublethal effects, metabolism, fate, bioaccumulation, and residues. In the area of microbiology specific work was done on microorganisms as pollutants, bacterial disease, viruses, pollutant-microbe interactions, and the conducting of surveys. For complex effluents and environments papers focused on the toxicity of contaminants to marine and estuarine animals. Oil pollution studies considered specific analytical methods, residues of oil in water and sediment, residues in biota, dispersants, field studies, toxicity and sublethal effects, bioaccumulation, diseases and abnormalities, and the ocean dumping of sludge plus methods of dredging and recovery. (Baker-FRC)
W82-01274

THERMAL EFFECTS,
Rexnord Inc., Milwaukee, WI.
J. B. Cravens.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 949-965, June, 1981. 9 Fig, 194 Ref.

Descriptors: *Thermal pollution, *Literature review, Heated water, Plumes, Thermal power, Thermal stress, Thermal water, Lakes, Reservoirs, Plants, Aquatic animals, Model studies, Streams, Rivers, Estuarine environment.

Recent research in the area of thermal effects as they relate to water pollution is cited in this literature review article. A far-field mathematical model was presented for numerical simulation of transient one- or two-dimensional thermal distribution in regions of severe reversing-flow conditions. Power plant intake effects were assessed at population and ecosystem levels. Temperature guidelines for power stations in Canada were concerned with protection of ichthyoplankton. The MacArthur-Wilson equilibrium model was used to analyze zooperiphyton on experimental substrates. Water temperature time series data was analyzed, leading to development and parameterization of a stochastic model able to simulate variations in water temperature characteristic of littoral zones of North American lakes. Specific site studies were conducted at cooling lakes and reservoirs, in specific streams and rivers, at the Great Lakes, in marine and estuarine systems, and in experimental ecosystems. Effects of hot-water evacuation were studied on growth and reproduction of plants in the vicinity. Effects of thermal water pollution were also studied on the reproduction, development, morphology, and feeding of animal species in the general area. The effects of temperature on specific diseases and parasites were investigated along with biochemical reaction studies. Some beneficial uses of warmer than natural water were also considered. (Baker-FRC)
W82-01275

BIOASSAYS - PROCEDURES AND RESULTS,
Ecological Analysts, Inc., Sparks, MD.
For primary bibliographic entry see Field 5A.
W82-01277

BIOACCUMULATION AND TOXICITY OF HEAVY METALS AND RELATED TRACE ELEMENTS,
O'Brien and Gere Engineers, Inc., Syracuse, NY.
C. B. Murphy, Jr.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 993-999, June, 1981. 1 Tab, 96 Ref.

Descriptors: *Heavy metals, *Environmental effects, *Bioaccumulation, Biological magnification, Acid rain, Mercury, Lead, Zinc, Copper, Cadmium, Lakes, Estuaries, Environmental pollutants, Toxicity, Water pollution effects, Path of pollutants.

Several studies have identified the presence of heavy metals in the environment. Average mercury levels in fish taken from New York waters appeared to be about 30% lower in recent tests than they had been in 1970 data. However, mercury levels were seen to be increasing in fish from several large non-industrialized Adirondack Mountain lakes, suggesting effects from acid rain. Cadmium and lead have been found in mussels from the St. Lawrence estuary. Studies are also cited dealing with the detection of copper and zinc in environmental waters and the effects of these metals on the surrounding environment. Bioconcentration studies have indicated that age of the cell population and concentration of the pollutant are factors which influence the degree of concentration of a chemical in an organism or in the tissue of an organism. Cadmium accumulation in sea worms, mercury accumulation in rainbow trout, pollutant biomagnification in bluegill sunfish, and the mercury content of pike have all been investigated. Toxicity studies and literature reviews have been conducted for arsenic, cadmium, copper, chromium, lead, mercury, zinc, selenium, and other metals. The effect of water hardness on toxicity of cadmium to aquatic organisms was investigated, along with the chloride dependent cellular detoxification mechanism. The role of bacteria in the detoxification of heavy metals in the environment, the effect of complexation of metals with synthetic agents, and the influence of water temperature on the transfer of methylmercury in the freshwater trophic chain were studied. Theoretical and mathematical approaches to the combined effects on freshwater fish and other aquatic life of mixtures of toxicants in water were also studied. (Baker-FRC)
W82-01278

EFFECTS OF POLLUTION ON FRESHWATER INVERTEBRATES,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
A. L. Buikema, Jr., E. F. Benfield, and B. R. Niederlehner.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 1007-1015, June, 1981. 105 Ref.

Descriptors: *Invertebrates, *Water pollution effects, *Literature review, Bibliographies, Toxicity, Bioindicators, Bioassay, Organic compounds, Metals.

A review is presented of 1981 literature dealing with the effects of pollution on freshwater invertebrates, which includes the general topics of methods, microcosms, communities, cladocera, other zooplankters, amphipods, decapods, insects, mollusks, and protozoa. The proceedings of a meeting on invertebrate bioassays emphasized toxicity testing. The proceedings covered the advantages and disadvantages of using the following in toxicity tests: Daphnia, chironomids, Hexagenia, amphipods, copecodes, molluscan larvae, polychaetes, and grass shrimp. A literature review paper considered other potential species and toxicity testing methods. An extensive review on polycyclic aromatic hydrocarbons in the aquatic environment is referenced, as is a similar review dealing with benzene, xylene, and toluene. Toxicity of metals was the subject of a new handbook and an aquatic toxicology meeting. A book on ecosystem restoration dealt with recovery processes in damaged ecosystems. A review is referenced which concerns aspects of the development of water quality standards. (Small-FRC)
W82-01280

FRESHWATER MACROINVERTEBRATES,
Michigan Univ., Ann Arbor. School of Natural Resources.
M. A. Quigley.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 1015-1027, June, 1981. 191 Ref.

Descriptors: *Macroinvertebrates, *Water pollution effects, *Literature review, Bibliographies, Ecology, Industrial wastes.

A review of 1980 literature on freshwater macroinvertebrates is presented which includes the general topics of indexes and indicators, organic and other wastes, physical environmental alterations, distribution and habitat requirements, production, food and feeding, periodicity and drift, animal-sediment interactions, and methods. A book on oligochaete aquatic biology and a proceedings on Corbicula cover information on population dynamics, the effects of human activities, and other topics. A collection of papers on Ephemeroptera and a similar collection on Chironomidae are referenced which concern the biology and ecology of these

macroinvertebrates. References dealing specifically with water pollution issues include a survey of the effects of coal mining on a stream environment and macroinvertebrate communities and an examination of the effects of coal industry wastes on a small river. The effects of organic pollutants in the River Trent and the consequences of acidified lakes in Sweden were considered by other referenced papers. (Small-FRC)
W82-01281

THE EFFECTS OF POLLUTION ON FRESHWATER FISH,
Environmental Protection Agency, Duluth, MN.
R. L. Spehar, A. E. Lemke, Q. H. Pickering, T. H. Roush, and R. C. Russo.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 1028-1076, June, 1981. 1 Tab, 376 Ref.

Descriptors: *Fish, *Water pollution effects, *Literature review, Fish toxins, Bibliographies, Organic compounds, Water quality, Industrial wastes, Environmental effects.

A review is presented of 1980 literature on the effects of pollution on freshwater fish. An extensive table is included which summarizes the acute and chronic toxicity of inorganic and organic pollutants to freshwater fish. Published literature included many reviews and symposia which presented information on water quality, physical and chemical pollutants, and industrial and municipal effluents. These include the aquatic toxicity of Cu, Cn, V, and chlorophenol, and the effects of natural and artificial sources of radiation. Other papers concerned the effects of Hg, the effects of mosquito control agents, and the relationship between biotransformation and toxicity of xenobiotic chemicals in fish. Most of the articles cited deal with the effects of chemical pollutants. Papers are cited which deal with the effects of chlorine and wastewater, and pulp and paper wastes. (Small-FRC)
W82-01282

SUBSTRATE ASSOCIATED MICROFAUNA,
Texas University at Dallas, Richardson.
G. R. Lanza, and W. T. Waller.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 1076-1083, June, 1981. 53 Ref.

Descriptors: *Microorganisms, *Literature review, *Toxicity, Water pollution effects, Bibliographies, Chlorine, Oil pollution, Pesticides.

A review is presented of 1980 literature on substrate associated microfauna which includes a section on papers dealing with toxicity studies. Respiration at two temperatures of two species of freshwater leech exposed to chlorine were studied. The use of Chilomonas paramecium populations in acute toxicity testing was evaluated, and the oxygen uptake in freshwater planaria exposed to various pesticides was studied. The sensitivity of 12 species of marine ciliates to high thermal stress was studied. The effects of crude oil on the Red Sea coral Stylophora pistillata were studied in the laboratory, and 500 potential pollutants were tested on bacteria, green algae, and protozoa. One study monitored stream pollution using protozoan communities and artificial substrates. The effect of the Cadiz oil spill on selected meiofauna was determined, and another study considered the effects of alkanes from the Buccaneer oil field in the Gulf of Mexico on benthic organisms. Other reports discussed the sampling, preservation, and physiological characterization of substrate-associated microfauna in aquatic systems. The structure, function and colonization patterns of substrate-associated microfauna as affected by ecological factors are also reviewed. (Small-FRC)
W82-01283

DISEASE OUTBREAKS CAUSED BY DRINKING WATER,
Harvard School of Public Health, Boston, MA.
G. F. Craun.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 1134-1138, June, 1981. 39 Ref.

Descriptors: *Diseases, *Drinking water, *Pathogens, Reviews, Water pollution sources, Water pollution effects, Epidemiology, Public health, Human diseases, Infection, Water treatment, Poisons, Giardiasis, Cooling water, Viruses, Bacteria, Parasites.

Disease borne by drinking water caused 2 deaths and 48,193 cases of Illness in the U.S. during 1971-78. Of the 224 outbreaks of disease, 58% were in non-community water systems. However, most cases of illness (69%) resulted from problems in community water systems. Contamination of distribution systems was responsible for 38% of the outbreaks, and treatment deficiencies, for 33%. Cases of chemical poisoning involved a cross connection between a ship's drinking water system and the photographic developing machines and several incidents of excessive fluoride addition in water treatment systems. Giardia lamblia was the most frequently encountered pathogen, and outbreaks of waterborne giardiasis have been increasing in frequency. Most have occurred in systems using surface water with chlorination as the only treatment. Studies of a gastroenteritis outbreak at Crater Lake National Park in 1975 showed 5 cases of hepatitis A in 2206 persons exposed and not given immune serum globulin, but this was not statistically significant. On a national level waterborne hepatitis A amounts to 35-120 average annual cases, or 1% of the annual reported hepatitis A cases. Other outbreaks of waterborne disease were caused by toxigenic E. coli on a cruise ship, a water humidification system in a large factory, Legionella pneumophila in cooling and air conditioning systems, and nontuberculous myobacteria in the southeastern U.S. (Cassar-FRC)
W82-01289

WATER CHARACTERISTICS,
Army Construction Engineering Research Lab. (Army), Champaign, IL.
For primary bibliographic entry see Field 5B.
W82-01305

INFLUENCE OF PCBS IN WATER ON UPTAKE AND ELIMINATION OF DDT AND DDE BY LAKE TROUT,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
R. J. Hesselberg, and L. W. Nicholson.
Journal of Environmental Quality, Vol 10, No 3, p 315-318, July-September, 1981. 1 Fig, 2 Tab, 13 Ref.

Descriptors: *Polychlorinated biphenyls, *DDT, *Trout, Water pollution effects, Pollutants, *Lake Michigan, DDE, Fish, Sublethal effects, Pesticides, Chlorinated hydrocarbons, Bioaccumulation, Metabolism.

Several species of fish in Lake Michigan, particularly lake trout, were heavily contaminated with DDT and its metabolites during the 1960s. Although DDT was banned in the states bordering the lake in 1970, researchers predicted that more than a century would be needed to reduce DDT contamination below detectable levels. However, by 1976, residues of total DDT in lake trout from Lake Michigan had declined from 10.5 micrograms per gram in 1970 to 5.7 micrograms per gram. The detection of relatively high concentrations of polychlorinated biphenyls (PCBs) in lake trout tissues during this period led to the hypothesis that uptake and elimination of DDT and DDE by the fish may have been influenced by the accumulation of PCBs in the fish. Fingerling lake trout were exposed to various combinations of DDT and DDE (100 nanograms per liter) and PCBs (100 and 500 nanograms per liter) in water for 12 weeks in order to determine what, if any, effect PCBs had on the uptake or elimination rates of DDT and DDE. PCB exposure was continued for an additional 16 weeks after completion of exposures to DDT and DDE in order to measure any effect the PCBs might have on DDT and DDE elimination by the fish. Comparison of the DDT and DDE accumulation and elimination rates showed that PCBs did not influence these processes in lake trout. These results indicate that the decline of DDT and DDE in fish from Lake Michigan is not related to the presence of PCBs, but actually reflects a decrease in the amount of these contaminants available to the fish from the food or water. (Carroll-FRC)
W82-01342

A HYDROBIOLOGICAL SURVEY OF A POLLUTED CANAL,
Baghdad Univ. (Iraq). Dept. of Biology.
M-B. M. Mohammad.
Hydrobiologia, Vol 74, No 2, p 179-186, September, 1980. 6 Fig, 1 Tab, 24 Ref.

Descriptors: *Water quality, *Wastewater disposal, *Aquatic life, *Water pollution effects, *Qanat Al-Jaish Canal, *Iraq, Canals, Benthic fauna, Invertebrates, Macroinvertebrates.

The chemical, physical, and biological aspects of the 23.5 km long, 25 meters wide, and 1.5 meters deep Qanat Al-Jaish canal, Baghdad, Iraq, is documented. The canal receives wastewater from the Jamila residential quarter and contains a variety of waste and refuse. Sampling at 4 stations over a 12-month period starting February 1978 showed that species diversity of net aquatic life varied inversely with the degree of pollution as measured by BOD (3.2-20 mg pr liter). In the benthos, diversity indices increased with increases in amounts of silt and organic detritus. Fauna in the canal consisted of 41 species in 6 phyla, arranged in order of abundance: Arthropoda, Annelida, Aschelminthes, Mollusca, Platyhelminthes and Rhynchocoela. The indices of diversity were not directly related to concentrations of phosphate (6.0-8.5 mg per liter), nitrite (0.3-0.46 mg per liter), ammonia (0.55-0.79 mg per liter), temperature (11-31 degrees C), oxygen content (0-9 mg per liter), chloride (70-130 mg per liter), hardness (400-600 mg per liter), pH (7.0-7.9), Secchi disk transparency (0.1-0.7 meters), and water velocity (0.5-1.3 meters per sec). The waste stream entering the canal contained no macroscopic animals except for the pollutant-resistant tubificid worm, Limnodrilus. The waste stream, with high levels of salts and low levels of dissolved oxygen, raised the canal BOD from 5 mg per liter to 11-20 mg per liter, with a reduction to 10-15 mg per liter within 14 km downstream. (Cassar-FRC)
W82-01356

MINING POLLUTION AND THE DIET OF THE PURPLE-STRIPED GUDGEON MOGURNDA MOGURNDA RICHARDSON (ELEOTRIDAE) IN THE FINNISS RIVER, NORTHERN TERRITORY, AUSTRALIA,
Australian Atomic Energy Commission Research Establishment, Lucas Heights.
R. A. Jeffree, and N. J. Williams.
Ecological Monographs, Vol 50, No 4, p 457-485, December, 1980. 5 Fig, 15 Tab, 102 Ref.

Descriptors: *Mine drainage, *Fish, *Diets, Heavy metals, Sulfate, Mine wastes, Industrial wastes, Aquatic animals, Toxicity, *Finniss River, *Australia, Water pollution effects, Eleotridae, Abandoned mines, Copper mines, Uranium mines.

The diet of the freshwater eleotrid Mogurnad mogurnda Richardson in the Finniss River, Australia, was investigated, and pollutants in the river were determined which reach the river from Rum Jungle, an abandoned uranium/copper mining area. The pollutant discharge contained large amounts of copper, zinc, manganese, and sulfate at low pH values. The fish ate high abundances of animals of the taxa Dytiscidae, Chironomidae, Ceratopogonidae, Trichoptera, Odonata, Copepoda, and Pisces. Five foods were more abundant in the diets of the polluted zone, and three in those of the unpolluted zone. Two categories of foods were contrasted for their usefulness in distinguishing between the zones by both hierarchical agglomerative and discriminant function analysis. Aquatic respirers were more effective than those obtaining oxygen directly from the atmosphere or via a film or bubble of air. The relevance for pollution studies of dietary analysis rather than sampling fauna directly is discussed in terms of food substitution,

switching, strategies for abundance and recovery by the fauna, and possible effects of pollutants on the fish as an intervening collector. (Small-FRC)
W82-01366

EVALUATION OF THE POLLUTED RIVER SAVINJA WITH THE HELP OF MACROPHYTES,
Ljubljana Univ. (Yugoslavia). Biological Inst.
D. Vrhovsek, A. Martincic, and M. Kralj.
Hydrobiologia, Vol 80, No 2, p 97-110, May, 1981. 6 Fig, 7 Tab, 23 Ref.

Descriptors: *Monitoring, *Pollution load, *Rivers, Environmental protection, Water pollution control, *Savinja River, *Yugoslavia, Saprophytic bacteria, Oligotrophy, Trophic level, Mesotrophy, Aquatic plants, Water quality, Water pollution effects.

The influence of inorganic and organic pollution on the river Savinja, Slovenia, a typical Alpine river in its upper part and a lowland river in its lower part, was evaluated with the help of macrophytes. Mosses were particularly helpful in quantitative estimations of the percentage of their coverage and species composition. All other emersal and submersal plants were also listed and included in the qualitative interpretations of the degree of saprobicity. Qualitative and percentile composition was investigated at nine points along the Savinja river, chosen with the intention of determining gradual changes in macrophyte growth on account of the water current and the influence of individual pollutants. With the aid of species composition and stages of saprobicity, the Savinja can be divided into segments. The upper part is oligosaprobic, from Celje to Lasko beta mesosaprobic, and to the river's mouth alpha-beta mesosaprobic. When comparing the concentrations of some ions it was determined that they do not surpass the toxic levels and therefore the differences in species content are not the result of ion concentrations, but rather of the synergistic effects with other types of pollution. (Baker-FRC)
W82-01377

THE EFFECT OF POLLUTANTS FROM THE COAL INDUSTRY ON THE FISH FAUNA OF A SMALL RIVER IN THE SOUTH WALES COALFIELD,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
J. Scullion, and R. W. Edwards.
Environmental Pollution (Series A), Vol 21, No 2, p 141-153, February, 1980. 3 Fig, 5 Tab, 38 Ref.

Descriptors: *Fish populations, *Mine wastes, *Coal mines, *Acid mine drainage, Water pollution effects, Toxicity, Rivers, Trout, Iron, Mine drainage, Acid streams, Suspended solids, Silting, Water quality, Invertebrates, Fish food organisms, Population density, Taff Bargoed, *Wales.

The Taff Bargoed, a river in south Wales, receives pollution from coal mine sources at three separate locations: acid drainage from coal stockpiles in the headwaters, pumped mine water containing high levels of silt, and ferruginous drainage of neutral pH from old mine workings. Brown trout (Salmo trutta) populations and water quality were studied at 11 stations in the river. Trout density was very low, less than 0.05 per sq meter, downstream of acid and ferruginous drainage, in the latter cases as a result of poor invertebrate food supplies rather than toxic water. In the silty water, average suspended solids 100 mg per liter, trout densities of less than 0.15 per sq meter were found, and the fish were in poorer condition. Trout eggs had 85-87% hatching rates in unpolluted water, 1.3% downstream of the silty mine water and 13.3% downstream of the ferruginous drainage. The stoneback (Noemacheilus barbarulus L.) was reduced in density at the silted stations. Bullhead (Cottus gobio L.) has been essentially eliminated since 1969, probably as a result of the acid water. Minnows (Phoxinus phoxinus L.) were only found in the upper and middle reaches of the river and in patchy distribution. Eels (Anguilla anguilla L.) were absent from the upper reaches and rare elsewhere. (Cassar-FRC)
W82-01389

ABATE: EFFECTS OF THE ORGANOPHOSPHATE INSECTICIDE ON BLUEGILLS AND INVERTEBRATES IN PONDS,
Columbia National Fisheries Research Lab., MD.
H. O. Sanders, D. F. Walsh, and R. S. Campbell.
Technical Papers of the U.S. Fish and Wildlife Service, No 104, 1981. 8 p, 3 Fig, 3 Tab, 11 Ref.

Descriptors: *Organophosphorus pesticides, *Toxicity, *Insecticides, *Bluegills, *Invertebrates, Growth, Immature growth stage, Fish food, Biomass, Larvicides, Aquatic insects, Enzymes.

The organophosphate insecticide Abate is used for controlling larvae of mosquitoes and black flies. In view of the possible broad use of Abate in different geographical locations, an attempt was made to evaluate the effects of this insecticide on pond fish and aquatic invertebrates. Application of Abate three times (at about montly intervals) to duplicate 0.04 ha earthen ponds at 18 g/ha (the recommended application rate) and 180 g/ha caused no mortality of bluegills. In ponds treated with 18 g/ha, fewer bluegill fry were produced than in control ponds, brain acetylcholinesterase activity was not affected, and accelerated growth of both fry and adults appeared to result from heavy feeding on dead or moribund Diptera larvae that resulted from each of the first two applications. In ponds treated with 180 g/ha, ovary development in bluegills was initially faster than in bluegills from control ponds, the number of fry produced per female was lower than in control ponds, brain acetylcholinesterase activity in bluegills was strongly inhibited after the second and third treatments, and biomass of Diptera in the ponds was reduced about 40%, but other invertebrates were unaffected. The routine use of Abate at the recommended rate should have little adverse effect on fishery resources. (Moore-SRC)
W82-01445

ENVIRONMENTAL IMPACT AND HEALTH EFFECTS OF WASTEWATER CHLORINATION,
Illinois Univ. at the Medical Center, Chicago, IL. School of Public Health.
For primary bibliographic entry see Field 5D.
W82-01451

THE EFFECT OF FERTILIZATION WITH PHOSPHORUS AND NITROGEN VERSUS PHOSPHORUS ALONE ON EUTROPHICATION OF EXPERIMENTAL LAKES,
Fisheries and Marine Service, Winnipeg (Manitoba). Freshwater Inst.
D. W. Schindler.
Limnology and Oceanography, Vol 25, No 6, p 1149-1152, November, 1980. 3 Fig, 1 Tab, 13 Ref.

Descriptors: *Nutrients, *Eutrophication, *Phytoplankton, Nitrogen compounds, Phosphorus compounds, *Lakes, Fertilizers, Chlorophyll, Water pollution effects, Ice, Productivity.

A paper by Fee (1979) (See W80-02462) on the relation between lake morphometry and primary productivity and its use in interpreting whole-lake eutrophication experiments was criticized on several points. An erroneous conclusion was drawn that the fertilization of a lake with both P and N caused larger increases in chlorophyll than fertilization with P alone. In addition, phosphorus inputs were uncorrected, and no allowance was made for a lag in phytoplankton response to changes in a lake's loading regime. Furthermore, it was erroneous to state that winter disposal apparently only slightly reduced the effect of nutrient additions. The author of these comments concluded that in the experimental lakes under investigation, which are near equilibrium in P loading, chlorophyll concentrations are not dependent on the amount of N added. P loading, corrected for water renewal, accounted for 80% of the variance in chlorophyll regardless of N:P ratio in the loading. Removal of nutrients under winter ice or into the hypolimnion greatly reduces chlorophyll concentration. (Cassar-FRC)
W82-01457

COMPARISON OF FIRST-ORDER ERROR ANALYSIS AND MONTE CARLO SIMULATION IN TIME-DEPENDENT LAKE EUTROPHICATION MODELS,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 2H.
W82-01460

ORGANIC CONTAMINATION OF GROUND WATER: TELL IT ALL,
Dedham Water Co., MA.
P. Burdan.
Journal of the New England Water Works Association, Vol 95, No 2, p 109-118, June, 1981. 4 Fig.

Descriptors: *Public relations, *Water conservation, *Groundwater pollution, *Water supply, Water conveyance, Public opinion, Public health, *Dedham, Massachusetts, Trichloroethane, Trichloroethylene, Water demand, Water pollution.

The community relations effort by the Dedham Water Company in Massachusetts after about 30% of the total water supply was lost due to organic contaminants is described. Increased consumer understanding of the problem facing the water company resulted in better community cooperation. The potential for customer water demand to exceed the available supply of 50 mgd over the Memorial Day weekend made necessary a general meeting with municipal and state officials, and the use of newspapers, radio, and television. The initial information released to the public told of the steps leading to the discovery of trichloroethane and trichloroethylene contamination, the attempts to determine the source of contamination, the adverse impact on total water supply by having to remove two wells from service, the type of restrictions placed on water use, and the steps the utility was taking to restore full service to customers. A data sheet on the company was also made available. A letter was also mailed to 11,500 customers. The program was successful in reducing water demand to the required levels. (Small-FRC)
W82-01474

THE INTERACTION OF TREATED BLEACHED KRAFT MILL EFFLUENT AND DISSOLVED OXYGEN CONCENTRATION ON THE SURVIVAL OF THE DEVELOPMENTAL STAGES OF THE SHEEPSHEAD MINNOW (CYPRINODON VARIEGATUS),
Academy of Natural Sciences of Philadelphia, PA. Benedict Estuarine Research Lab.
W. C. Graves, D. T. Burton, L. B. Richardson, and S. L. Margrey.
Water Research, Vol 15, No 8, p 1005-1011, August, 1981. 6 Tab, 41 Ref.

Descriptors: *Pulp wastes, *Dissolved oxygen, Fish, *Fish toxins, Kraft mills, Pulp and paper industry, Industrial wastes, Ecological effects, Growth stages, Water pollution effects.

The interaction of various dissolved oxygen concentrations on the acute toxicity of treated bleached kraft mill effluent (BKME) was investigated using sheepshead minnow: embryos, fry, juveniles, and adults. The comparative sensitivity among developmental stages was determined. The interaction between dissolved oxygen concentration and effluent toxicity was assessed by exposing the organisms to a complete composite design in a 3 x 3 factorial matrix with two replicates per cell. Nominal effluent test concentrations were 0, 50 and 100%, and nominal DO concentrations were 1.0, 3.0, and 5.0 mg/liter. Effluent concentration influenced embryo survival, but there was no reaction to DO concentration. The survival of fry was related to DO concentration, with no interaction with BKME concentrations up to 100%. Juvenile minnows demonstrated increased sensitivity to BKME at a nominal DO concentration of 1.0 mg/liter. BKME did not affect adult fish under any of the conditions tested. Thus, the toxicity of BKME to the minnow is a function of developmental stage and DO concentration. (Small-FRC)
W82-01494

EFFECT OF COPPER ON NITRIFICATION IN ACTIVATED SLUDGE,
Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
F. Braam, and A. Klapwijk.
Water Research, Vol 15, No 9, p 1093-1098, September, 1981. 10 Fig, 3 Tab, 10 Ref.

Descriptors: *Copper, *Nitrification, *Activated sludge, Hydrogen ion concentration, Nitrilotriacetic acid, Bacteria, Microorganisms, Heterotrophic bacteria, Toxicity, Water pollution effects.

The nitrification rate in activated sludge was affected by the free copper concentration in bath experiments. In turn, the free copper concentration was influenced by pH, sludge concentration, and the presence of nitrilotriacetic acid (NTA). Free copper concentrations increased with decreases in pH. For example, with 9.13 times 10 to the minus 5th power mol Cu per liter the free copper concentration was 4.0 times 10 to the minus 7th power mol per liter at pH 6.5 and 10 to the minus 8th power mol per liter at pH 8.4. At constant pH, free copper concentrations as a function of added copper were greater at 0.7 g per liter of mixed liquor suspended solids than at 1.4 g per liter. Extending the copper exposure period from 1 day to 3 days did not improve the nitrification rate; the organisms did not acclimatize to copper. Addition of NTA, a strong copper-complexing agent, allowed recovery of the nitrification rate; the longer the interval between copper addition and subsequent NTA addition, the longer the recovery time. Nitrifying bacteria were no more or less sensitive to copper toxicity than were heterotrophic microorganisms. (Cassar-FRC)
W82-01497

THE EFFECTS OF A NEW RESERVOIR ON THE ATTACHED DIATOM COMMUNITIES IN HUNTINGTON CREEK, UTAH, U.S.A.,
Brigham Young Univ., Provo, UT. Dept. of Botany and Range Science.
For primary bibliographic entry see Field 2H.
W82-01521

ENVIRONMENTAL RECOVERY IN A MARINE ECOSYSTEM IMPACTED BY A SULFITE PROCESS PULP MILL,
Victoria Univ. (British Columbia).
For primary bibliographic entry see Field 5B.
W82-01548

THE EFFECTS OF ORGANOPHOSPHORUS PESTICIDES ON ESTUARINE AMMONIUM OXIDIZERS,
University of West Florida, Pensacola. Dept. of Biology.
R. D. Jones, and M. A. Hood.
Canadian Journal of Microbiology, Vol 26, No 11, p 1296-1299, 1980. 3 Fig, 1 Tab, 11 Ref.

Descriptors: *Organophosphorus pesticides, *Ammonium, *Pesticides, Water pollution effects, Insecticides, Methyl parathion, Parathion, Guthion, Fonofos, EPN, Abate, Dicapthon, Phenols, Sediments, *Estuarine environment, Oxidation, Nitrites, Anaerobic conditions, Aerobic conditions, Aquatic bacteria, Bacteria, Microbial degradation.

The effects of seven organophosphate pesticides and their degradation products on ammonium oxidation (nitrate formation) in the estuarine environment were studied with pure compounds in axenic cultures, with pure compounds in natural sediment populations, and with aged pesticides in axenic cultures. Ammonium oxidation inhibition at the level of 10 mg per liter pesticide was less than 1% for methyl parathion, EPN, guthion, and dicapthon; 3% for abate; 5% for parathion; and 32% for fonofos. Inhibitions by degradation products of methyl parathion at 10 mg per liter were: methyl paraoxon, zero; p-nitrophenol, 25%; and p-aminophenol, 100%. Nitrite inhibition by 10 mg per liter pesticides and degradation products in natural sediments varied with time of incubation. Guthion, fonofos, methyl parathion, and parathion cultures were almost completely inhibited by day 14, but some showed increased temporary activity about day 9. In aging studies using methyl parathion, parathion, and guthion nitrite production (in mg nitrite-N per liter) was as follows: unaged-84.1-86.0; aerobic conditions-control 83.7, pesticides, 74.4-75.4; static aeration--control 88.4, pesticides, 69.2-77.9; and anaerobic conditions--control, 35.4, pesticides 24.5-27.3. Data suggest that parent compounds have little effect on ammonium oxidation in estuarine sediments, but certain pesticide metabolites may reduce ammonium oxidation, especially under anaerobic conditions. (Cassar-FRC)
W82-01567

ACID PRECIPITATION: BASIC PRINCIPLES AND ECOLOGICAL CONSEQUENCES,
North Carolina State Univ. at Raleigh.
E. B. Cowling, and C. B. Davey.
Pulp and Paper, Vol 55, No 8, p 182-185, August, 1981. 25 Ref.

Descriptors: *Acid rain, *Pulp and paper industry, *Forests, Water pollution effects, Ecological effects, Air pollution, Aquatic life, Soil chemistry, Heavy metals, Nutrient loss, Water quality.

The pulp and paper industry is involved with both the cause and effects of acid precipitation. It is responsible for small, but locally important, emissions, and it owns a significant share of forest land impacted by this pollution. Although significant quantities of desirable plant nutrients (nitrogen and sulfur) are added to the forest system by precipitation, the acidity and its determental effects may outweight the benefits. Damage to the ecosystem is most likely to occur when major inputs of acid precipitation coincide with sensitive stages of a life form (such as fish eggs and larvae), and in poorly buffered, noncalcareous soils and rocks. In the laboratory and field, many biological effects of acid precipitation have been demonstrated--necrotic lesions on foliage, nutrient loss from foliar organs, reduced resistance to pathogens, accelerated erosion of waxes on leaf surfaces, reduced rates of decomposition of leaf litter, inhibited formation of terminal buds, increased seedling mortality, and heavy metal accumulation. Soil microbiological processes such as nitrogen fixation, mineralization of forest litter, and nitrification of ammonium compounds are inhibited, the degree depending on degree of cultivation and soil buffering capacity. Water quality is impacted by contact with vegetation, soil, and bedrock. Acid precipitation mobilizes cations, especially the toxic Al, Mn, and Zn, and nutrients, K, Ca, and Mg. (Cassar-FRC)
W82-01586

STRATEGIES OF RESPONSE TO COPPER, CADMIUM, AND LEAD BY A BLUE-GREEN AND A GREEN ALGA,
Ottawa Univ. (Ontario). Dept. of Biology.
V. M. Laube, C. N. McKenzie, and D. J. Kushner.
Canadian Journal of Microbiology, Vol 26, No 11, p 1300-1311, 1980. 7 Fig, 6 Tab, 33 Ref.

Descriptors: *Algae, *Heavy metals, *Toxicity, Water pollution effects, Fate of pollutants, Chlorophyta, Cyanophyta, Growth rates, Food chains, Metals, Copper, Cadmium, Lead, Eutrophication, Nitrilotriacetic acid, Chelation, Accumulation, Sediments, Ecological effects.

Interactions between algae and heavy metals varied with the type of algae and the metal. Heavy metal ions, Cu(2+), Cd(2+), and Pb(2+), inhibited growth of the cyanophyte, Anabaena strain 7120, and the chlorophyte Ankistrodesmus braunii. Complete inhibition was observed at 0.0001 and 0.001 M Cu and Cd, and a lag in growth at lesser concentrations. In 0.0001, 0.00001, and 10 to the minus 8th power M Pb, cells grew as well as controls. Intermediate Pb concentrations of 10 to the minus 6th power and 10 to the minus 7th power were more inhibitory than some higher concentrations because of precipitate formation at concentrations higher than 0.00001 M. Addition of the chelating agent nitrilotriacetic acid did not protect the algae from metal toxicity. In Anabaena 7120 lysis occurred in early but not late stages with Cu; the other metals did not cause lysis. A. braunii cells were not lysed by any of the metals. Anabaena 7120 growing in 0.00001 M Cu did not accumulate Cu within the cell, but about half the Cd was cell-associated in Anabaena cells growing in 0.00001 M Cd. A. braunii bound substantial amounts of Cu and Cd during growth in metal ion solutions. When algae were grown over dialysis sacs containing sediment with 100 ppm Cu(2+) or Cd(2+), metals were mobilized from the sediment and accumulated in the A. braunii cells and culture medium. In Anabaena 7120 cultures, Cd removed from the sediment was found in cells and culture medium, but Cu was associated entirely with the culture medium. Large algal blooms could be a significant factor in accumulating toxic metals from the water and sediments and thus entering the food chain. (Cassar-FRC)
W82-01598

5D. Waste Treatment Processes

RECLAMATION OF WASTEWATER WITH A SOIL-TURF FILTER: I: REMOVAL OF NITROGEN,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
E. L. Anderson, I. L. Pepper, and W. R. Kneebone.
Journal of the Water Pollution Control Federation, Vol 53, No 9, p 1402-1407, September, 1981. 2 Fig, 7 Tab, 11 Ref.

Descriptors: *Wastewater treatment, *Filtration, Filtered wastewater, Clay, Sand, Nitrogen, Filter media, Water quality, *Soil-turf filter.

Maximum rates at which secondary treated wastewater could be applied to a soil-turf filter without harming the turf and still yield leachate averaging less than 10 mg/liter nitrate-nitrogen were determined. Two lysimeter units were filled with 95% sand, 1% silt, and 4% clay. Ten others were filled with 89% sand, 5% silt, 4% clay, and 2% organic matter. Both soils had a pH of 8.3. All plots were seeded to bermudagrass. Overseeded annual ryegrass was grown during cooler seasons. Plots were drip-irrigated with secondary wastewater twice a week. Secondary treated wastewater was obtained from the Randolph Park Sewage Treatment Plant. Nitrogen in the wastewater varied seasonally from 3 to 23 mg/l ammonium-nitrogen, from 0.5 to 16 mg/l nitrate nitrogen, and from 1 to 5 mg/l organic nitrogen. During the first 6 weeks of the study less than 10% of the applied N was recovered in leachates. These initial high removal values were probably the result of ammonium adsorption in the soil and high turf grass use, as plots had not been fertilized for 3 months prior to the study. Stepwise regression equations showed that predictions of nitrate-nitrogen concentration in leachate could be based mainly on the rate of wastewater application. Season and dry weight yield of turf clippings were also important factors. In summer the sand-turf filter could renovate a maximum 12.7 cm/week, yielding 9 cm/wk recharge, compared to 18.7 cm/wk, yielding 12.5 cm/wk recharge for the mix-turf filter. Selection of soils with a higher clay content would increase purification of the wastewater, but decrease the volume of recharge water. (Baker-FRC)
W82-01101

RECLAMATION OF WASTEWATER WITH A SOIL-TURF FILTER: II: REMOVAL OF PHOSPHORUS, BORON, SODIUM AND CHLORINE,
Arizona Univ., Tucson. Dept. of Soils, Water, and Engineering.
E. L. Anderson, I. L. Pepper, W. R. Kneebone, and R. J. Drake.
Journal of the Water Pollution Control Federation, Vol 53, No 9, p 1408-1412, September, 1981. 2 Fig, 6 Tab, 11 Ref.

Descriptors: *Wastewater treatment, *Filtration, Filtered wastewater, Filter media, Sodium, Calcium, Magnesium, Boron, Phosphorus, Chlorine.

This paper discusses the removal and potential hazards of phosphorus, boron, sodium, and chlorine from wastewater secondarily treated by means

of a soil-turf filter. Ten lysimeters were filled with sand, and ten were filled with mix. Plots were drip-irrigated with secondarily treated wastewater at high loading rates. Lysimeter leachate was collected and analyzed. As the rate of application of wastewater increased, leachate P concentrations significantly increased. Once the soil became saturated with P, more P remained in solution. For recharge purposes, application rates of wastewater to the soil-turf filter were limited primarily by leachate nitrate concentrations currently determined by the US EPA. Summer values were 12.7 cm/wk for the sand-turf filter compared to 18.7 cm/week for the mix-turf filter. Corresponding winter values for sand and mix were 13.6 and 21.9 cm/wk, respectively. Boron as borate is not retained by a soil-turf filter because it is an anion and not held by exchange sites, nor is it easily precipitated in the soil. Hence leachate concentrations of B were similar to those of wastewater. Sodium was not removed by a soil-turf filter, but in itself is unlikely to be a human health hazard of the reclamation process. Chlorine concentrations were generally low due to sunlight-induced degradation of chlorine during aerated lagoon storage of wastewater. Overall, the reclamation system described would seem to have good potential for reducing water deficits in the southwestern US. (Baker-FRC)
W82-01102

BACTERIA: MAN'S ALLIES IN WATER POLLUTION CONTROL,
China Features, Beijing (China).
H. Lin.
Environmental Management, Vol 4, No 4, p 285-286, July, 1980. 1 Fig.

Descriptors: *Chemical wastes, *Bacteria, *Biodegradation, *Water pollution control, Wastewater treatment, Industrial wastewater, Organic compounds, Degradation, Ponds, Fish, Aquatic animals, Toxicity, Ya'er Lake, *China.

Bacteria were used to treat organic chemical manufacturing wastes in a series of three purification ponds before entering the 7000 hectare Ya'er Lake, Hubei Province, People's Republic of China. The first and second ponds, 100 ha each, use the native pond bacteria to decompose the organic wastes for 100-120 days, during which 80-90% of the pollution is eliminated. Fish in the third pond, 210 ha, are healthy and show no abnormalities. Water from this pond enters the lake pollution-free. Prior to 1976, when this treatment system was built, the few fish and shrimp surviving in the polluted lake were not fit for human consumption. The methods developed here have been applied to other industrial wastewaters as well. (Cassar-FRC)
W82-01158

DEMONSTRATION TESTING OF ALUM RECOVERY BY LIQUID ION EXCHANGE,
Michigan State Univ., East Lansing. Dept. of Civil Engineering.
D. A. Cornwell, G. C. Cline, J. M. Przybyla, and D. Tippin.
Journal of the American Water Works Association, Vol 73, No 6, p 326-332, June, 1981. 12 Fig, 7 Tab, 6 Ref.

Descriptors: *Ion exchange, *Alum, *Sludge conditioning, Coagulation, Water treatment, Pilot plants, *Tampa, Florida.

A pilot plant for alum recovery from water treatment sludge by liquid ion exchange was operated at the Tampa, Florida, Hillsborough River plant. The major components of the 0.63 liter per sec system were sludge collection and feed, extraction, stripping, and residual sludge treatment. Both types of mixing, rapid and slow, recovered more than 90% of the alum. It is predicted that the full-scale plant would have a similar recovery. The solvent consisted of 15% volume to volume octyl acid phosphate, 2% tributyl phosphate, and 83% petroleum solvent (Kermac 627). Of the two process flow schemes the contactor performed better than the mixer-settler. The contactor was easier to operate, did not produce phase inversion or raffinate entrainment in the extract, and had a much smaller bleed solids stream requiring solvent recovery. However, the contactor required a longer detention time and was more expensive to construct. The quality of the recovered alum was similar to that of the commercial alum. There was no significant buildup of Ba, Na, Cu, Cr, Mg, Mn, or Ag. Zn and Pb were extracted at low concentrations, and the metal concentrations in the recovered alum were in the same range as in the commercial alum. Total organic carbon was 206 mg per liter, compared with 100 mg per liter in commercial alum. Recovered alum contained 34 g per liter Al(3+), but when adjusted to 17.1% Al_2O_3, jar test results were identical for recovered and commercial alum. The sludge showed a 50% reduction and readily settled to a 10% solids concentration. (Cassar-FRC)
W82-01167

ADVANCED WASTEWATER PLANT IS ENERGY SAVER,
Capital Consultants, Inc., Lansing, MI. Industrial and Environmental Div.
R. T. Beaupre, W. T. Harvey, and J. R. Marry.
Water/Engineering and Management, Vol 128, No 8, p 30-33, August, 1981. 1 Fig, 2 Tab.

Descriptors: *Biological wastewater treatment, *Wastewater treatment facilities, *Treatment plants, Gravity filters, Aeration, Ammonia, Biochemical oxygen demand, Energy, Economic aspects, *Advanced wastewater treatment.

A new advanced wastewater treatment plant built for Charlotte, Michigan, uses rotating biological disc units. The secondary treatment system consists of 12 electro-mechanically driven rotating biological discs. The primary and secondary processing was designed to remove 90% BOD5 and suspended solids and 95% ammonia at an average wastewater flow of 1.2 mgd. Outdoor concrete tanks with mixed media beds, precast concrete underdrains, water surface wash, and pneumatic controls make up the gravity filters. A reaeration systems ensures a minimum of 5.0 mg/liter of dissolved oxygen in the final effluent. The sludge digestion system is a high-rate, two-stage system which generates digester gas. Primary heating for the control building is provided by three water-to-air heat pumps which operate with the chlorinated final effluent. These heat pumps provide heating, ventilation, dehumidification, and cooling. The low bid for construction of the facility was $4,895,000, and the plant was completed in August 1980. (Small-FRC)
W82-01177

A SUCCESSFUL LOW TECHNOLOGY WASTEWATER PROCESS,
Donohue and Associates, Inc., Sheboygan, WI. Environmental Div.
P. P. Stecker.
Water/Engineering and Management, Vol 128, No 8, p 46, 47, 49, August, 1981. 2 Fig.

Descriptors: *Filtration, *Sand filters, *Seasonal variation, Wastewater treatment, Performance evaluation, Recreation wastes, Economic aspects, Biochemical oxygen demand, Nitrification, Lake Michigan, Barleys Harbor, *Wisconsin.

A circulating sand filtration system was installed in the small resort town of Baileys Harbor, Wisconsin. Activated sludge and rotating biological systems were also considered for the site, but they could not as easily produce a 20 mg/liter effluent, would be more difficult to operate, and would be less able to accomodate the varying wastewater loadings. The recirculating sand filter effluent was discharged to a wetland, as this cost $500,000 less than a Lake Michigan discharge. The system is made up of a septic tank and the intermittent sand filter. The system produces effluent BOD and suspended solids levels of 10 to 20 mg/liter or less, and high levels of 10 to 20 mg/liter or less, and high levels of nitrification are also obtained. Sand with an effective size in the range of 0.25 to 1.5 mm was used in the filter. The system easily handles wide seasonal or weekly variations in wastewater flow. (Small-FRC)
W82-01178

PHARMACEUTICAL COMPANY'S AERATION SYSTEM SAVES ENERGY,
Hoffmann-la-Roche, Belvidere, NJ.
J. S. Brandl.
Industrial Wastes, Vol 26, No 2, p 16, 19, March/April, 1980.

Descriptors: *Wastewater treatment, *Industrial wastes, *Aeration, Aerobic digestion, *Pharmaceutical industry, Mechanical equipment, Activated sludge process, Mixing, Oxygenation, Energy conservation.

An expanded wastewater treatment plant at the Hofmann-la-Roche facility processes all the industrial waste water (about 98%) and the sanitary sewage (about 2%) from the plant's 1000 employees. During periods of rain the entire facility's rooftop surfaces, diked areas, and tank farm drain into the treatment plant. A total of 2 MGD, on the average, flow to the treatment plant, which discharges effluent to the Delaware River within the limits of the EPA NPDES permit. The aeration system is efficient, providing cost savings in electric power. A two-stage activated sludge system functions as the heart of the treatment plant. The wastewater treatment plant is manned 24 hr, seven days a week, by 11 licensed operators. The annual budget to run the plant is in excess of $1,000,000. Wastewater entering the treatment plant has a pH ranging from 2.0 to 12.5, an average temperature of 90 degrees F and an average 5-day BOD of 1,000 mg/liter. The average daily flow is 2 MGD and presently ranges from 1.6 to 2.2 MGD. Grit is removed in a 75,000 gal pre-clarifier, before wastewater enters the equalization ponds. From the primary clarifiers the wastewater enters the two-stage activated sludge process. The flow is nutrient adjusted by adding either ammonium hydroxide or phosphoric acid. All sludges generated are sent to the aerobic digester where detention time is 20-30 days. (Baker-FRC)
W82-01180

HIGH-SOLUBILITY GAS FLOTATION,
Union Carbide Corp., South Charleston, WV. Chemicals and Plastics.
R. A. Conway, R. F. Nelson, and B. A. Young.
Journal of the Water Pollution Control Federation, Vol 53, No 7, p 1198-1205, July, 1981. 7 Fig, 4 Tab, 23 Ref.

Descriptors: *Sludge thickening, *Flotation, *Solubility, Activated sludge, Digestion, Performance evaluation, *Wastewater treatment, Industrial wastes, Separation techniques.

A comprehensive bench-scale evaluation was made of dissolved gas flotation for sludge thickening, comparing air and two potentially available higher solubility gases. The two process gases chosen for comparison with air were an off-gas from an oxygen activated sludge system and combusted digester gas. Flotation tests using each gas were conducted with an industrial recycle sludge, 9900 mg/liter total suspended solids, at R/Q values (ratio of recycle to sludge flow) of 0.11 to 1.5. Another duplicate series was run at R/Q = 0.97 with coagulant addition. Results indicated that the operation of existing dissolved-air systems could be improved by decreasing the recycle flow or increasing the sludge flow. Also, a new flotation system could be smaller and more competitive if high-solubility gases were used. Combusted digester gas was effective at a gas to solids ratio of 0.01 to 0.04, while oxygen activated sludge gas was effective at a gas to solids ratio of 0.04 or greater. (Small-FRC)
W82-01184

ENERGY REQUIREMENT FOR SMALL WASTEWATER TREATMENT SYSTEMS,
Utah State Univ., Logan. Coll. of Engineering.
E. J. Middlebrooks, C. H. Middlebrooks, and S. C. Reed.
Journal of the Water Pollution Control Federation, Vol 53, No 7, p 1172-1197, July, 1981. 15 Fig, 24 Tab, 14 Ref.

Descriptors: *Energy, *Wastewater treatment, *Costs, Economic aspects, Data collections,

Ponds, Infiltration, Overland flow, Secondary treatment.

Energy requirements are summarized for all viable alternatives available for the treatment of flow rates of 190 to 19,000 cu m/day of wastewater. Data are presented in tabular form, and most unit operations and processes can be estimated by combining data. As energy costs increase, they are fast becoming the predominant factor in the selection of small-flow treatment systems. Low energy systems are attractive because they are often easier to maintain and minimize highly skilled operation requirements. The most energy efficient system described is a facultative pond followed by rapid infiltration. If surface discharge is necessary and impermeable soils exist, a facultative pond followed by overland flow is the second most energy efficient system considered. Physical-chemical advanced secondary treatment systems utilize the most energy of conventional systems which meet the federal standard effluent requirements. (Small-FRC)
W82-01185

DATA BASE DEVELOPMENT FOR THE DESIGN OF A RADIUM-226 REMOVAL PROCESS,
Environmental Protection Service, Burlington (Ontario). Waste Water Technology Centre.
D. W. Averill, P. M. Huck, G. H. Kassakhian, D. Moffett, and R. T. Webber.
Journal of the Water Pollution Control Federation, Vol 53, No 7, p 1233-1242, July, 1981. 6 Fig, 7 Tab, 6 Ref.

Descriptors: *Data collections, *Radium-226, *Chemical precipitation, *Wastewater treatment, Barium, Clarification, Filtration, Pilot plants, Radium radioisotopes.

Benchmark and pilot plant studies were performed on mechanical wastewater treatment systems to remove radium-226 from impoundment area effluents. Two wastewater treatment processes have been evaluated thus far; both of them incorporate barium-radium coprecipitation in series-connected stirred tank reactors. A clarification process included coprecipitation followed by rapid mixing of a chemical coagulant, flocculation in series connected mechanical flocculators, and solids-liquid separation in a clarifier. The other process is a filtration process which includes coprecipitation followed directly by solid-liquid separation using chemically aided granular media filtration. Both processes produced total radium-226 activity levels of less than 0.37 Becquerel/liter and dissolved radium-226 levels approaching or equal to 0.11 Becquerel/liter. The results of these studies make up a preliminary data base on physico-chemical treatment methods for radium-226. The processes will be tested under steady-state conditions. (Small-FRC)
W82-01188

DENITRIFICATION OF BLACKWATER WITH GREYWATER,
Connecticut Univ., Storrs. Dept. of Civil Engineering.
R. Laak, M. A. Parese, and R. Costello.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE3, p 581-590, June, 1981. 2 Fig, 3 Tab, 15 Ref. OWRT-A-999-CONN(20), 14-34-0001-0107.

Descriptors: *Denitrification, *Biological treatment, *Domestic wastes, Nitrogen removal, Performance evaluation, *Wastewater treatment, Organic carbon, Wastewater.

A nitrogen removal technique called RUCK is being developed for on-site systems, which will be useful where nitrate pollution from septic tank systems may be a potential problem. It is a biological technique which is passive, energy-free, and requires no more maintenance than a septic tank. The system was field tested for nitrogen removal efficiency at a house site using laundry and sink wastes as the organic carbon source, and at condominiums using the entire greywater flow. Blackwater and greywater flowed into separate septic tanks. Blackwater passed through a subsurface sand bed and then to a rock filter tank, while greywater went straight to the rock filter tank. Final treatment was a seepage bed. Nitrifying reactors of 1.5 ft of concrete-sand media provided a reliable method for the nitrification of blackwater septic tank effluent. Comparable denitrification efficiencies were obtained using either greywater or methanol as a carbon source. When greywater and blackwater are separated, an overall nitrogen removal of over 70% can be achieved. (Small-FRC)
W82-01225

PHYSICAL AND CHEMICAL METHODS,
Florida Univ., Gainesville.
J. Zoltek, Jr., and E. L. Melear.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 679-687, June, 1981. 158 Ref.

Descriptors: *Physicochemical treatment, *Wastewater treatment, Industrial wastewater, Organic compounds, Water reuse, Coagulation, Filtration, Membrane processes, Adsorption, Activated carbon, Ion exchange, Oxidation, Reviews.

New developments in physical and chemical methods of wasteater treatment are reviewed. Water reuse is a reality at several plants. Topics classified under coagulation and solids separation include dissolved air flotation and foam separation. Polymers removed wastewater components in woolscour effluent, kraft liquor, and raw wastewater. Phosphates were precipitated by fly ash extract, alum, iron and aluminum hydroxides, oxygen nitrification, and FeC13-lime. Efficiency and mechanisms of coagulation, sedimentation, and filtration were discussed in about 30 papers. Activated carbon was the most commonly reported adsorption material for wastewater treatment. In addition to theoretical studies, papers describe activated carbon treatment for a variety of organic chemicals and oil refinery wastewater. Other adsorbents mentioned were synthetic resins, sludges, sediments, clays, and peat. Ion exchange systems were used to remove heavy metals, detergents, ammonium, hydrochloric acid, and low molecular weight organic acids. Membrane processes successfully treated waters containing radium, thio salts and metal ions from mining effluents, paraffin oil/water emulsions, polyvinyl alcohol, and inorganic salts inmine water. Suspended solids (60%) and BOD (27%) were removed in a combined sewer system flow by ultra high rate filtration. Air, oxygen, or ozone were used to oxidize various pollutants--hydrogen sulfide, phenols, toxic refractories, nitrilotriacetic acid, cyanide, and surfactants. (Cassar-FRC)
W82-01241

BIOLOGICAL FILTERS,
Brigham Young Univ., Provo, UT.
S. L. Klemetson, and G. L. Rogers.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 687-700, June, 1981. 144 Ref.

Descriptors: *Biological filters, *Rotating biological contactors, *Reviews, *Wastewater treatment, Filters, Trickling filters, Nitrification, Anaerobic conditions, Fluidized beds, Aquaculture.

Rotating biological contactors (RBC) formed the topic of more than half of the recent papers on the subject of biological filters in wastewater treatment. Among the apsects of RBC discussed were: microbial populations, biofouling, kinetics of denitrification, kinetics of nitrification, mathematical models, operating and performance, oxygen transfer, anaerobic RBC, pressurized systems, ferrous iron removal, and treatment of specific wastewaters (explosives, phenol-formaldehyde, aquaculture, chemicals, tanneries, and combined sewer overflows). Fixed biological filters were successfully adapted for many applications. However, problems were experienced in pesticide removal. Fluidized bed reactors were studied theoretically and using models. The most promising adsorbent for removing residual organics was activated carbon. A fluidized bed process removed 95% of the BOD from corn wet milling wastewater. Use in domestic and industrial waste treatment is still in the experimental stage. Anaerobic biological filters treated vegetable tanning effluents, carbohydrate wastes, and wastewaters containing soluble gum, propylene glycol, and caustic soda. Biofilters were used in recirculating filters for aquaculture. The inert media were stone, shells, plastics, sand, and charcoal or combinations of these materials. (Cassar-FRC)
W82-01242

ACTIVATED SLUDGE,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
J. H. Sherrad, D. A. Smith, and J. E. Alleman.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 700-709, June, 1981. 135 Ref.

Descriptors: *Activated sludge, *Industrial wastewater, *Nitrification, *Wastewater treatment, Model studies, Design criteria, Phosphorus removal, Sludge, Microorganisms, Shock loads, Oxygen transfer, Oxygen uptake, Aeration, Activated carbon, Aerobic digestion, Reviews.

A review of recent literature on activated sludge lists mathematical models for analyzing the process. Design concepts and options studied in the laboratory and in pilot plants include determination of sludge age by total solids mass, mutant bacteria for refinery wastewaters, air vs. pure oxygen, continuous vs. intermittent feeding conditions, the deep shaft process, calculation of rotor size based on hydraulic head losses in looped reactors, and rotary biological contactors for supplemental oxidation in activated sludge aeration basins. Responses of activated sludge systems to shock loads and methods of improving performance are discussed. Various workers improved sludge characteristics by using a minimum 2.0 mg per liter dissolved oxygen in a brewery treatment plant, sludge ages of 15-20 days, a stalked bacteria (Caulobacter), growth inhibitors for Sphaerotilis, plug flow, an anoxic mixing stage in the aeration basin, and reduction in longitudinal mixing. Oxygen uptake and transfer is shown to depend on diffuser header pattern and desnsity. Some authors propose oxygen uptake and transfer as a control variable; others state the opposite. Nitrification is the subject of several reviews and many studies. Phosphorus removal for advanced wastewater treatment is accomplished by adding metallic salts to the activated sludge tanks without chemical addition (dependent on COD removal), adding an anaerobic stage, the PHOSTRIP process, and ferrous ion addition. The activated sludge process is used to treat industrial wastewaters containing phenol, coal gasification quench wastes, petrochemical wastes, chemical-pharmaceutical wastes, textile wastes, tannery wastes, food processing wastes, distillery wastes, and brewery wastes. Powdered activated carbon improved the activated sludge process with respect to organic compounds, color, and organic shock loads. (Cassar-FRC)
W82-01243

LAGOONS AND OXIDATION PONDS,
Utah State Univ., Logan.
D. B. George.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 709-711, June, 1981. 14 Ref.

Descriptors: *Oxidation lagoons, *Stabilization lagoons, *Literature review, Bibliographies, Wastewater treatment, Water reuse, Mathematical models, *Lagoons, *Oxidation ponds.

A literature review is presented of publications on lagoons and oxidation ponds published in 1980. Articles fall into the general categories of process performance and biology, upgrading of lagoons, and process models. Connecticut published standards on lagoon systems for the disposal of septage. Several studies dealt with the Dan Region Project, which is the largest and most advanced water reuse scheme in Israel which utilizes oxidation ponds. A study on stabilization ponds in Peru

examined the use of treated wastewater for agricultural purposes. More stringent wastewater treatment plant discharge standards resulted in several studies on upgrading existing lagoons. An in situ method is alum addition, another study investigated water hyacinth, and another evaluated the culturing of fathead minnows. Process models included a biogeochemical model developed to describe the dynamic responses of carbon, nitrogen, phosphorus, and pathogenic contaminants in facultative wastewater stabilization ponds. (Small-FRC)
W82-01244

ANAEROBIC PROCESSES,
Institute of Gas Technology, Chicage, IL.
K. F. Fannin, J. R. Conrad, D. E. Jerger, V. Srivastava, and S. Gosh.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 711-720, June, 1981. 1 Tab, 79 Ref.

Descriptors: *Anaerobic digestion, *Literature review, *Bibliographies, Anaerobic bacteria, Wastewater treatment, Fermentation, Anaerobic lagoons.

A review of the literature published in 1980 is presented for anaerobic processes. Several papers dealt with microbiology, including classification and characterization, cellulose hydrolysis and ethanol production, acidogenesis, and methanogenesis. Papers on process characterization concerned biodegration and biotoxicity, while process optimization and process application were the topics of other publications. A general review was published on the status of research and technology on the conversion of wastes and biomass to various forms of usable energy. Another review of solar and biomass technologies considered applications for cotton ginning residue combustion, etc. Studies on the development and investigation of fermenters were reviewed, and the potential of anaerobic digestion for the conversion of wet biomass to energy was evaluated. A table is presented which summarizes data from the operation and performance of anaerobic digestion studies. (Small-FRC)
W82-01245

DENTRIFICATION,
Greater Chicago Metropolitan Sanitary District, IL.
M. Krup, and B. S. Prakasam.
Journal of the Water Pollution Federation (Literature Review Issue), Vol 53, No 6, p 720-726, June, 1981. 65 Ref.

Descriptors: *Dentrification, *Literature review, *Bibliographies, Nitrogen removal, Nitrogen, Bacteria, Activated sludge process, *Wastewater treatment.

A literature review is presented of publications appearing during 1980 on the topic of denitrification. Papers were published in several areas including slurry processes, attached growth processes, and soil denitrification, and there were several new patents. Bench-scale studies were reported of sequencing batch biological reactors utilizing bacterial storage of raw waste organic components to supply the electron donor needed for denitrification. Studies designed activated sludge units for the removal of nitrogen and phosphorus, and one study reported on the results of an activated sludge system utilizing passes through an aeration tank to treat wastewater. Forty-seven denitrifying bacteria were isolated in one study of a model wastewater treatment system which consisted of two nitrification reactors and clarifiers and three denitrification columns. Environmental factors which affect soil column denitrification were explored, and pilot plant studies were used in one investigation of plant-soil systems to determine the fate of applied N during overland flow. Many patents were obtained for denitrifying systems employing mainly suspended growth systems. (Small-FRC)
W82-01246

ONSITE ALTERNATIVES FOR TREATMENT AND DISPOSAL,
Wisconsin Univ.-Madison.
W. C. Boyle, and R. J. Otis.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 733-737, June, 1981. 48 Ref.

Descriptors: *Literature review, *Bibliographics, *Wastewater treatment, *Underground waste disposal, Septic tanks, *Wastewater disposal, On-site investigations, Sewage disposal, Reviews, Conferences.

A literature review is presented of 1980 publications on the topic of onsite alternatives for wastewater treatment and disposal. It covers the general areas of onsite treatment, subsurface disposal systems, evapotranspiration, septage management, management, and small community facilities. A book was published outlining alternatives for homes, groups of dwellings, and some industrial and commercial establishments. EPA published a comprehensive design manual, and the forty papers presented at the 6th National Conference on Individual Onsite Wastewater Systems addressed state-of-the-art research. Several articles focused on the compost toilet and septic tank design. Subsurface disposal systems were studied, and the attenuation of pollutants in soils, site evaluation, and the performance of soil adsorption systems were addressed. A state-of-the-art review was published on cost effective and environmentally sound alternatives to septage treatment and disposal. As many small communities are interested in alternative treatement, one paper reviewed the role of public and private interests in onsite system management programs. (Small-FRC)
W82-01248

O & M WASTEWATER COLLECTION AND TREATMENT FACILITIES,
Valley Sanitary District, CA.
D. D. Drury.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 737-739, June, 1981. 30 Ref.

Descriptors: *Literature review, *Wastewater collection, *Wastewater facilities, Operating policies, Maintenance, Bibliographies, Activated sludge process, Wastewater treatment.

A literature review is presented of 1980 literature on the operation and maintenance of wastewater collection and treatment facilities. In the area of improving operations, a study of 120 plants concluded that 85 to 90% of the plants were not meeting NPDES discharge permit requirements but could have if appropriate operations and maintenance procedures had been followed. Studies in operating the activated sludge process included one on the deep-shaft activated sludge plant in Marsh Farm, Tilbury, and the startup of an oxidation ditch in winter. Plant startup and operator training studies included a study of the problems associated with fluctuating waste loads. Computer control systems were described in papers on computer aided operations. The effect of the collection system on plant operations was explored in several papers including a survey of 14 treatment plants in Northern California before and during the recent drought. Other papers on operation and maintenance included some on the maintenance problems caused by the eruption of Mount St. Helens. (Small-FRC)
W82-01249

DISINFECTION,
Georgia Inst. of Tech., Atlanta.
J. P. Gould, and C. N. Haas.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 739-748, June, 1981. 2 Tab, 154 Ref.

Descriptors: *Disinfection, *Literature review, *Chlorination, *Ozonation, Trihalomethanes, Environmental effects, Water treatment, *Wastewater treatment, Bibliographies, Carcinogens.

A literature review is presented of 1980 publications dealing with disinfection of water and wastewater. Two tables are included: the first on inactivation of various microorganisms by chlorine, and the second on inactivation of various microorganisms by ozone. A comprehensive review of potable water disinfection was published which summarized aspects of wastewater chlorination. One paper reported on the use of chlorine for the prevention of well clogging during groundwater recharge, while another dealt with the inactivation by ozone of six viruses in a continuous flow reactor. The effects of disinfectants on higher organisms were investigated in studies of bluegill, catfish, bass, crustaceans, and insects. One epidemiologic study found a significant positive correlation between pancreatic cancer and trihalomethane levels in drinking water. New analytical methods were described, and the chlorination of inorganic compounds was explored by several studies. The formation of trihalomethanes was also investigated, including one study on the influence of ozone pretreatment on their formation. (Small-FRC)
W82-01250

WASTEWATER COLLECTION,
AES Engineers, Inc., Willow Springs, IL.
S. Chatterjee, and T. Heuer.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 748-750, June, 1981. 32 Ref.

Descriptors: *Sewer systems, *Literature review, *Bibliographies, Wastewater facilities, Design criteria, Construction, Rehabilitation, *Wastewater collection.

A review of the 1980 literature published on wastewater collection is presented. It covers publications in the areas of design and construction, sewer rehabilitation, safety, and wastewater pumping. Papers referenced include a concise and systematic method for the determination of optimum sewer diameter and slope for a given flow capacity. Another paper noted water conservation measures that may reduce wastewater flows by 25%. One experimental study demonstrated the use of conduits for wastewater treatment using sludge and air/oxygen supply. Sewer rehabilitation topics included a study emphasizing the need for assessment of infiltration/inflow problems in order to better define the role of sewage treatment plant operators. An overview was presented of the potential methods of combined sewer overflow pollution abatement. Safety was addressed in several papers, one of which attributed most sewer worker deaths to hydrogen sulfide gas rather than lack of oxygen. Troubleshooting techniques for wastewater pumping systems were outlined in one paper, and the results of an EPA pipe needs survey were published. (Small-FRC)
W82-01251

LAND APPLICATION OF MUNICIPAL WASTEWATER,
Nielson, Maxwell and Wangsgard, Salt Lake City, UT.
J. H. Reynolds.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 767-770, June, 1981. 30 Ref.

Descriptors: *Land disposal, *Literature review, *Municipal wastewater, *Bibliographies, Water reuse, Overland flow, Denitrification, Infiltration, Design criteria.

A literature review is presented on the land application of municipal wastewater. Articles published during 1980 covered the general topics of design parameters, case studies, and water reuse. General publications included a history of the federal water pollution control legislation, including a discussion of EPA policy on land treatment. A published review of the recent application of overland flow treatment of municipal wastewater included a design guide based on operating experience in Davis, California. Laboratory studies on design parameters included a study of nitrogen removal and infiltration rates using primary effluent applied to soil columns. The long-term effects of irrigation with wastewater as well as the effects of rapid infiltration were examined. Reuse studies included groundwater recharge with tertiary effluent by way of spreading basins, and a water quality management facility which is designed to demonstrate

innovative techniques for recycling municipal wastewater including a lake-land treatment system. (Small-FRC)
W82-01253

HEALTH EFFECTS ASSOCIATED WITH WASTEWATER TREATMENT AND DISPOSAL,
Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 5C.
W82-01255

MEAT-, FISH-, AND POULTRY-PROCESSING WASTES,
Battelle-Columbus Lab., Columbus, OH.
J. H. Litchfield.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 787-791, June, 1981. 1 Tab, 56 Ref.

Descriptors: *Meat processing industry, *Fish handling facilities, *Poultry, Industrial wastewater, *Food processing industry, Proteins, Land disposal, Wastewater disposal, *Wastewater treatment, Lagoons, Flotation, Odor control, Reviews.

Meat processing wastewaters were successfully treated in aerated lagoons, by electrocoagulation and flotation of fat and oil, in a vertical cylindrical separating chamber, in an electrolytic microbubble system using a noncoagulant mineral acid, and by digestion (fellmongering wastes). In addition to publications on environmental regulations and bibliographies, work was done on fish processing wastewater treatment by primary methods, pressure flotation, activated sludge, rotating disks, activated carbon-activated sludge, coagulation, aerated chambers, and recovery of protein for reuse. Water from poultry processing was frequently land-applied. Other treatment systems were chemical coagulation, DAF treatment, aerated lagoons, clarification, stabilizing lagoons, filtration, ultrafiltration, and breakpoint chlorination. Disinfection of poultry wastewater was accomplished with chlorine or chlorine dioxide. Odors from an anaerobic lagoon system were controlled by treating the odorous air with gaseous chlorine, dilute acid bed, and dilute caustic bed, in series. (Cassar-FRC)
W82-01256

FERMENTATION INDUSTRY,
Notre Dame Univ., IN.
R. L. Irvine.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 791-795, June, 1981. 57 Ref.

Descriptors: *Fermentation, Wastewater disposal, *Wastewater treatment, Reviews, Aerobic treatment, Anaerobic digestion, Biological treatment, *Industrial wastewater.

The 1980 literature on treatment and disposal of fermentation industry wastes includes 18 review articles on general subjects; reuse, recycle, and recovery of single-cell protein and other products; and comparisons of treatment alternatives (anaerobic systems were generally superior to aerobic treatment). Some of the individual papers describe treatment alternatives. A Canadian brewery uses a full-scale deep shaft treatment facility to meet pretreatment effluent standards of 300 g per cu meter BOD and 350 g per cu meter suspended solids. Bench scale continuous flow activated sludge reactors removed > 90% of brewery wastewater COD in another study. Problems with filamentous organisms in bench reactors were solved by aerating recycled sludge separately for 19-32 hours before return to the aeration basin. Distillery waste treatment methods included ultrafiltration, reverse osmosis, electrodialysis, and anaerobic treatment. Winery wastewaters were easily and inexpensively disposed of on soil with good drainage. Formaldehyde in pharmaceutical fermentation waste products was reduced to 0.5-1 g per cu meter using a maximum initial concentration of 1200 g per cu meter and 3 weeks incubation. Other treatment methods for pharmaceutical wastes included aerobic digestion, biological treatment, and biofiltration. (Cassar-FRC)
W82-01257

DAIRY WASTES,
Kraft, Inc., Glenview, IL.
J. C. Groenewold.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 795-797, June, 1981. 34 Ref.

Descriptors: *Dairy industry, *Wastewater treatment, Industrial wastewater, Milk, Activated carbon, Trickling filters, Flotation, Reviews.

Recent literature on managing dairy industry wastewaters included papers on minimizing the amount of waste by improving manufacturing processes and equipment, characterization of wastewaters from a multiproduct plant, and whey disposal and utilization. In individual papers the following subjects were discussed: discharge of dairy plant wastewater without pretreatment into a properly functioning municipal treatment system, advantages of deep shaft treatment facilities, use of trickling filters to remove 50% BOD as a pretreatment, land disposal on soil with good drainage properties, activated carbon treatment of a 164.5 g per cu meter carbohydrate and 23.5 g per cu meter protein wastewater, extended aeration activated sludge treatment (removed 99% BOD and 95-98% suspended solids), the difference in the metabolic rates for lactose and proteins in a milk plant wastewater, activated sludge-biological filters, and an aerated lagoon treatment system for ice cream waste. Current research concerned protein removal with activated carbon (96% BOD, 93% solids, 91% hexane extractables), acidification and continuous air flotation for protein and fat removal, electroflotation, electrocoagulation with ferric chloride addition, and the best grases for a cold weather cheese factory irrigation system. (Cassar-FRC)
W82-01258

TEXTILE WASTES,
Auburn Univ., AL.
J. F. Judkins, Jr.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 797-799, June, 1981. 25 Ref.

Descriptors: *Textile mill wastes, *Dye industry wastes, Reviews, *Wastewater treatment, Industrial wastewater, Flotation, Flocculation, Surfactants, Ozonation, Chlorination, Oxidation, Activated carbon, Adsorption, Water reuse, Aerobic treatment.

The variety of substances (dyes, retarding agents, softening agents, surfactants, fibers, sizing agents, etc.) occurring in textile wastewaters requires a variety of treatment processes. Some of the recent developments in textile wastewater treatment are reviewed: equalization and neutralization, flocculation, flotation, activated sludge treatment, evaporation, activated carbon adsorption, ozonation, chemical coagulation, biological treatment, chlorination, reverse osmosis, foam fractionation, gamma radiation, wet oxidation, ion exchange, TSF filtration process, ultrafiltration for size recovery, and aerobic digestion. The reuse of partially purified water or recycled municipal effluent for some processes such as rinse water or dyeing water was studied. (Cassar-FRC)
W82-01259

PULP AND PAPER INDUSTRY EFFLUENT MANAGEMENT,
National Council for Air and Stream Improvement, Inc., Medford, MA.
G. W. Gove.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 799-814, June, 1981. 158 Ref.

Descriptors: *Pulp and paper industry, *Water pollution effects, Secondary wastewater treatment, Industrial wastewater, Wastewater treatment, Regulations, Economic aspects, Forest management, Effluents, Model studies, *Reviews, Aquatic life, Pollutant identification, Water pollution prevention, Color removal, Coagulation, Clarification, Foam separation, Sludge disposal.

This review of recent papers on pulp and and paper industry wastewater is divided into five classifications. General subjects include national policies, economics, and sources and treatment of effluents. Studies on receiving waters, biological effects of pulp and paper mill effluents, and characterization of effluents resulted in information on predicting the path of pollutants in rivers, containment of wastewaters in ponds, bioassays of aquatic life (fish, shellfish, phytoplankton), mutagenicity of components in mill effluents, a fish tainting protocol, guidelines for priority pollutant sampling and analysis, analytical methods for effluents, and characterization of process streams. Pulping liquor disposal and recovery work concerned methods to reduce the amount of pollutants discharged into the environment. Physicochemical treatment methods include changes in various processes to minimize pollutant formation; water recycling and reuse; coagulation; clarification; ultrafiltration, radiation, and biological treatment for color reduction; condensate stripping; fractionation; membrane techniques; ion exchange; electrochemical processes; and ozonation. Secondary treatment processes in use on the plant scale are: activated sludge, oxygen activated sludge, aerated stabilization basins, 2-stage biological treatment, and flood irrigation of tree plantations. Laboratory and pilot plant secondary treatment studies concern filamentous growth in oxygen activated sludge plants, biological filters, short circuiting in oxidation ponds, and the oxygen balance in aeration tanks. (Cassar-FRC)
W82-01260

PETROLEUM PROCESSING WASTES,
Oklahoma State Univ., Stillwater.
E. L. Stover, and M. F. Torpy.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 824-828, June, 1981. 53 Ref.

Descriptors: *Oil recovery, *Water reuse, *Wastewater treatment, Industrial wastewater, Reviews, Oil wastes, Organic compounds, Flotation, Filtration, Ultrafiltration, Algae.

A review of recent literature on petroleum processing wastes includes information on regulations, literature reviews, analytical methods, and treatment systems. An analytical method for polynuclear aromatic hydrocarbons at levels of 1.0 micrograms per liter has been used successfully. One widely used treatment process for wastes of simple to complex composition included API primary treatment, granular filtration, and biological filtration. Dissolved air flotation and electrolyte techniques were more effective in oil and grease removal than was dispersed air application. Tubular ultrafiltration systems produced effluents meeting regulatory requirements; 2 to 3 year membrane lives were expected. Several aerobic treatment units operating at refineries produced effluents with total BOD of 13 mg per liter. In one case, oily wastewater and domestic wastewater were treated in 2-stage aeration tanks. Mutant microbes adapted to refinery wastes were studied in the laboratory and with mathematical models. The activated sludge process was improved by using high sludge age and adding powdered activated carbon. Other methods of treating refinery wastewaters included single cell algae (Chlorella and Scenedesmus), land application to crops, reverse osmosis and reuse in the refinery, lime soda ash, and evaporation using waste heat as an energy source. A method for recovering fuel oil from contaminated groundwater was described. Laboratory studies on transport of oil to the sediments in an estuarine system showed that 10-20% persisted after a year. (Cassar-FRC)
W82-01262

SYNTHETIC FUEL EFFLUENTS,
Argonne National Lab., IL.
For primary bibliographic entry see Field 5B.
W82-01263

STEEL INDUSTRY WASTES,
Environmental Protection Service, Burlington (Ontario). Waste Water Technology Centre.
D. T. Vachon, and N. W. Schmidtke.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 844-847, June, 1981. 58 Ref.

Descriptors: *Metal finishing wastes, *Steel industry, *Wastewater treatment, Industrial wastewater, Reviews, Heavy metals, Cyanide.

The past year's literature on steel industry wastes included general articles on environmental impacts, including water quality, and pollution control regulations. Water recycling systems were the subject of 7 papers. Wastewater from coke production was treated by several processes: hydrogen peroxide; separate removal of ammonia, cyanide, and oil, with recombination for phenol and organics removal by biological oxidation; FeSO4 plus polyacrylamide; precipitation of iron cyanides with Na salts of sulfite, thiosulfate, dithionite, and pyrosulfite; ion exchange; nitrification; and settling tanks with filter beds. Dry quenching was less damaging to the environment than wet quenching. Blast furnace gas scrubbing water was treated with alkaline chlorination, ozonation, and reverse osmosis. Magnetic filtration was effective in removing suspended solids from hot strip mill effluent. Pickling wastewater lowered phosphorus levels and improved process operating conditions in municipal wastewater treatment systems. Metal finishing wastewaters, high in heavy metal and cyanide, were subjected to electrolytic precipitation, evaporation, reverse osmosis, ion exchange, electrodialysis, ozonation, and many other methods. (Cassar-FRC)
W82-01264

ELECTROPLATING AND CYANIDE WASTES,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
W. R. Knocke.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 847-851, June, 1981. 47 Ref.

Descriptors: *Metal-finishing wastes, *Cyanide, *Heavy metals, Wastewater treatment, Industrial wastes, Reviews, Metals, Chromium, Cadmium, Regulations, Water conservation, Ozonation, *Electroplating.

A review of 1980 literature on electroplating and cyanide wastes included recent regulations and methods for wastewater treatment and analysis. Four categories of metal finishing wastes were classified as hazardous under the Response Conservation and Recovery Act, Part 261.31: spent solutions from electroplating operations, wastewater treatment sludges from electroplating operations, plating sludges from plating baths, and spent stripping and cleaning solutions from plating operations. It was expected that 1680 of the 2336 operating electroplating jobshops would be closed because of the new regulations. Processes for wastewater treatment and metals removals were: sulfide precipitation techniques, electrolytic ferrite formation for removal of chromate, seawater electrolysis, chromium ferrocyanide gels, chelating resins containing an iminodipropionic acid salt, and the surfactant Amifat (N-acyl-L-glutamic acid). A centralized system was proposed to treat wastes from 10 nearby shops in Providence, Rhode Island. Metal recovery techniques which conserve energy, metals, and water were reviewed. These involved temperature modifications, evaporative recovery, filtration, ion exchange, electrolytic transfer systems with polyester membranes, and electrochemical cells. Cyanide waste treatment was examined by several authors. Some of the processes were: ozonation, activated carbon adsorption, heating to 210 C in a sealed container, percolating through a column of steel scrap, and algal systems which work best at cyanide levels < 1 mg per liter. Sludge treatment and disposal methods were reviewed. (Cassar-FRC)
W82-01266

CHEMICALS AND ALLIED PRODUCTS,
Union Carbide Corp., South Charleston, WV.
T. W. Siegrist.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 851-861, June, 1981. 139 Ref.

Descriptors: *Chemical wastewater, *Organic compounds, *Activated carbon, *Wastewater treatment, Reviews, Industrial wastewater, Regulations, Physicochemical treatment, Insecticides, Phenols, Ozonation, Biological treatment, Oxidation, Water reuse.

Waste treatment in the chemical industry was reviewed. Costs of pollution abatement were outlined in several papers. Treatment methods, classified by product type, were discussed for phenol and derivatives (adsorption with activated carbon and/or polymers, acidification with sulfuric acid plus alpha-ray irradiation, ozonation, combined physicochemical and biological treatment); polychlorinated biphenyls (ultraviolet-ozone treatment, critical-fluid extraction, bacterial degradation); kepone (aerobic treatment, photolytic decomposition promoted by amines); dioxins (bacterial oxidation); fatty acid wastes (upflow anaerobic treatment); and other organic compounds--heterocyclics, halogenated diphenylmethanes, melamine-formaldehyde resin wastewater, methanol manufacturing wastes, glycol and glycerol production wastes, butyl benzyl phthalate, dichloromethane, and 3,3'-dichlorobenzidine. Wastes treated at the source for recycling, recovery, or pretreatment purposes included those from manufacturing of fertilizers, acrylic monomers, organic solvents, benzene, munitions, polystyrene, caprolactam, and polyester fibers. A variety of organic chemicals were degraded by biological treatment. Physical-chemical treatment for chemical pollutants was the subject of 42 papers, for example, trihalomethanes, trichloroethylene, petrochemical wastewaters, phenol and derivatives, polychlorinated biphenyls, proteins, amino acids, polysaccharides, phthalates, oil and grease, and heavy metals. Activated carbon treatment was widely used for many of these wastes. Other treatment processes were wet oxidation, shipboard incineration, ozonation-radiation, reverse osmosis, steam stripping, electrolytic treatment, ion-precipitate flotation, and solidification. (Cassar-FRC)
W82-01267

RADIOACTIVE WASTES,
Oak Ridge National Lab., TN.
B. G. Blaylock, and C. S. Fore.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 861-896, June, 1981. 8 Tab, 375 Ref.

Descriptors: *Radioactive wastes, *Path of pollutants, Waste disposal, Regulations, Radioisotopes, Uranium, Water pollution control, Industrial wastes, Literature review.

Several topics pertinent to water pollution were included in a review of the 1980 literature on radioactive wastes. Eight tables summarize the activities at symposia and workshops. The remaining literature has been divided into nine categories: general programs, isolation, waste treatment, storage, environmental transport, monitoring, risk assessment, remedial action programs, and socioeconomic aspects. The path of radioactive materials buried in rocks was studied by several authors. One stated that leach rate experiments were grossly over-pessimistic. Data was collected as input for a model which will predict the fate of radionuclides in canisters dumped into the ocean. Shallow land burial for low-level wastes was studied, and the danger of water penetration and plant root penetration noted. About 85 papers concerning radioactive waste treatment were classified as follows: volume reduction, incineration, calcination, vitrification, solidification, partitioning (separating) and transmutation (changing) troublesome radionuclides, transuranic wastes, and facilities for handling wastes. Migration of radionuclides in the environment (theoretical and case studies) was described by many authors. Over 350 computer models have been developed for this purpose. Remedial action programs included regulations and methods for prevention and cleaning up of uranium mill tailings at several active and inactive sites. (Cassar-FRC)
W82-01268

MICROBIOLOGY OF WASTEWATER TREATMENT,
Drexel Univ., Philadelphia, PA.
W. O. Pipes.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 1142-1145, June, 1981. 44 Ref.

Descriptors: *Microbiological studies, *Viruses, *Water pollution sources, Reviews, Activated sludge, Microorganisms, Pathogens, *Wastewater treatment, Industrial wastewater, Sphaerotilus, Trickling filters, Oxidation ponds, Land disposal, Indicators, Bacteria.

A variety of subjects is included in a review of recent literature on wastewater treatment microbiology. Bacteria causing a filamentous sludge were identified as Sphaerotilus and Leucothrix. Some of the conditions inhibiting growth of these undesirable organisms were dissolved oxygen concentrations above 2 mg per liter, chlorination of return sludge, presence of antibiotics, and soluble Fe. Other studies on activated sludge concerned a method for estimating the viable fraction of microorganisms, a prey-predator model, and a method for enumeration of bacteriophages. Oocystis cells were used in a two-phase tertiary treatment process in ponds. Ozone doses of 15-50 mg per liter removed 98% of green algae from an oxidation pond. Virus survival in land application of wastewater was studied by several authors. Since drying inactivated the viruses, a cyclic application procedure was suggested. Clays removed viruses most effectively, and sandy soils the least. The first 5 cm of soil adsorbed about 75% of the viruses. Later, mobilization by rain caused viruses to be readsorbed at lower levels in the soil profile. In the sludge treatment process viruses were quickly inactivated in an anaerobic digester. However, fecal coliforms were destroyed 7-8 times faster at mesophilic temperatures and 9-10 times faster at thermophilic temperatures. Microorganisms suitable for degrading certain industrial wastewaters were found for distillery wastes and lemonade processing water. In searches for bacterial indicators of viruses, there was no relationship between coliforms and certain viruses. Several authors measured airborne pathogens near wastewater treatment plants. (Cassar-FRC)
W82-01291

FORMATION OF N-NITROSODIMETHYLAMINE DURING TREATMENT OF MUNICIPAL WASTE WATER BY SIMULATED LAND APPLICATION,
Cornell Univ., Ithaca, NY. Dept. of Agronomy.
S. Greene, M. Alexander, and D. Leggett.
Journal of Environmental Quality, Vol 10, No 3, p 416-421, July-September, 1981. 4 Fig, 1 Tab, 28 Ref.

Descriptors: *Nitrogen compounds, *Land disposal, *Wastewater treatment, Municipal wastewater, Nitrogen, Simulation analysis, Nitrosation, Carcinogens, Mathematical equations, Nitrites, Soil filters, Soil water, Notrosamines, *Leachates.

N-nitrosamines represent a group of potentially serious pollutants which may be formed or leached through soil when wastewater is applied to land. One of these, N-nitrosodimethylamine (NDMA) is a highly toxic compound which can be formed from amines added by pesticides or root excretions in nitrate-amended soil. The extent of NDMA formation and the behavior of its precursors were examined in soils incubated with sewage and in effluent from soil columns percolated with sewage. NDMA formation was investigated in Lake George sand and Arkport fine sandy loam amended with sewage, 250 micrograms of dimentylamine (DMA), and 50 micrograms of nitrite-nitrogen per gram. Although the rates of NDMA formation were similar in the two soils, the rates of destruction of DMA and nitrite differed significantly between the two soils. Both DMA and nitrite levels

decreased more rapidly in the Arkport soil than in the Lake George soil. The amount of NDMA that accumulated in Lake George sand amended with sewage under nonpercolating conditions was found to be a linear function of the amount of DMA and nitrite added. On a molar basis, 0.8% of the DMA and 1.3% of the nitrite added to the soil was converted to the carcinogen, NDMA. Smaller amounts of conversion occurred when sewage containing the precursors was percolated through this soil. The moisture level of the soil also influenced the extent of nitrostation. These findings demonstrate the facility with which NDMA leaches through soils. Although it is not known whether DMA and nitrite levels ever reach concentrations high enough to result in NDMA formation in the field, the demonstrated fact that nitrosamine formation is likely to occur under conditions resembling those of land application of wastes suggests that groundwater and surface water near existing land treatment areas should be monitored for NDMA and other nitrosamines. (Carroll-FRC)
W82-01343

REMOVAL OF PHOSPHORUS FROM WASTE WATER BY SOIL UNDER AEROBIC AND ANAEROBIC CONDITIONS,
Connecticut Agricultural Experiment Station, New Haven.
D. E. Hill, and B. L. Sawhney.
Journal of Environmental Quality, Vol 10, No 3, p 401-405, July-September, 1981. 6 Fig, 2 Tab, 25 Ref.

Descriptors: *Phosphorus removal, *Wastewater treatment, *Soil filters, Anaerobic conditions, Aerobic conditions, Groundwater pollution, Fertilizers, Tile drains, Soil absorption capacity.

Previous studies have demonstrated that the movement of phosphorus added to soils in wastewater or as fertilizer is extremely slow. Reducing conditions caused by flooding in cultivated soils with tile drains can increase the mobility of this phosphorus, however. A simulated wastewater containing 12 micrograms of phosphorus per milliliter of solution was added to a fine sandy loam soil underlain by bedrock at 72 centimeters two or three times a week over a 2.5 year period. The water table fluctuated between 25 and 75 centimeter depths during this period. Analyses of the effluent from weep holes at different depths indicated that the wastewater moved along preferred pathways in heterogeneous soil and produced breakthrough of phosphorus to ground water before all sorption sites were fully saturated with phosphorus. The mobility of phosphorus increased under the anaerobic conditions produced when the water table was closest to the surface. This enhanced mobility increases the transport of phosphorus to the groundwater in soils which are used for continued wastewater disposal. The phosphorus sorption capacity of a soil is reduced by long-term wastewater renovation, although sorption sites can be regenerated and the potential for additional phosphorus sorption increased by periodic resting. There was a reasonably good agreement between estimates of phosphorus retention based on its concentration in influent and effluent solutions and bulk density of the soil and laboratory determinations of phosphorus retained following wastewater renovation. Most of the phosphorus retained in the soil is transformed into unavailable forms. (Carroll-FRC)
W82-01344

SANITATION SERVICE MANAGEMENT IN FRANCE (LA GESTION DES SERVICES D'ASSAINISSEMENT EN FRANCE),
Ingenieurs a la Societe Lyonnaise des Eaux et de l'Eclairage, Paris (France).
For primary bibliographic entry see Field 6F.
W82-01351

A LOOK AT SOME WATER RECLAMATION PLANTS IN SOUTHERN AFRICA,
National Institute for Water Research, Pretoria (South Africa).
J. Van Leeuwen, L. R. J. Van Vuuren, J. W. Funke, and A. J. Clayton.
Aqua, No 2, p 0256-0262, 1981. 6 Fig, 1 Tab, 25 Ref.

Descriptors: *Water reuse, *Water resources development, *Wastewater renovation, Water use, Water quality, Water pollution control, Drinking water, Potable water, *Water conservation, *South Africa.

Various water reclamation plants operation in South Africa are reviewed, including the Sappi plant near Springs, the Mondi plant near Durban, the Stander Water Reclamation Plant at Pretoria, the LFB pilot plant at Pretoria, the Athlone pilot water reclamation plant at Cape Town, and the Windhoek Water Reclamation Plant in South West Africa. A review of these plants indicated that it is possible to reclaim water from wastewater for many applications. Water can be reclaimed to conform to any quality criteria, including those for potable water. Reclaimed water may in many cases be an economically viable alternative to water from conventional, potable supplies. Cooperation between local authorities and industry is a vital part of the success of any reclamation operation. In southern Africa the cost of reclaimed water is about equal to the consumer price of drinking water obtained by conventional purification of surface water. In some cases costs of pumping water from distant sources are high, and it may prove economical to distribute reclaimed water from wastewater sources which are easily accessible. Since quality standards for industrial processes are lower than for domestic reuse purposes, the cost is lower for industrial reuse. The relatively low irrigation water quality requirements in the area lend themselves to water reuse without costly intermediate treatment. Water reclamation not only offers an extension of the usefulness of a given quantity of water, but can also play an important role in combating pollution. (Baker-FRC)
W82-01352

EXPANSION OF EFFLUENT CONSTRAINED TREATMENT PLANTS,
Newcastle Univ., New South Wales (Australia). Dept. of Civil Engineering.
B. J. Williams.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE3, p 571-589, June, 1980. 7 Fig, 9 Tab, 10 Ref.

Descriptors: *Water treatment facilities, *Cost analysis, Design criteria, Water quality, Wastewater treatment, Land application, Wastewater facilities, Loading rate.

An approach is presented for use in planning an extension of sewage treatment plants to provide both for increased loads of sewage and for more stringent controls on the concentrations of various pollutants in the effluents from the treatment plants. The objective is to determine what size primary, secondary, and tertiary treatment plants should be built in each of several planning stages in order to minimize total discounted costs over the entire planning period and provide sufficient treatment for the increasing raw sewage load. The plan was applied to the Melbourne and Metropolitan Board of Works Farm (MMB), which has represented a very successful example of land treatment of sewage for the last 85 years. The farm comprises a carefully operated system of land filtration, grass filtration and lagoons, but has become overloaded over the past few years. Extension is limited by the availability of suitable land. The MMB plans to build conventional treatment plants on the site to supplement the farm. The proposed schemes involve continued use of existing farm treatment processes plus primary and secondary treatment with either tertiary treatment or an outfall to Bass Strait. A series of sensitivity tests has been carried out on operations and maintenance costs of plant and the farm, predicted sewage loads and scale factors. The most important of these was the effect of variation in sewage load. A 10% reduction in waste load results in savings of between 17 and 24% for the 1 and 8% discount rates. Relaxation of the water quality constraint allows substantial savings to be made in treatment costs. (Baker-FRC)
W82-01355

DESIGN AND CONSTRUCTION OF SHIELDHALL SEWAGE-TREATMENT WORKS, GLASGOW,
Strathclyde Regional Council (Scotland).
W. T. Greer.
Water Pollution Control, Vol 80, No 2, p 260-272, 1981. 10 Fig.

Descriptors: *Wastewater treatment, *Design criteria, Water treatment facilities, Economic aspects, Construction, Planning, Costs, *Glasgow drainage area, Great Britain.

Shieldhall was the third and last sewage treatment works built to serve the Glasgow drainage area. It was opened in May of 1910. Site selection had been beset with difficulties over the years. Until the early 1960's siting choice was restricted by the fact that the most valuable industrial land in Glasgow was along the riverside and adjacent to the shipyards. After siting problems had been solved, a new wastewater treatment works was designed for the area, which would produce a 30:20 standard effluent. In view of the necessity of maintaining treatment throughout the reconstruction period, it was decided to build the new works in two phases. Phase I was constructed on newly acquired ground and consists of a low-level pumphouse, presedimentation works, primary-sedimentation tanks, storm-sewage tanks, a sludge pumphouse and underground storage tanks, sewer diversions and a new outfall channel to the River Clyde. Phase II was to include aeration tanks, secondary settlement tanks, a return activated-sludge pumphouse and a further overhead sludge-storage tank. Work began on Phase I in April of 1975. Permission has now been obtained to proceed with phase II, and the civil engineering work commenced in March of 1980. The entire project is to be completed by 1984. (Baker-FRC)
W82-01385

SCAYNES HILL STW EXTENSIONS INCLUDE PLASTIC MEDIA FILTRATION.
Water Services, Vol 85, No 1020, p 92-93, 95, February, 1981. 3 Fig.

Descriptors: *Wastewater treatment, Sludge lagoons, Lagoons, Wastewater irrigation, Filtration, Tertiary wastewater treatment, *Water treatment facilities, Haywards Heath sewage, Great Britain.

Prior to 1905 Haywards Heath sewage was treated at three separate sewage farms. In 1934, due to pollution of the River Ouse, a modern disposal works was begun to replace the broad irrigation system that had been in use. This new system consisted of four brick inverted pyramid primary settling tanks with a total capacity of 814 cubic meters and six brick percolating filters containing 2800 cubic meters of clinker. Phase I of a new sewage system began in 1961 to deal with flooding at Ashenground. Phase II consisted of enlarging the Scaynes Hill Works and laying a 840 mm gravity sewer. Phase III involved the closure of another works and construction of a pumping station. Each of these phases was completed by 1966. In 1971 the sludge lagoons were abandoned and a vacuum filtration sludge dewatering plant constructed with three tertiary effluent lagoons. Recently two settling tanks with mechanical scrapers were built to supplement the two existing ones, and the four tanks now handle all incoming flows up to 21,600 cubic meters/day. (Baker-FRC)
W82-01386

RURAL SANITATION IN DEVELOPING COUNTRIES,
Hawksley (Watson), High Wycombe (England).
J. M. Sidwick.
Effluent and Water Treatment Journal, Vol 21, No 5, p 210-212, 214, 215, May, 1981. 2 Fig, 3 Tab, 10 Ref.

Descriptors: *Waste disposal, *Developing countries, *Sanitation, Public health, Rural areas, *Wastewater treatment, Methane, Septic tanks, Agriculture, Composting, Fish ponds, Algae, Irrigation, Wastewater irrigation, Land disposal.

Disposal methods for human excreta in developing countries are evaluated and compared. In the ab-

sence of adequate waste disposal, the benefits from water supplies being developed through the International Drinking Water Supply and Sanitation Decade programs are reduced. Low cost methods listed in order of increasing mean total cost ($18.7-$64.9 per household per year in 1978 dollars) are pour flush toilet, pit privy, communal toilet, vacuum truck cartage, low cost septic tank, composting toilet, and bucket cartage. Although many of these disposal methods produce odors, insect problems, and health hazards in handling and removal, they can provide an answer to handling excreta in rural areas until more effective waterborne sewage systems are feasible. Reuse of excreta is a widely used disposal method throughout the world. However, public health hazards must be reduced to an absolute minimum. The main reuse options are direct use of nightsoil on the land, composting, wastewater irrigation, agriculture, algae and fish culture, animal food, and biogas production. (Cassar-FRC)
W82-01392

NEW APPROACHES TO ANAEROBIC SLUDGE DIGESTION,
Water Pollution Research Lab., Stevenage (England).
A. M. Bruce.
Journal of the Institution of Water Engineers and Scientists, Vol 35, No 3, p 215-229, May 1981. 4 Fig, 5 Tab, 35 Ref.

Descriptors: *Anaerobic digestion, *Sludge digestion, *Wastewater treatment, Biological treatment, Biodegradation, Digestion, Composting, Aerobic digestion, Lime, Sludge thickening, Lagoons, Great Britain.

Mesophilic anaerobic sludge digestion has been a satisfactory process since its development in the 1920's. The high initial cost is a disadvantage. Of the alternative processes reviewed (aerobic digestion, lime stabilization, and composting) lime stabilization is most satisfactory, depending on the local cost of lime and the land available for disposal. The efficiency of the conventional single stage, completely mixed reactor design may be improved either by reducing retention periods or by thickening sludge before digestion. Recent experiments have shown that mesophilic digestion of raw sludge of up to 9% solids and retention periods as low as 13 days may be satisfactory. Removing dead zones by adequate mixing and grit removal also improves efficiency. A graph shows the effect of population size on capital costs of a primary anaerobic digestion plant at different loading rates (1 to 4 kg volatile solids per cu meters per day). (Cassar-FRC)
W82-01398

REMEDIAL TECHNIQUE OF CONTROLLING AND TREATING LOW VOLUME LEACHATE DISCHARGE,
Nassaux-Hemsley, Inc., Chambersburg, PA.
For primary bibliographic entry see Field 5G.
W82-01428

COMPARATIVE EVALUATION OF PROCESSES FOR THE TREATMENT OF CONCENTRATED WASTEWATERS AT UNCONTROLLED HAZARDOUS WASTE SITES,
TRW Environment Engineering Div., Redondo Beach, CA.
M. Ghassemi, K. Yu, S. Quinlivan, and F. J. Freestone.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC, Environmental Protection Agency Report (1980). p 160-164, 4 Tab.

Descriptors: *Wastewater treatment, *Wastewater facilities, *Hazardous materials, *Evaluation, Economic aspects, Reverse osmosis, Ultrafiltration, Ion exchange, Wet oxidation process, Coagulation, Precipitation, Activated sludge process, Ozonation, Waste disposal sites.

This paper summarizes the results of an evaluation of the suitability and economics of several commercially available water and wastewater treatment processes for use in mobile units for on-site treatment of highly contaminated waters. Seven processes were evaluated: reverse osmosis (RO); ultrafiltration (UF); ion exchange (IE); wet air oxidation (WAO); high purity oxygen activated sludge process (HP); UV-ozone oxidation (UV); and coagulation/precipitation (CP). It was assumed the equipment mounted on a single trailer would treat 227,000 l/day, based on single processes, not combinations. All the processes except UF and UV are widely used commercially and all but HP, CP, RO and IE appear to be the most promising processes, because they are compact, quick to start and stop, convenient to service, and do not require skilled field operating labor. The necessary electricity can be generated on-board and they can handle a wide variety of wastes. None of the processes was effective individually, but RO and IE could be made so with either pretreatment of post-treatment, or a combination of two processes could be used. Capital costs range from $35,000-$650,000; labor, energy, and materials costs also vary widely. (Brambley-SRC)
W82-01430

EVALUATION OF REMEDIAL TREATMENT, DETOXIFICATION AND STABILIZATION ALTERNATIVES,
Anderson-Nichols and Co., Inc., Boston, MA
M. A. Sills, J. J. Struzziery, and P. T. Silbermann.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC, Environmental Protection Agency Report (1980). p 192-201, 5 Fig, 3 Tab, 9 Ref.

Descriptors: *Groundwater pollution, *Groundwater management, *Water pollution control, *Waste disposal, *Hazardous material, Detoxification, Immobilization, Stabilization, Wastewater treatment, Wastewater collection, Wastewater disposal, Economic aspects, Environmental effects.

A systematic evaluation procedure has been developed for the identification of the most cost effective, environmentally sound treatment, detoxification or stabilization methods for the remedial management of uncontrolled hazardous waste sites. In situ detoxification, stabilization and immobilization techniques have been developed. Detoxification involves the injection of chemicals or biological agents into the contaminated soil. Stabilization is accomplished by converting contaminants to insoluble forms through chemical reactions, or encapsulating them in a highly insoluble matrix. Immobilization techniques may be applied alone or in conjunction with others; they rely on the injection of materials which prevent further movement of the contaminants. Withdrawal, treatment and disposal options depend on the nature of the site and the contaminants. Collection and withdrawal methods include collection wells, subsurface gravity collection drains, impervious grout curtains, and cut-off trenches, while the treatment options include reverse osmosis, ultrafiltration, ion exchange, wet air oxidation, activated carbon, ozonation/UV radiation, and chemical and biological treatment. Three final disposal options to be evaluated are discharge to municipal sewage treatment plant, discharge to a surface water body, and land application. The systematic two-phase iterative screening procedure identifies the most promising management alternatives in the first phase, then subjects them to more intense technical, economical and environmental evaluations. (Brambley-SRC)
W82-01434

BACKGROUND DOCUMENT FOR MODIFICATION OF PH EFFLUENT LIMITATIONS GUIDELINES AND STANDARDS FOR POINT SOURCES REQUIRED BY NPDES PERMIT TO MONITOR CONTINUOUSLY EFFLUENT PH.
Environmental Protection Agency, Washington, DC. Office of Analysis and Evaluation.
Report EPA-440/2-80-083, November, 1980. 132 p, 6 Fig, 21 Tab, 13 Ref.

Descriptors: *Industrial wastewater, *Hydrogen ion concentration, *Monitoring, *Regulations, Water pollution control, Water quality standards, Effluents, Industrial plants.

The information presented in this report evolved in response to a petition from various industries seeking relief from absolute compliance with the 6-9 pH categorical standard when continuous monitoring is required. The standard of pH 6-9 was initially intended for those situations where grab or composite samples were to be monitored, but has been adopted for use in continuous monitoring situations. Two studies were conducted to verify the original regulations. A total of 15 plants were visited, each of which was using continuous pH monitoring, and their monitoring data were surveyed to determine how frequently the effluent was out of the standard pH range. The causes of the excursions out of range were identified. Thirteen of fourteen plants for which data were available were able to achieve compliance over 99% of the time over periods of 6 months and more. On a monthly basis eight of the plants had at least one month exceeding a 99% monthly standard. The long excursions from the standard were usually due to process or treatment system upsets, and instrumentation malfunctions, none of which should be a factor in modifying pH standards. The EPA maintains the 99% monthly compliance time, and recommends that a plant is not to be outside the categorical pH range continuously for more than 30 min. (Brambley-SRC)
W82-01438

ENVIRONMENTAL IMPACT AND HEALTH EFFECTS OF WASTEWATER CHLORINATION,
Illinois Univ. at the Medical Center, Chicago, IL. School of Public Health.
G. R. Brenniman.
Illinois Institute of Natural Resources, Chicago. Document No 81/27, July 1981. 63 p, 8 Tab, 149 Ref.

Descriptors: *Chlorination, *Wastewater treatment, *Residual chlorine, *Public health, Chloriform, Water treatment, Chlorinated hydrocarbons, Carcinogens, Fish toxins, Safety, Toxicity, Epidemiology, *Environmental effects.

There are some benefits to chlorinating wastewater effluents; however, many scientists have expressed a concern about the environmental impact and health effects of this process, particularly the effect of residual chlorine on fish and other aquatic life, and about the reaction of chlorine with organic materials in the effluents. These may form chlorinated hydrocarbons that persist in the environment, magnify through the food chain, and even cause cancer. A critical review of the literature and studies on quantifying the toxicity of chlorine to aquatic organisms showed that low concentrations of total residual chlorine (TRC) in wastewater are detrimental to aquatic life. A TRC concentration of 0.003 mg/l is safe for freshwater aquatic life continuously exposed to this residual; however, chlorine residuals in wastewater effluents and many receiving streams in Illinois exceed this safe concentration. The human cancer risk from chloroform found in drinking water appears to be low, but the risk from several carcinogens mixed together in water supplies and extrapolated from animal studies is not known. Epidemiologic studies have shown some association between gastro-intestinal and urinary tract cancer mortality and exposure to chlorinated drinking water. Most of these associations are not consistent across gender and race groups and generally are inconclusive. Research is needed on the transformation, metabolism, and bio-magnification of organochlorine compounds as they move through the food chain, and more epidemiologic studies are needed to clarify the risks of drinking chlorinated water. (Garrison-Omniplan)
W82-01451

ANAEROBIC CARBON FILTER FOR DEGRADATION OF PHENOLS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
M. T. Suidan, W. H. Cross, M. Fong, and J. W. Calvert.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE3, p 563-579, June,

1981. 10 Fig, 3 Tab, 15 Ref. OWRT-A077-6A(3), 14-34-0001-8011.

Descriptors: *Anaerobic digestion, *Activated carbon, *Phenols, Industrial wastes, *Wastewater treatment, Chemical oxygen demand, Methane, Catechol, Cresol, Mathematical equations.

An anaerobic activated carbon packer bioreactor was used to treat synthetic wastewaters bearing catechol, o-cresol, and a mixture of o-cresol and glucose. The process performance in converting the primary phenolic constituent as well as reducing the COD and organic content of the substrate was evaluated. Also, methane production was monitored. Chemical oxygen demand biomass yield coefficients of 11 to 15% were obtained. This low sludge productivity represents savings in sludge disposal costs. A methane gas production rate equivalent to 2.21 kcal/g of COD can be expected from the system. A mathematical expression which represents the relationship between wastewater characteristics that favor an anaerobic filter is $0.00457C - (35 - T) > 0$, where C = the concentration of biodegradable COD in milligrams/liter and T = the temperature of the raw wastewater in degrees C. (Small-FRC)
W82-01454

PURIFICATION OF MUNICIPAL WASTEWATER BY SUBSEQUENT REVERSE OSMOSIS AND ANAEROBIC DIGESTION,
Amsterdam Univ. (Netherlands). Lab. of Chemical Technology.
J. C. Van Den Heuvel, R. J. Zoetemeyer, and C. Boelhouwer.
Biotechnology and Bioengineering, Vol 23, No 9, p 2001-2008, September, 1981. 3 Fig, 3 Tab, 11 Ref.

Descriptors: *Reverse osmosis, *Anaerobic digestion, *Combined treatment, *Wastewater treatment, Municipal wastewater, Drinking water, Methane, Performance evaluation, Water quality.

The combined process of reverse osmosis followed by anaerobic digestion was applied to municipal wastewater. Membrane deterioration was studied in terms of permeate flux and rejection, and the quality of the permeate with respect to its possible use for the production of drinking water was determined. Also, the digestability of the brine by the anaerobic process and the amount of methane evolved were determined. The results of experiments were positive, with the permeate being a good quality as a raw material for drinking water. The wastewater was concentrated 7.7 fold, and continuous anaerobic digestion of the brine removed over 90% of the BOD, evolving the expected amount of methane. When environmental quality and the production of drinking water are considered, the combined process shows promise for highly populated areas which lack groundwater or surface water of good quality. (Small-FRC)
W82-01468

MECHANISM OF ENTEROVIRAL INACTIVATION BY OZONE.
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
D. Roy, P. K. Y. Wong, R. S. Engelbrecht, and E. S. K. Chian.
Applied and Environmental Microbiology, Vol 41, No 3, p 718-723, March, 1981. 5 Fig, 20 Ref.

Descriptors: *Wastewater treatment, *Viruses, *Ozone, Enterovirus, Poliovirus, Laboratory studies, Mirobiological studies, Disinfection, Kinetics.

The mechanism by which ozone inactivates viruses was elucidated using radiolabeled poliovirus 1 (Mahoney) to identify the major reactions and lethal sites involved. Residual ozone concentrations in viral suspensions were maintained at 0.3-0.8 mg/l to ensure at least 99% inactivation. Ozone had no effect on the overall structural integrity of the viral protein coat. Electrophoretic analysis of poliovirus capsid polypeptides labeled with 14C-amino acids suggested possible damage to two of the four polypeptide chains on the protein coat (VP1 and VP2), but the damage was insufficient to prevent attachment to host cells and thus to block viral replication. The sedimentation profile of centrifuged viral RNA extracted after exposure of labeled virus to 0.31 mg/l ozone for up to 2 min indicated damage to the RNA, which may have been fragmented into a number of short chains. Such damage would account for inactivation. This finding is consistent with studies showing that inactivation of viruses by ozone is rate limited by the diffusion of ozone through the protein coat and into the nucleic acid core. (Carroll-FRC)
W82-01482

STABILITY OF ACTIVATED SLUDGE PROCESSES BASED ON STATISTICAL MEASURES,
California Univ., Davis. Dept. of Civil Engineering.
S. Niku, and E. D. Schroeder.
Journal of the Water Pollution Control Federation, Vol 53, No 4, p 457-470, April, 1981. 4 Fig, 9 Tab, 16 Ref.

Descriptors: *Activated sludge process, *Statistical analysis, *Stability analysis, Wastewater treatment, Design criteria, Biological oxygen demand, Suspended solids, Contact stabilization, Standard deviation, *Wastewater facilities.

The stability of 43 activated sludge treatment plants was evaluated by statistical analysis. Standard deviation was selected as the most appropriate indication of stability in this study. Theroretically, it is a measure of dispersion, and practically, it is the most familiar and simplest term among the possible measures of stability--variance, coefficient of variation, and coefficient of stability. Plants were ranked with respect to stability, based on standard deviation vs. coefficient of stability of effluent BOD concentration and by standard deviation vs. coefficient of stability of effluent suspended solids (SS) concentration. Plants defined as stable operated at a standard deviation of less than 10 g per cu m for both effluent BOD and SS and a mean effluent BOD of less than 17 g per cu m, mean effluent SS less than 15 g pr cu m. There was little correlation between plant size and effluent quality. Examination of process type vs. stability revealed that the step feed or step aeration modifications of the conventional activated sludge process gave the best-year-round results for BOD removal; conventional activated sludge, for SS removal. The complete mix modification of the activated sludge and the contact stabilization process produces higher than average effluent BOD and SS concentrations, with the contact stabilization process having the worst performance characteristics. To achieve a stable activated sludge process plants should be designed for an effluent BOD concentration of less than 13-15 g per cu m and an effluent SS concentration of less than 1012 g per cu m. (Cassar-FRC)
W82-01489

EFFECT OF COPPER ON NITRIFICATION IN ACTIVATED SLUDGE,
Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
For primary bibliographic entry see Field 5C.
W82-01497

OPTIMUM RECYCLE AND REUSE COOLING SYSTEM DESIGNS USING THE BCT PROCESS,
Tower Systems Inc., Tacoma, WA.
For primary bibliographic entry see Field 3E.
W82-01503

THE WAYNE COUNTY, MICHIGAN, WASTEWATER COLLECTION AND TREATMENT SYSTEM,
Wayne County Board of Public Works, MI.
D. R. Egeland, and T. G. Biehl.
Journal of the Water Pollution Control Federation, Vol 53, No 9, p 1366-1369, September, 1981. 3 Fig.

Descriptors: *Wastewater treatment, *Wastewater collection, Sludge, *Wayne County, *Michigan, Design criteria, Municipal wastewater, Wastewater management, Wastewater facilities.

A description is offered of the wastewater collection and treatment system in service for Wayne County, Michigan. Planning for the system began in the early 1930s; it currently serves a population of 1,100,000 in 39 municipalities located in 5 counties. Initial designs called for seven primary-treatment plants, together with intercepting sewers to convey the wastewater to the plants. Growth during the ensuing years resulted in the construction of two or more inland treatment plants and a large lagoon facility. Overall planning has been developed so as to use the large flow in the Detroit River to assimilate the treatment wastewater effluent and to protect the water quality of the smaller tributary rivers by eliminating wastewater treatment plant discharge. When the Huron Valley Project is completed, the Wayne County system will include the Northeast District, the Rouge Valley District and the Downriver District. The proposed Huron Valley plant features a biological treatment process involving a sequential anaerobic/aerobic environment that promotes the growth of organisms suitable for removing excess phosphorus as well as biochemical oxygen demand from the waste stream. The sludge disposal facilities consist of thickening in circular covered gravity tanks, sequential thermal conditioning and decanting of sludge, vacuum filtration with cloth media, fluid bed incinerators designed to achieve autogenous combustion of the thermally conditioned sludge with waste heat recovery, steam and electric power generation, and sidestream treatment, involving precipitation of phosphorus with lime. The Wayne County Board's largest plant treated an average of 85 mgd in 1980 at a basic charge of $552/million gallons. (Baker-FRC)
W82-01505

DETROIT - FRESH CLEAN WATER,
Detroit Water and Sewerage Dept., MI.
H. W. Bierig, A. C. Davanzo, J. W. Hubbell, and F. Pollard.
Journal of the Water Pollution Control Federation, Vol 53, No 9, p 1359-1369, September, 1981. 3 Fig.

Descriptors: *Wastewater treatment, *Detroit, Municipal wastewater, Municipal wastes, History, Water pollution control, Wastewater management, Combined sewers.

In 1836 a water pollution control program was begun for the city of Detroit with the construction of sewers that ran perpendicular to the river and emptied directly into it. The city continued to grow, and in 1914 a proposal was made to screen the combined sewer outfalls at the river's edge. In 1925 a comprehensive study proposed a plant near the southwestern corner of the city, with local topography and geological conditions being of key importance in planning one large treatment plant. Despite the flat terrain, almost 85% of Detroit is served by a gravity collection system, with pumping needed only at the treatment plant's main pump station. The other 15% of the city is served by combination sanitary/stormwater pump stations, remotely controlled from a central location in downtown Detroit. Although the combined system was constructed using mostly typical interceptor-level, float-controlled regulators, larger units at key locations have been modified for remote operation. The adverse effects of incoming rainfall can be reduced through reliance on weather forecasts. In 1969 it was decided to proceed with construction of two activated sludge systems. The first-phase construction of activated sludge systems included two intermediate variable-speed lift pumps, feeding the two aeration basins. Following aeration the flow proceeded to clarifiers, each with its own return sludge pump. While all this work was being undertaken in the Detroit area, other localities in the metropolitan region took their own approach to the collection and treatment of wastewater. (Baker-FRC)
W82-01506

DYNAMIC NUTRIENT CYCLE MODEL FOR WASTE STABILIZATION PONDS,
Princeton Univ., NJ. Dept. of Civil Engineering.
R. A. Ferrara, and D. R. F. Harleman.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil

Engineers, Vol 106, No EE1, p 37-54, February, 1980. 19 Fig, 2 Tab.

Descriptors: *Cycling nutrients, *Stabilization ponds, Ponds, Nutrients, *Wastewater treatment, Tertiary wastewater treatment, Advanced wastewater treatment, Model studies, Mathematical models, Optimum development plans, Design criteria.

A reliable and predictive method was sought for the optimum design and analysis of waste stabilization ponds that would go beyond the classical biochemical oxygen demand (BOD) approach and consider biological and nutrient dynamics. Attention is focused on facultative stabilization ponds, as they appear to be very promising and widely used for complete treatment of wastewater. In order to develop a usable model for waste stabilization ponds, it is necessary to describe both the hydraulic transport and the biological and chemical transformation of material. A model is developed which includes representation of the following: mineralization of organic compounds, organism growth, net loss of material by settling of nonbiodegradable organic matter, atmospheric reaeration of carbon dioxide, and removal of fecal coliforms by death and predation. Stabilization ponds are capable of providing at least secondary treatment of raw sewage while also removing significant amounts of nitrogen and phosphorus without process modification. While the use of stabilization ponds alone for high level tertiary treatment may not be feasible, they can, if properly designed in conjunction with solids removal mechanisms, provide a tertiary level of treatment. At present primary concern of future research on waste stabilization ponds should be in the area of data collection. (Baker-FRC)
W82-01541

SURVEY OF TREATMENT PLANT DESIGN AND OPERATION DEFICIENCIES,
Montgomery (James M.) Inc., Pasadena, CA.
D. L. Smith, and R. V. Daigh.
Journal of the Water Pollution Control Federation, Vol 53, No 8, p 1272-1282, August, 1981. 15 Fig, 1 Tab.

Descriptors: *Performance evaluation, *Process control, *Design criteria, *Wastewater treatment facilities, Operating policies, Training, Activated sludge, Clarification, Sludge disposal, Monitoring.

A survey of eight wastewater facilities with chronic operating problems revealed that the reasons for poor performance were evenly split between design and operation deficiencies. The most frequent design problems were grit removal/clarifier, pump control, and sludge handling systems. Of less importance were design loadings, reactor design, chlorine contact time, metering, and laboratory minor design details to cause severe operations problems. Inadequate monitoring was slightly more prominent among the operations deficiencies than other factors: staffing, inadequate maintenance, digester supernating/sludge withdrawal, return activated sludge operation, sludge pumping, infiltration/inflow industrial discharge, and aerator operation maintenance. Where chronic noncompliance at a plant is noted, emphasis should be placed on cause-effect relationships and controlled experimentation with process variables during operator training programs. (Cassar-FRC)
W82-01543

DESIGN AND COST COMPARISON OF BIOLOGICAL NITROGEN REMOVAL PROCESSES,
International Environmental Consultants Ltd., Toronto (Ontario).
R. W. Wilson, K. L. Murphy, P. M. Sutton, and S. L. Lackey.
Journal of the Water Pollution Control Federation, Vol 53, No 8, p 1294-1302, August, 1981. 2 Fig, 9 Tab, 18 Ref.

Descriptors: *Denitrification, *Nitrogen removal, *Biological treatment, *Wastewater treatment, *Penticton, British Columbia, Cost analysis, Design criteria, Nitrates, Ammonium, Land disposal, Ion exchange.

The most cost effective biological nitrogen removal process for the City of Penticton, British Columbia, was one-sludge pre-denitrification. This process uses the oxidizable organic matter in the raw wastewater as electron donor for the denitrification process. The process design was based on a 20-day aerobic solids retention time and a 10-day anoxic solids retention time at a minimum temperature of 8 C. Desired N levels in the treated effluent were 5 mgd per liter nitrate-N and 1 mg per liter ammonium-N. The one-sludge post-denitrification process was nearly as cost effective, followed by the two-sludge post-denitrification. Non-biological methods studied were ammonia stripping, ion exchange, and land disposal, all of which were 30-50% more expensive than the biological N removal processes. (Cassar-FRC)
W82-01544

PIPELINE FRICTION LOSSES FOR WASTEWATER SLUDGES,
Havens and Emerson Ltd., Cleveland, OH.
M. C. Mulbarger, S. R. Copas, J. R. Kordic, and F. M. Cash.
Journal of the Water Pollution Control Federation, Vol 53, No 8, 1303-1313, August, 1981. 16 Fig, 2 Tab, 18 Ref.

Descriptors: *Pipelines, *Friction loss, *Head loss, *Wastewater treatment, Pipe flow, Sludge, Rheology, Reviews, Shear stress, Turbulent flow, Laminar flow, Rigidity, Hydraulic loss, *Literature review.

The past 50 years' literature on frictional head losses associated with pipeline conveyance of wastewater solids was reviewed. The rheological data were summarized to discover trends as a function of the sludge slurry concentration. Trend lines were drawn to allow prediction of laminar flow head losses and the transition from laminar to turbulent flow regimes. Turbulent flow head losses obeyed conventional flow relationships. The head loss predictions divided into operating and worst case categories, were verified with operating data from several cities' treatment plants. Appended are predictive head loss curves for cast or ductile iron lines of seven diameters from 4 inches to 20 inches, representing both routine operation and worst case. (Cassar-FRC)
W82-01545

FACTORS AFFECTING THE FATE OF HEAVY METALS IN THE ACTIVATED SLUDGE PROCESS,
Oregon State Univ., Corvallis. Dept. of Civil Engineering.
P. O. Nelson, A. K. Chung, and M. C. Hudson.
Journal of the Water Pollution Control Federation, Vol 53, No 8, p 1323-1333, August, 1981. 12 Fig, 5 Tab, 34 Ref.

Descriptors: *Heavy metals, *Activated sludge process, *Adsorption, Water pollution effects, Wastewater treatment, Metals, Zinc, Copper, Bacteria, Cadmium, Microorganisms, Fate of pollutants, Toxicity.

Activated sludge bacteria rapidly adsorbed cadmium, copper, and zinc from solution within 1 hour after dosing in batch reactor experiments. Attempts to compare metal ion adsorption by live and inactivated bacteria produced erratic results; it is likely that physical and chemical factors, rather than biological factors, control the adsorption mechanism. Adsorption isotherms represented the distribution of metals between bacterial solids and solution phases. Conditional adsorption constants, presented in a table, indicated that Cu had a greater adsorption density than Cd at equivalent molar concentrations. As the pH increased, Cu adsorption increased up to pH 8, then decreased. The order of affinity for bacterial solids at pH 7 was Zn > Cu > Cd. pH was the single most important factor affecting metal adsorption on organic and inorganic surfaces. As pH increased, adsorption of Cd and Zn increased, reaching a maximum 90% removal at pH 10. Cu adsorption was almost 100% at pH 7, decreasing sharply to 40% or less at low and high pH. Adsorption of Cd, Cu, and Zn was greater at 5 days residence time than at 1 day, consistent with the hypothesis that exocellular polymers produced by the bacteria are largely responsible for uptake of metal ions. Solubilities, speciation, and distribution between the soluble and particulate (bacteria) phases were calculated from data obtained in this study and from the literature. (Cassar-FRC)
W82-01547

OPERATIONAL PROBLEMS WITH ROTATING BIOLOGICAL CONTACTORS,
Army Environmental Hygiene Agency, Aberdeen Proving Ground, MD.
J. A. Hitdlebaugh, and R. D. Miller.
Journal of the Water Pollution Control Federation, Vol 53, No 8, p 1283-1293, August, 1981. 10 Fig, 5 Tab, 26 Ref.

Descriptors: *Nitrification, *Rotating biological contactors, *Performance evaluation, *Wastewater treatment, Ammonia, Solids contact processes, *Biological treatment, Chemical oxygen demand, Dissolved oxygen, Suspended solids.

Investigation into the cause of operating difficulties with a rotating biological contactor, part of a U.S. Army installation's 23,000 cu meters per day wastewater treatment plant, showed that the reasons for exceeding effluent limitations were different in summer and winter. In summer the poor performance was caused by low dissolved oxygen (less than 1 mg per liter) in the first four of six stages in the contactor. The white mass of Beggiatoa in the early stages indicated anaerobic conditions. Although very little soluble BOD remained after treatment, the suspended solids and ammonia exerted considerable oxygen demand. Supplemental oxygen and removal of suspended solids would allow more surface area for nitrification. Nitrification was limited both by low dissolved oxygen and low pH (6.5-6.7 vs. optimum 8.0-8.5). The winter difficulties were not a result of low dissolved oxygen but of low wastewater temperatures and too low pH. (Cassar-FRC)
W82-01549

HIGH TEMPERATURE ULTRAFILTRATION WITH KYNAR POLY(VINYLIDENE FLUORIDE) MEMBRANES,
Penwalt Corp., King of Prussia, PA. Technological Center.
W. D. Benzinger, B. S. Parekh, and J. L. Eichelberger.
Separation Science and Technology, Vol 15, No 4, p 1193-1204, 1980. 3 Fig, 3 Tab, 5 Ref.

Descriptors: *Waste water treatment, *Membrane filters, *Ultrafiltration, *Performance evaluation, Separation techniques, Industrial wastes, Textile mill wastes, Oxidation, Oxidized waste water, Organic solvents, Polymers.

Many commercial ultrafiltration membranes used in concentrating textile sizing wastes and other industrial wastes and in processing food products are damaged by drying, extremes of temperature and pH, organic solvents, and strong oxidants. An ultrafiltration membrane made from KYNAR poly(vinylidene fluoride) is described, which resists many of these elements. The membranes may be dried and rewetted or even autoclaved and still retain their integrity. Pilot plant studies were performed on simulated textile sizing wastes using spiral-wound modules made from these ultrafiltration membranes. Satisfactory performance of the membranes has been noted after continuous operation at 186 F and 20-25 psi for 7 months with flux rates up to 15 gallons/sq ft/day and 97% retention of the poly(vinyl alcohol). (Geiger-FRC)
W82-01566

APPLICATION OF AERIAL PHOTOGRAPHS AND SURFICIAL GEOLOGIC MAPS TO THE DETERMINATION OF SUITABILITY OF LAND FOR SEPTIC TANK SYSTEMS,
Federal Energy Regulatory Commission, Washington, DC.
For primary bibliographic entry see Field 7B.
W82-01569

OPEN-PORE POLYURETHANE AS A MEDIUM FOR COAL CONVERSION PROCESS AQUEOUS EFFLUENT CLEANUP,
Oak Ridge National Lab., TN. Chemical Technology Div.
M. S. Denton, S. R. Dinsmore, J. I. Brand, and J. Beams.
Separation Science and Technology, Vol 15, No 3, p 587-613, 1980. 13 Fig, 3 Tab, 14 Ref.

Descriptors: *Wastewater treatment, *Absorption, *Polymers, *Synthesis, Separation techniques, Industrial wastes, Liquid wastes, Electron microscopy, Graphical methods, Cleanup, Coal conversion wastewater.

In coal conversion processes, polymerized open-pore polyurethane is often used as a medium for the cleanup of aqueous effluents. Optimum conditions for synthesizing open-pore polyurethane (OPP) were investigated in situ by varying the reaction conditions and studying OPP structures by electron microscopy and flow-rate tests. Under these conditions, large 1-inch by 12-inch columns were polymerized and compared with identical columns filled with three common commercial adsorbents (a petroleum-based activated charcoal, a carbonaceous adsorbent and XAD-2) using a four-column, bench-scale adsorption apparatus. For each column, breakthrough curves of a synthetic and an actual coal conversion waste water were plotted. OPP was intermediate in capacity for synthetic effluent adsorption between XAD resin and carbon adsorbents, and phenol breakthrough was minimal. The in-situ polymer was more readily eluted with solvent than the other sorbents. OPP efficiency for carbonizer aqueous scrubber adsorption was somewhat lower, possibly because of the low phenol content. (Geiger-FRC)
W82-01577

O2 BLEACHING SHOWS POTENTIAL FOR REDUCING COSTS AND EFFLUENT PROBLEMS,
North Carolina State Univ. at Raleigh. Dept. of Pulp and Paper Science.
H-M. Chang.
Pulp and Paper, Vol 54, No 3, p 87-91, March, 1980. 4 Fig, 20 Ref.

Descriptors: *Pulp and paper industry, *Oxygen, *Bleaching wastes, Closed systems, Pollutant load, Water pollution control, Water quality standards, Industrial wastes, Economic aspects.

Oxygen bleaching processes are the only commercially proven alternatives that significantly reduce pollutant load and effluent volume in pulp and paper mills. The basic process is reviewed, and the major advantages and disadvantages are discussed. Oxygen bleaching is a modular operation between the digesters and conventional bleach plant. It continues delignification and removes about 50% of the residue lignin from the pulp. Because the oxygen bleaching effluent can be integrated into the closed cycle of the pulp mill chemical-recovery system, up to 50% of the total organic load in the bleach plant effluent can be eliminated. Oxygen bleaching may be the most cost-effective method of meeting anticipated stringent effluent standards. The system does entail high capital costs, as it requires expensive equipment which must be fabricated from stainless steel to avoid corrosion problems. Also, special safety considerations are required to monitor and control buildup of explosive vapors and gas. (Small-FRC)
W82-01578

CLOSEUP OF WHITEWATER SYSTEM HELPS MENASHA MEET EFFLUENT STANDARDS,
Menasha Corp., Otsego, MI.
B. Buchanan.
Pulp and Paper, Vol 54, No 3, p 60-62, March, 1980. 3 Fig, 1 Tab.

Descriptors: *Pulp and paper industry, *White water, *Water reuse, Industrial wastes, Closed systems, Industrial plants, Water quality standards.

Closeup of the whitewater system was implemented at a 360 tpd non-sulfur corrugating medium mill in order to meet effluent standards. Whitewater was screened for long fiber removal, and an in-line turbine flowmeter network was installed in the freshwater system, while daily mill balances were run on the computer. The system had a relatively low cost, modular construction, short installation time, positive long-fiber protection for critical reuse areas, and the capability to handle a high feed solids loading. A Sinclair Float Wash FD6 fractionator was used. The next phase of the mill closeup program will be to replace the following current freshwater-supplied items on fractionated whitewater: pulp, refiner and agitator seals, deck and vibrating flat screen showers, breast roll showers, and trim knockoff showers. Satisfactory performance of the fractionator and satisfactory response of the paper machine to the fractionated water have made the initial closeup a success. (Small-FRC)
W82-01579

TREATMENT OF SEWAGE PLANT EFFLUENT FOR USE AS MAKEUP WATER,
Burbank, CA.
For primary bibliographic entry see Field 3C.
W82-01585

ROSARIO DOMINICANA'S CYANIDE TAILINGS DAM CONSTRUCTION AND OPERATION.
Martiki Coal Corp., Denver, CO.
R. Addison, and R. O. Cranor.
Mining Engineering, Vol 33, No 6, p 709-714, June, 1981. 12 Fig, 4 Tab.

Descriptors: *Tailings, *Mine wastes, *Waste water treatment, *Dam construction, Surface runoff, Dam design, Cyanide, Diversion dams, Mine drainage, Gold, Silver, Gravity dams, Reclaimed water, Separation techniques, Relief, Wells, Diversion structures, *Dominican Republic.

The construction and operation of a tailings dam in the Dominican Republic are described. The dam is located downstream from an 8.5 kt/d open pit gold/silver mine located in an agricultural area subject to earthquakes and heavy rainfall. Incorporated into the core of the dam is a vertical gravel filter drain which discharges into the horizontal drainage blanket that extends to the downstream toe of the embankment. This arrangement prevents saturation of the downstream half of the dam wall. Relief/observation wells were drilled at critical points along the downstream toe to allow for seepage through the limestone foundation and to relieve uplift pressures. Tailings from the mill are discharged from a 4-train countercurrent decantation (CCD) thickener system after cyanide extraction of gold and silver. A water reclamation system was set up for use as wash on the last thickener of the CCD train. The alkalinity of the reclaim water serves to bind dust on road surfaces, and the reclaim water storage tank provides reserve water for the fire pump. A polyvinyl chloride pipe was used to divert a runoff stream from the dam to the Mejita River. (Geiger-FRC)
W82-01589

TREATMENT OF PULP AND PAPERMILL WASTEWATERS AND THE USE OF THE OXYGEN ACTIVATED SLUDGE SYSTEM,
R. W. Fuggle.
Effluent and Water Treatment Journal, Vol 21, No 6, p 259-262, 266-269, June, 1981. 3 Fig, 5 Tab, 10 Ref.

Descriptors: *Pulp and paper industry, *Unox process, *Oxygenation, Ozonation, *Wastewater treatment, Industrial wastewater, Activated sludge process.

The oxygen activated sludge process, or Unox process, is used to treat wastewaters at 24 pulp and paper mills worldwide. The basis of this process is economical separation of oxygen from air on site and a covered tank divided into compartments, providing a series of completely mixed stages and retaining the characteristics of the plug flow reactor. This process has several advantages over air aeration: more efficient contact of oxygen with sludge, saving power; a more stable, better-settling biomass; reduced retention time; better performance under shock loads; decreasing oxygen costs with increasing size of generator; better odor control; and use of oxygen in additional plant processes. Pilot plant and bench scale studies of this process were carried out in several countries widely varying wastewater types. The following conclusions were reached: (1) 90% of BOD can be removed at sludge loadings up to 1 kg BOD per kg MLVSS, (2) a large proportion of suspended solids are inert to biological treatment, especially in sulfite pulping mills, (3) the system was sensitive to the high temperatures (50C) encountered, (4) the Unox process handled shock loadings and mill shutdowns with greater stability, (5) caustic was required for pH maintenance, and (6) fish toxicity tests showed a 90% survival in treated effluent vs. zero in untreated kraft mill effluent. The use of ozone as a chlorine substitute, as a tertiary treatment, and in managing sulfide odors is in the research stage. (Cassar-FRC)
W82-01594

LAND TREATMENT SITE EVALUATION IN SOUTHEASTERN MOUNTAINOUS AREAS,
Law Engineering Testing Co., Marietta, GA.
G. L. Taylor, Jr.
Bulletin of the Association of Engineering Geologists, Vol 18, No 3, p 261-266, August, 1981. 4 Tab, 12 Ref.

Descriptors: *Wastewater treatment, *Municipal wastewater, *Land disposal, *Site selection, Waste disposal, Wastewater disposal, Hydraulic loading, Environmental effects, Design criteria, Percolation, Evapotranspiration, Mathematical studies.

The treatment of municipal waste water by application to land offers an alternative to in-plant treatment which eliminates the environmental impact of direct discharge to surface waters. The site for land treatment must take into account soil, climatic, geologic, hydrologic and vegetation factors. The hydrologic budget evaluation consisting of investigations of design precipitation, evapotranspiration, percolation of water to groundwater, and waste water hydraulic loading must also be performed. Seventeen site selection guidelines are presented and divided into two groups according to their impact on the site selection process. In addition, computation of a hydraulic loading range allows comparison of different land treatment sites and enables evaluation of the feasibility of land treatment with respect to other alternate treatments on a preliminary basis. (Geiger-FRC)
W82-01596

5E. Ultimate Disposal Of Wastes

ARTIFICIAL GROUNDWATER RECHARGE,
Water Research Centre, Marlow (England).
For primary bibliographic entry see Field 4B.
W82-01110

INFRARED SPECTROSCOPIC STUDY OF THE WATER-SOLUBLE FRACTION OF SEWAGE SLUDGE-SOIL MIXTURES DURING INCUBATION,
Sonoma State Univ., Rohnert Park, CA. Dept. of Chemistry.
G. D. Schaumberg, C. S. LeVesque-Madore, G. Sposito, and L. J. Lund.
Journal of Environmental Quality, Vol 9, No 2, p 297-303, April-June, 1980. 6 Fig, 2 Tab, 27 Ref.

Descriptors: *Sludge disposal, *Sludge digestion, *Soil water, *Alkaline soils, *Acidic soils, Wastewater disposal, Soil amendments, Soil organic matter, Biodegradation, Anaerobic digestion, Infrared spectroscopy, Degradation, Decomposition, Nitrates, Sulfates.

Four soil-sludge mixtures prepared from two anaerobically digested sewage sludges and two sandy soils with different pH's were maintained at two different levels of soil water content for 100 weeks at 250 degrees under laboratory conditions. Sludge decomposition was monitored by infrared spectra

of evaporated films prepared from extracts taken periodically from the mixtures. In alkaline soil maintained at 1/3-bar soil water tension, and for both sludges, polysaccharides, proteinaceous material, and sulfonate and/or sulfate compounds disappeared after about 10 weeks. During the same time, carboxylates and nitrates appeared or increased in intensity. Similar changes occurred in the alkaline soil maintained at water saturation, but at a much slower pace. IR spectral changes in the acidic soil maintained at 1/3-bar soil water tension were also slightly retarded. The extracts of acidic, water-saturated soil incubated with either sludge gave the least amount of spectral changes. (Geiger-FRC)
W82-01130

DEMONSTRATION TESTING OF ALUM RECOVERY BY LIQUID ION EXCHANGE,
Michigan State Univ., East Lansing. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W82-01167

STUDIES ON UNSATURATED ZONE HYDROLOGY AND RADIONUCLIDE MIGRATION AT A SHALLOW-LAND BURIAL SITE,
California Univ., Berkeley, Dept. of Plant and Soil Biology.
For primary bibliographic entry see Field 5B.
W82-01172

SLUDGE TREATMENT, UTILIZATION, AND DISPOSAL,
Duke Univ., Durham, NC.
P. A. Vesilind.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 726-733, June, 1981. 173 Ref.

Descriptors: *Literature review, *Bibliographies, *Sludge disposal, Wastewater treatment, Sludge utilization, Wastewater management, Public health, Legal aspects.

A literature review is presented of 1980 publications on sludge treatment, utilization, and disposal. Environmental Protection Agency regulations on the manufacture of sludge-derived products were reviewed, and several papers dealt with energy considerations in sludge management. Optimization of sludge management techniques was explored in studies which included the development of a computer program which permitted the selection of various sludge handling unit operations. The importance of public opinion in sludge management alternatives selection was emphasized by one paper. Waste activated sludge processing was investigated, and the most cost effective system was dissolved air flotation, mesophilic digestion, centrifugal dewatering, compost drying, and sale of the final product. Safety hazards in sludge processing were examined in one article. This included the health risks associated with producing food chain substances out of the sludge. General areas covered by the publications were: sludge properties; industrial, nutrient-laden, and water treatment sludges; thermal conditioning and incineration; thickening; dewatering; stabilization; and ultimate disposal and utilization. (Small-FRC)
W82-01247

ONSITE ALTERNATIVES FOR TREATMENT AND DISPOSAL,
Wisconsin Univ.-Madison.
For primary bibliographic entry see Field 5D.
W82-01248

A STUDY OF REGIONAL TEMPERATURE AND THERMOHYDROLOGIC EFFECTS OF AN UNDERGROUND REPOSITORY FOR NUCLEAR WASTES IN HARD ROCK,
California Univ., Berkeley. Lawrence Berkeley Lab.
J. S. Y. Wang, C. F. Tsang, N. G. Cook, and P. A. Witherspoon.
Journal of Geophysical Research, Vol 86, No B5, p 3759-3770, May, 1981. 17 Fig, 4 Tab, 18 Ref.

Descriptors: *Waste disposal, *Radioactive wastes, *Groundwater movement, *Thermodynamics, Temperature effects, Density, Viscosity, Transmissivity, Geologic fractures, Environmental effects, Toxicity.

Three important aspects of the design and performance of underground respositories for the disposal of nuclear wastes were investigated. First, heat released by the radioactive decay of the nuclear wastes causes changes in the temperature distribution in the rock which produce thermally induced components of compressive stress in the heated rock and tensile components of stress outside of this zone. Second, the magnitude and temporal changes of the temperatures in the rock are affected by the type of waste and the time it is buried, and the characteristics of different wastes are discussed. Third, the temperature changes in the rock affect the density and viscosity of water. These changes in the temperature of groundwater may result in perturbations of the hydrologic flow which in turn may affect the isolation of toxic components of the waste. A model is presented of buoyancy groundwater flow through a simple fracture system. This flow is a function of vertical and horizontal fracture transmissivities as well as changes in groundwater density and viscosity. (Small-FRC)
W82-01347

THE INFLUENCE OF CHEMICAL CONDITIONING AND DEWATERING ON THE DISTRIBUTION OF POLYCHLORINATED BIPHENYLS AND ORGANOCHLORINE INSECTICIDES IN SEWAGE SLUDGES,
Imperial Coll. of Science and Technology, London (England). Dept. of Public Health Engineering.
A. E. McIntyre, J. N. Lester, and R. Perry.
Environmental Pollution, Series B, Vol 2, No 4, p 309-320, 1981. 6 Tab, 27 Ref.

Descriptors: *Polychlorinated biphenyls, *Insecticides, *Sludge conditioning, *Chlorinated hydrocarbons, Pollutant identification, Organic compounds, Pesticides, Dieldrin, Gamma-HCH, Aroclors, Land application, Sludge disposal, Dewatering, Path of pollutants, Water pollution sources.

Polychlorinated biphenyls and organochlorine insecticides were associated with the solid matter in sewage sludge, according to mass balances derived for these materials in two treatment works. One process involved coagulation of primary digested sludge with aluminum chlorohydrate followed by dewatering using vacuum filtration; the other, conditioning of consolidated mixed primary sludge with Zetag 94S, an organic polyelectrolyte, and subsequent dewatering by pressure filtration. The dewatering chemicals did not interfere with analysis of the organochlorine compounds in conditioned sludges. Using either Aquafloc 4051 or Zetag 94S the ranges (in micrograms per liter) were: Aroclor 1260, 3.14-3.74; p,p'-DDE, 1.04-1.54; gamma-HCH, 6.54-8.60; and dieldrin, 7.72-9.00. In the filtrates from the vacuum filtration plant and the pressure filtration plant no Aroclor 1260, gamma-HCH, or p,p'-DDE was detected. The vacuum process filtrate contained 0.007-0.026 micrograms per liter dieldrin and the pressure filtration filtrate, 0.008-0.012 micrograms per liter dieldrin. Concentrations of organochlorines in sludge cakes (micrograms per g) were: Aroclor 1260, 0.25-0.51; p,p'-DDE, 0.04-0.05; gamma-HCH, 0.13-0.16; and dieldrin, 0.15-0.17. (Cassar-FRC)
W82-01387

THE NATIONAL ASSESSMENT OF THE GROUND-WATER CONTAMINATION POTENTIAL OF WASTEWATER IMPOUNDMENTS,
Environmental Protection Agency, Washington, DC.
For primary bibliographic entry see Field 5G.
W82-01419

COMPARATIVE EVALUATION OF PROCESSES FOR THE TREATMENT OF CONCENTRATED WASTEWATERS AT UNCONTROLLED HAZARDOUS WASTE SITES,
TRW Environment Engineering Div., Redondo Beach, CA.
For primary bibliographic entry see Field 5D.
W82-01430

STABILIZATION/SOLIDIFICATION OF WASTE FROM UNCONTROLLED DISPOSAL SITES,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
P. G. Malone, R. J. Larson, and T. E. Meyers.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC, Environmental Protection Agency Report (1980). p 180-183, 1 Fig, 2 Tab, 10 Ref.

Descriptors: *Land disposal, *Waste disposal, *Hazardous materials, *Water pollution prevention, Toxicity, Metals, Anions, Organic compounds, Landfills, Incineration, Portland cements, Asphalt, Polymers, Adsorption, Waste disposal sites.

Stabilization/solidification can be employed as a step to facilitate safe transport and disposal of the wastes at the estimated 2000 unauthorized or uncontrolled sites in the U.S. Stabilization/solidification is appropriate for both on-site and off-site ultimate disposal, and has cost and safety advantages over drum overpacks. Once the liquid wastes have been identified and characterized by their major constituents the stabilization/solidification process may be chosen. Admix techniques using Portland cement, organic polymers or other binding agents are most suited to toxic metal wastes. Thermoplastic incorporation into asphalt, sulfur or polyethylene, and encapsulation in an inert jacket are suitable disposal techniques to contain soluble toxic dry salts and toxic anions. Toxic organics can be adsorbed onto clays, but their continued volatilization must be prevented by some sort of vapor-tight barrier. All the stabilized wastes may be recontainerized and landfilled since they no longer threaten to contaminate ground or other water resources. The stabilized organics may also be incinerated. (Brambley-SRC)
W82-01432

IDENTIFICATION AND RECLAMATION OF CHROMIUM SLUDGE DISPOSAL SITES,
Maryland Office of Environmental Programs, Annapolis.
W. L. Ramsey.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC, Environmental Protection Agency Report (1980). p 259-261, 2 Fig, 2 Tab, 4 Ref.

Descriptors: *Sludge disposal, *Chromium, *Groundwater pollution, *Land disposal, Monitoring, Soil contamination, Sludge bed, Water pollution control, Wastewater treatment, Industrial wastes, Organic solvents, *Sludge treatment.

In 1978 an Interim Facility Permit was issued in Maryland to a company requiring it to develop a new technique for handling chromium sludge and a plan to renovate existing sludge beds. Twenty-five wells were located in the area; water from them was analyzed. Chromium levels up to 276 ppm were reported. Monitoring wells were dug around the sludge beds. The ground water was found to be contaminated to a level of 0.25 ppm, but the direction of groundwater was found to be southeast, and not the anticipated southwest. In searching for additional monitoring well sites, another dump was discovered which was the major source of contamination. The sludge beds were renovated by removing contaminated soil to bedrock and hauling it to a safe site. The area was backfilled, contoured and stabilized, and within 2 months the groundwater in the monitoring wells closest to the site showed declines in chromium from 0.25 ppm to 0.001 ppm. The dimensions of the new dump were determined by taking core samples and placing sampling wells. Traces of organic solvents were found. The heavily contaminated soil will be removed down to the bedrock, and the site will be capped with clay, regraded and

stabilized. The company has installed a new wastewater treatment system which reduces the volume of sludge. The sludge is transported to a safe disposal facility. (Brambley-SRC)
W82-01437

EFFECTS OF SANITARY LANDFILL LEACHAGE ON SOME SOIL CHEMICAL PROPERTIES,
Science and Education Administration, Morgantown, WV.
W. M. Winant, H. A. Menser, and O. L. Bennett.
Journal of Environmental Quality, Vol 10, No 3, p 318-322, July-September, 1981. 6 Tab, 21 Ref.

Descriptors: *Soil chemistry, *Leachages, *Sanitary landfills, Landfills, Chemical properties, Soil properties, Wastewater treatment, Effluents, Land disposal, Chemical composition.

Land disposal by spray irrigation has been successfully used to treat leachate from sanitary landfills through substantial reductions in chemical oxygen demand, electroconductivity, and total nutrient content of the leachate. Soil chemical analyses were performed to determine the efficacy of land disposal used in conjunction with soil amendments as a method for decontamination of leachage from a sanitary landfill. Experimental plots received leachage only or leachate plus lime, rock phosphate, or superphosphate. The plots received about 100 centimeters of leachage from a sanitary landfill over a 6-month period, after which soil samples were collected to a depth of 60 centimeters. Application of the fertilizers and leachage in combination to woodland soils significantly increased the extractable soil calcium, magnesium, potassium, strontium, and zinc levels as compared with pre-irrigation values at a soil depth of 0 to 5 centimeters. Extractable manganese was significantly higher at soil depths of 30 centimeters in all of the leachate-treated plots as compared with pre-irrigation values. Iron, phosphorus, and Kjeldahl nitrogen levels were not significantly changed by leachate irrigation. Soil pH was increased from 4.7 to 5.8 at the 0 to 5 centimeter depth and from 4.5 to 5.7 at the 15 to 30 centimeter depth by irrigation with leachate. Although most elements were attenuated to some extent by the soil, lime and fertilizer addition did little to influence soil absorptive capacity. (Carroll-FRC)
W82-01480

VEGETATION SELECTION AND MANAGEMENT FOR OVERLAND FLOW SYSTEMS,
Cold Regions Research and Engineering Laboratory, Hanover, NH.
A. J. Palazzo, T. F. Jenkins, and C. J. Martel.
Public Works, Vol 112, No 8, p 49-52, August, 1981. 2 Tab, 5 Ref.

Descriptors: *Overland flow, *Vegetation, *Crop yields, *Land disposal, Flow, Wastewater disposal, Agriculture, Nutrients, Nitrogen, Phosphorus, Grasses.

Domestic wastewater was applied over a four-year period at various rates to study plant growth and nutrient removal on each of three overland flow test slopes. Establishment of forage grasses, plant yields, and uptake of nutrients were determined. Domestic sewage from the town of Hanover, New Hampshire, was applied weekly, with each weekly application period spanning a five-day period, seven hours per day. The waste contained an average of 35 mg/liter of total nitrogen and 6 mg/liter of total phosphorus. Annual plant yields on a dry weight basis for a minimum of two harvest periods ranged from 3.4 to 5.4 tons/acre. This was almost three times the average yield of hay grown in the state. None of the concentrations of elements measured in the harvested plants was in the deficiency or toxicity ranges, indicating growth of healthy plants. Reed canary grass, orchard grass, and tall fescue all had good persistence on the overland flow slopes. (Small-FRC)
W82-01500

ELECTRO-OSMOSIS CHEMISTRY AND WATER QUALITY,
Lowell Univ., MA.
B. A. Segall, C. E. O'Bannon, and J. A. Matthias.
Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No GT10, p 1148-1152, October, 1980. 1 Fig, 1 Tab, 4 Ref.

Descriptors: *Waste disposal, *Dewatering, *Electro-osmosis, *Slope stabilization, Waste management, Separation techniques, Membrane processes, Electrochemistry, Electrodes, Anodes, Cathodes, Water quality, Soil water, Dredging.

Studies were made on the feasibility of using electro-osmosis to increase the capacity of dredged material disposal sites by reducing the water content of in-place material and increasing the shear strength of containment area embankment foundations. Some theories on the electrochemical process of electro-osmosis which may be used to improve the process for application in slope stabilization and foundation dewatering are reported. The chemical characteristics of electro-osmosis process water, which may become an environmental pollutant, are presented. Electro-osmosis water is highly alkaline, contains organic material, is highly colored, and may contain high levels of pesticides, heavy metals, or other substances from the soil or water mass. Moving the electrodes during electro-osmotic dewatering was effective in reducing polarization and increasing the rate of dewatering. This procedure has the added advantage of enabling dewatering of an entire soil mass when needed for a particular application. (Geiger-FRC)
W82-01518

REMEDIAL ACTION CONTROLS GROUNDWATER CONTAMINATION AT A PAPER MILL SLUDGE DISPOSAL SITE,
Soil Testing Services of Wisconsin, Inc., Green Bay.
For primary bibliographic entry see Field 5G.
W82-01582

5F. Water Treatment and Quality Alteration

THE PROBLEMS OF NON-RETURN AND THE USE OF VALVES IN DRINKING WATER PROTECTION AGAINST WASTE WATER RETURN, APPLYING THE REGULATIONS IN FORCE,
B. Rochette.
Aqua, No 2, p 27-31, 1980. 4 Fig, 2 Tab.

Descriptors: *Hydraulic valves, *Return flow, *Wastewater management, Water distribution, *Drinking water, Water pollution control, Flow regulations, Water mains, Pressure head, Regulations, Water pollution sources, *Water supply systems.

Many cases of wastewater entering the water distribution system have been reported in European cities. Common causes of this problem are lowering of main pressure caused by large demand, repairs, and breakage; and high pressure systems on the consumer end. Most European countries have regulations for preventing return flow. Check valves are often used to control the problem. The linear parallel displacement valve fulfills conditions specified by most legislatures. Minimum and maximum requirements are described for mechanical characteristics of the casing, tightness (must be tight for 3-10 min at 3 cm water column pressure and from 0-16 bars), head loss, and reliability (must work through 100,000 cycles of operation) of non-return valves. (Cassar-FRC)
W82-01142

CHEMICAL EQUILIBRIA IN SPLIT-TREATMENT SOFTENING OF WATER,
Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering.
K. A. Zipf, Jr., and R. G. Luthy.
Journal of the American Water Works Association, Vol 73, No 6, p 304-311, June, 1981. 8 Fig, 5 Tab, 11 Ref.

Descriptors: *Water softening, *Equilibrium, *Split treatment, Hardness, Calcium compounds, *Water treatment, Lime, Sodium carbonate, Chemical reactions, Langlier equations, Saturation index, Carbonates, Water quality.

Equations and methods of solution are developed for split treatment water softening problems in order to see how treated water quality parameters and operating variables are related to chemical requirements. Split treatment, generally applied to high-Mg waters, divides the raw water into two streams, one treated with excess lime, and the other bypassed or untreated. These streams are recombined and treated with soda ash for noncarbonate hardness removal. Both the lime softening process (9 equations, 12 variables) and the lime-soda ash process (10 equations, 12 variables) may be solved by assigning values to two decision variables. The soda ash dosage is zero in the one treatment. Solution sets are described for the decision variables combinations as follows: effluent hardness and pH, effluent alkalinity and pH, lime dose and bypass fraction. Several examples of computer-aided graphical solutions are presented. The bypass fraction may be raised from about 0.25 to about 0.90. Effective minimum effluent pH is 7.8-8.0. There is usually a minimum associated with chemical costs and effluent quality variables. The hydroxide concentration is usually a limiting figure in split treatment. (Cassar-FRC)
W82-01165

INTERPRETING LABORATORY RESULTS FOR THE DESIGN OF RAPID MIXING AND FLOCCULATION SYSTEMS,
Servicos de Engenharia Emilio Baumgart Ltd., Belo Horizonte (Brazil).
J. R. Bratby.
Journal of the American Water Works Association, Vol 73, No 6, p 318-325, June, 1981. 11 Fig, 2 Tab, 21 Ref.

Descriptors: *Flocculation, *Coagulation, *Mixing, *Water treatment, Alum, Turbidity, Settling velocity, Polyelectrolytes, Laboratory tests, Brazil.

A 3-liter laboratory batch reactor for measuring flocculation under rapid mixing conditions is described. The raw water was obtained from the Lago Descoberto, Brazil water supply. Optimum conditions derived from using this batch reactor were: primary coagulant--3 mg per liter alum at pH 6.4; rapid mixing velocity gradient--650 per sec for 0.5 to 8 sec; anionic polyelectrolyte--0.15 mg per liter; preflocculation--3 equal volume tanks, velocity gradients 100 per sec each, total retention time 20 min; flocculation system--3 tanks with velocity gradients, 100 per sec, 50 per sec, and 30 per sec, respectively; total retention time, 31.5 min; settling overflow rate, 9 cm per min with effluent quality of 0.5 ftu; design overflow 6 cm per min. (Cassar-FRC)
W82-01166

DISINFECTION,
Georgia Inst. of Tech., Atlanta.
For primary bibliographic entry see Field 5D.
W82-01250

MICROBIOLOGY OF POTABLE WATER,
Environmental Protection Agency, Dallas, TX. Region VI.
M. J. Allen.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 1109-1112, June, 1981. 42 Ref.

Descriptors: *Microbiological studies, *Potable water, *Literature review, *Bibliographies, Drinking water, Domestic water, Viruses, Bacteria, Water distribution, Water quality.

A literature review is presented of 1980 articles on the microbiology of potable water. Research included an evaluation of the use of granular activated carbon whicch identified needed research including investigation of the factors responsible for the initiation of microbial growth on GAC surfaces and the microbial generation of organic compounds during carbon treatment. A study on the

inactivation of cell-associated poliovirus and coxsackievirus found that higher ozone residuals were required than for nonassociated viruses. Also, natural poliovirus isolates found in drinking water were more resistant to chlorine inactivation than were standard laboratory virus strains. One study examined 23 potable water supplies for viruses and found ten virus positive samples. An investigation of water encrustations from seven water systems by scanning electron microscopy found algae, actinomycetes, diatoms, and filamentous and flagellated bacteria. Several studies supported the concept that microorganisms promote a localized corrosion of metal and tubercle formation, and that the microbial ecosystems influence the concentrations of numerous constituents in distributed waters. (Small-FRC)
W82-01287

MALAWI: A COMMUNITY APPROACH.
UNESCO Courier, Vol 34, No 2, p 16-17, February, 1981.

Descriptors: *Water supply development, *Public participation, *Malawi, Developing countries, *Water distribution, Drinking water, Africa.

Clean water is now available to 70% of urban dwellers and 35% of the rural inhabitants in Malawi, population 5 million. Local involvement has been responsible for this progress toward the government's goal of safe, potable water within 400 meters for all people by 1990. As an example, the Mulanje West Project is described. When shallow wells and the nearby river periodically failed after extensive tree removal, the government designed a water distribution system, and the villagers provided construction labor. About 200 men, women, and children worked enthusiastically on digging trenches for 30 km of main line and 210 km of branch lines, as well as installing concrete aprons and drains for the taps. In other areas where shallow wells are appropriate, villagers supply bricks, sand, oxcarts, and labor, and the government provides pumps and concrete slabs. In cities, water projects are financed by water charges. (Cassar-FRC)
W82-01365

THE RIVER OUSE WATER SUPPLY SCHEME,
Yorkshire Water Authority (England).
R. Dobson.
Journal of the Institution of Water Engineers and Scientists, Vol 34, No 3, p 265-290, May, 1980. 7 Fig, 3 Tab.

Descriptors: *Water treatment facilities, *Construction, *Yorkshire Water Authority, Water resources development, Ouse River, Political aspects, Social aspects, Reservoirs, Pipelines, Pumping plants, Planning, Rivers, *England.

The background, planning, and construction of a large water source development on the River Ouse in Yorkshire, England, is described in detail. The facilities consisted of abstraction works, pumping station, a 28.6 km pipeline, and a reservoir bypass. Although planning began in the late 1960's the drought of 1975-76 was a factor in deciding in October 1976 to build the plant as quickly as possible. Water was pumped from the river only 18 months after detail design commenced and 11 months after construction contracts were let. Overall costs were 10,000,000 pounds. Some of the noteworthy details involved in the project were: (1) the raw water has wide variations in hardness (65 to 290 mg per liter) and a rich nutrient supply, (2) river flooding is frequent and widespread, (3) a 48-hour storage channel protects the supply from pollution, (4) landowners objected to installation of power transmission lines and pipeline construction, (5) delivery of construction materials and equipment was closely monitored to prevent delays, (6) the abstraction works land was owned by a fishing club, (7) the pipeline route had to be adjusted so archaeologists could study two medieval villages, and (8) excavation in hard sandstone near the reservoir was simplified by threading the bypass pipe through an unused 40 inch diameter cast iron pipe laid in 1847. (Cassar-FRC)
W82-01371

DEVELOPMENTS IN SEDIMENTATION AND FLOTATION,
Water Research Centre, Stevenage (England).
T. F. Zabel.
Effluent and Water Treatment Journal, Vol 21, No 4, p 166, 168-169, 172, April, 1981. 2 Fig, 1 Tab.

Descriptors: *Sedimentation, *Flotation, *Suspended load, Drinking water, Flocculation, *Water treatment, Performance evaluation, Pilot plants, Rivers, Water treatment facilities, *Great Britain.

Lamella sedimentation and flotation are developments which increase the surface loadings of water treatment plants. In co-current or down-flow lamella sedimentation systems developed in Sweden, the flocculated suspension passes in laminar flow from the surface downwards through a system of parallel plates. Flocculated particles settle on the plates and run smoothly down to the sludge collector. The clarified water is withdrawn at the bottom of the plates. In the counter-current system, the flocculated water enters from the sides at the lower edge of the lamellae through channels and moves upwards between the lamellae. Again, the particles settle on the plates and slide down into the sludge collector. This system has a simpler design and was tested in a pilot plant on the Thames River. The process can be operated up to 30 m/hr and produces acceptable settled water for further treatment by rapid gravity filtration. The most likely application for lamella sedimentation is the treatment of lowland river waters with heavy solids loads. Flotation is particularly effective for stored waters containing high algal loads or low turbidity, highly colored waters. There are approximately 20 flotation plants operating in the United Kingdom, which range in size from 2.3 to 36 M liter/day. (Small-FRC)
W82-01391

REGENERATION OF ANION EXCHANGE RESINS BY CALCIUM CARBONATE AND CARBON DIOXIDE,
Kernforschungszentrum Karlsruhe (Germany, F.R.).
W. Holl, and B. Kiehling.
Water Research, Vol 15, No 8, p 1027-1034, August, 1981. 8 Fig, 4 Tab, 18 Ref.

Descriptors: *Anion exchange, *Bicarbonates, *Regeneration, Ion exchange, Resins, Drinking water, *Water treatment, Sulfates, Nitrates, Chlorides, Costs, Environmental effects.

Anion exchange resins in the bicarbonate form can reduce the concentration of neutral salts in water at a lower cost than cation exchange resins. Regeneration can be carried out with CO2 and CaCO3, which are inexpensive, environmentally safe substances. The wastewater generated contains only calcium salts in moderate concentrations, and total dissolved salinity is actually reduced because of the low solubility of carbonates of bivalent cations. Sulfate and nitrate ions are strongly preferred by all ion exchange resins, while affinity for chloride ions is less pronounced. Theoretical and experimental evaluations of exchange equilibria in regeneration with CO2 and CaCO3 found that only in incomplete conversion to the bicarbonate form is achieved. Method efficiency depends on the type of resin, the original counterion, and CO2 pressure. Thus, the resins only reduce sulfate, nitrate, and chloride concentrations. Since SO4(2-) and NO3(1-) are the most noxious anions in drinking water, anion exchange resins in the bicarbonate form are important. (Small-FRC)
W82-01484

INVESTIGATION OF VOLATILE ORGANICS REMOVAL,
American Water Works Service Co., Inc., Haddon Heights, NJ.
D. L. Kelleher, E. L. Stover, and M. Sullivan.
Journal of the New England Water Works Association, Vol 95, No 2, p 119-133, June, 1981. 8 Fig, 4 Tab, 1 Ref.

Descriptors: *Activated carbon, *Groundwater pollution, *Filtration, Adsorption, Water treatment, Iron, Manganese, Trichloroethane, Wells, Public health, Dedham, Massachusetts, Volatility, *Organic compounds, Westwood.

A comprehensive program to evaluate treatment techniques for removing volatile organic compounds from the wells of the Dedham Water Company (White Lodge Well fields in Westwood, Massachusetts) is described. The well field consisted of four conventional gravel-packed wells ranging from 70 to 76 feet deep with an estimated safe yield of 4.5 mgd. Significant levels of 1,1,1-trichloroethane (TCEA) were found in two of the wells. Twenty-five locations throughout the watershed were sampled, but no source was found for the contamination. Parallel air stripping and carbon adsorption studies were conducted to determine the feasibility of removing the organic compounds. Aeration and glauconite or greensand were evaluated for the removal of iron and manganese. The manganese greensand filter was capable of removing iron and manganese, and both packed-bed stripping columns and activated carbon columns were capable of removing TCEA. The most economical treatment alternative was air stripping and manganese greensand filtration. (Small-FRC)
W82-01490

RELATIONSHIP OF THE RAW WATER QUALITY TO MUTAGENS DETECTABLE BY THE AMES SALMONELLA/MICROSOME ASSAY IN A DRINKING-WATER SUPPLY,
National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 5A.
W82-01493

CHEMICAL CONTROL OF MUSSEL SETTLEMENT IN A COOLING WATER SYSTEM USING ACROLEIN,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
J. W. Rijstenbil, and G. C. Van Galen.
Environmental Pollution, Series A, Vol 25, No 3, p 187-195, 1981. 7 Fig, 2 Tab, 10 Ref.

Descriptors: *Cooling water, *Fouling, *Mussels, Acrolein, Powerplants, Aquatic animals, Corrosion control, Estuaries, Toxicity, Industrial water, *Water treatment.

The influence of acrolein on young, newly settled mussels in a powerplant cooling water system is described. The aim of the control program is to expel most of the young mussels at a sublethal acrolein level, having a minimum discharge of the antifoulant into the receiving estuary. Young mussels were collected from bottom material and seaweeds of Lake Grevelingen in October of 1978. Toxicity tests were conducted in aquaria. Seawater was refreshed weekly and kept in circulation. Acrolein was added in concentrations of about 0.2, 0.4, 0.6 and 1.0 ppm. After exposure for periods of 2, 4, 6, 8, 12, 16, 20, or 24 hr, samples of mussels were examined. Two types of reaction were noted in mussels exposed to acrolein. Some had closed valves, and some mussels had become detached. There was no relationship between valve closure and time of exposure. It appeared that the mussels reacted immediately after exposure to acrolein by closing their valves. However, the percentage of mussels with closed valves increased with higher acrolein concentrations. In control experiments about 13% of the mussels became detached in the absence of acrolein in flowing seawater. Under the same circumstances a settlement reduction of 84% may be achieved in practice. A 24 hr application of 0.6 ppm acrolein followed by a 48 hr seawater flow was recommended. An environmental concentration below the toxicity threshold of 0.06 ppm acrolein will be achieved by a tenfold dilution on discharge. (Baker-FRC)
W82-01501

ORGANICS IN WATER - AN ENGINEERING CHALLENGE,
Stanford Univ., CA. Dept. of Environmental Engineering.
P. L. McCarty.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil

Engineers, Vol 106, No EE1, p 1-17, February, 1980. 4 Fig, 6 Tab, 16 Ref.

Descriptors: *Organic matter, *Drinking water, Reviews, *Water treatment, Water treatment facilities, Wastewater treatment, Industrial wastes, Domestic wastes, Organic wastes, Separation techniques, Organic compounds, Activated-carbon, Adsorption, Filtration, Adsorbents, Suspended solids, Coagulation, Oxidation, Volatility.

The nature of organic matter in water and its removal characteristics by possible treatment processes are reviewed. The purpose of the review is to indicate those processes which appear to have most promise in the near and far term for removing organic materials from drinking water supplies. Organic material in water may be either suspended or dissolved. That which is suspended is readily removed by normal chemical treatment and filtration. Dissolved materials may range from simple organic molecules to large and complex polymeric materials. Most of them arise from biological processing and decomposition of natural materials and are called humic materials. Processes for removal of organic materials include coagulation; oxidation, both chemical ad biological; membrane filtration; adsorption; liquid-liquid extraction; and volatilization. Activated-carbon adsorption has been shown in several studies to be the most effective single process for removing soluble organic materials in general. Mention is made of Water Factory 21, where treatment includes lime addition, air stripping, recarbonation, multi-media filtration, activated-carbon adsorption, and final chlorination. Reverse osmosis has also been employed at this plant since 1978. More than 100 different trace organics were identified in biologically treated wastewaters used as the water supply to Water Factory 21. In order to continue to protect the environment, the fate of organics stripped from water into the air must be carefully evaluated. Activated-carbon adsorption and biological growths associated with its use result in the production of organic chemicals that are different from those being removed. (Baker-FRC)
W82-01540

SMALL WATER SYSTEMS: ROLE OF TECHNOLOGY,
Municipal Environmental Research Lab., Cincinnati, OH. Drinking Water Research Div.
R. M. Clark.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE1, p 19-35, February, 1980. 7 Fig, 8 Tab, 13 Ref.

Descriptors: *Water supply, *Reviews, Water supply development, Water quality, *Water treatment facilities, Maintenance, Cost analysis, Water supply systems, Technology.

Some of the issues related to small water system problems are reviewed, with suggested feasible solutions. A prevailing characteristic of water supply technology is the effect of economics of scale. Small systems are a victim of their own size. Installation, operation, and maintenance of sophisticated control processes together with monitoring systems may result in substantial total and unit cost increases for small systems. Small systems also seem to have a larger share of quality problems. Some of the more common deficiencies include inadequate source protection, improper disinfection or control of disinfection or both, inadequate clarification or control of clarification and insufficient pressure in the distribution system. A commonly suggested solution for small system problems is that of regionalization in which a small community can join with other small communities or with a larger one to form a regional water supply. Technological solutions have also been investigated. The effectiveness of conventional coagulation and lime softening processes for the removal of certain metals has been studied. Package water treatment plants consisting of prefabricated and largely preassembled clarification and filtration units are commonly used in some sections of the US by small water systems. Various approaches to managing small systems are also being investigated and tried at various locations. (Baker-FRC)
W82-01542

CHRYSOTILE ASBESTOS FIBERS IN DRINKING WATER FROM ASBESTOS-CEMENT PIPE,
Wisconsin Univ. Madison. Dept. of Preventive Medicine.
For primary bibliographic entry see Field 5B.
W82-01592

5G. Water Quality Control

PUBLIC CONCERNS AND PLUARG: SELECTED FINDINGS AND DISCUSSION,
Toronto Univ. (Ontario). Dept. of Geography.
R. J. Mason.
Journal of Great Lakes Research, Vol 6, No 3, p 210-222, 1980. 1 Fig, 8 Tab, 24 Ref.

Descriptors: *Public participation, *Water pollution control, *Land use, Water policy, Planning, *International Joint Commission, *Great Lakes, Attitudes, Agriculture, Surveys, Pollution from Land Use Activities Reference Group.

The International Reference Group on Great Lakes Pollution from Land Use Activities (PLUARG) completed a program in which 17 public consultation panels (9 from 8 U.S. states and 8 from Canada) submitted reports detailing their views and recommendations on pollution control and land use. There were few significant differences on the national level in output from the 17 panels, which consisted of persons representing 19 categories, such as small business, students, women, farmers, and conservationists. There were some differences between the panels' consensus and the PLUARG report to the International Joint Commission on the importance of certain issues. The public consultation program was judged successful in terms of achieving its objectives and in terms of participant satisfaction. (Cassar-FRC)
W82-01137

MODELLING EFFECTS OF REMEDIAL PROGRAMS TO AID GREAT LAKES ENVIRONMENTAL MANAGEMENT,
Canada Centre for Inland Waters, Burlington (Ontario).
M. G. Johnson, J. C. Comeau, T. M. Heidtke, W. C. Sonzogni, and B. W. Stahlbaum.
Journal of Great Lakes Research, Vol 6, No 1, p 8-21, 1980. 4 Fig, 8 Tab, 38 Ref.

Descriptors: *Phosphorus, *Great Lakes, *Water pollution control, Lakes, Lake Erie, Lake Huron, Lake Ontario, Model studies, Nonpoint pollution sources, International Joint Commission, Water pollution sources, Agriculture, Water quality control, Urban runoff, Fertilizers, Effluent standards, Storm water.

PLUARG (the International Joint Commission's Pollution from Land Use Activities Reference Group) used computer simulation to determine which remedial programs were most economical, practical, and effective for reaching target lake loads of phosphorus for Lakes Erie, Ontario, and southern Huron. The process relied on a large and diverse information base on point and nonpoint pollution sources in the Great Lakes basin, including sub-basin unit area pollution loads (classified by land use and land form), per capita municipal pollutant inputs, river transmission factors, and remedial program effectiveness. The remedial measures included three levels of treatment for rural areas with reductions in total P load of 5-10%, 25%, and 40% (costs: minimal, $600 per sq km, and $2700 per sq km, respectively), and two treatment levels for urban areas: vacuum street cleaning and runoff storage and treatment by sedimentation. For municipal treatment plants three levels of residual P concentrations were considered, 1.0 ppm, 0.5 ppm, and 0.3 ppm, at costs of $2350, $3340, and $9370 per 1000 persons served. For example, the least cost strategy for Lake Ontario's 7000 ton P reduction was as follows: rural management, lowest level; effluent from treatment plants, 0.5 ppm; and urban nonpoint treatment, lower level. (Cassar-FRC)
W82-01146

STUDIES FOR ABATEMENT OF POLLUTION FROM COMBINED SEWER OVERFLOWS IN CANADA,
MacLaren (James F.) Ltd., Toronto (Ontario). Water Resources Div.
P. E. Wisner, W. G. Clarke, and A F. Roake.
Journal of Hydrology, Vol 51, No 1-4, p 329-338, May, 1981. 4 Fig, 4 Tab, 5 Ref.

Descriptors: *Model studies, *Combined sewers, Simulation, Runoff, *Urban runoff, Biological oxygen demand, Oxygen demand, Suspended solids, Water pollution sources, Municipal wastes, Municipal wastewater, Sewers, Water quality, *Combined sewer overflows, Pollution abatement studies, *Canada.

The use of urban runoff models to study water quality problems in Winnipeg, Edmonton, Hamilton, St. Thomas, Sarnia and other Canadian cities is described. Different simulation models were used at different stages of a project. Planning models were used for an overall assessment of the urban runoff problem and for preliminary estimates of the cost effectiveness of different abatement procedures. Design/analysis models are oriented towards the detailed simulation of storm events, and can be used for accurate predictions of flows and concentrations at any point in the urban system and the receiving waters as well. The lumped quality model offers a preliminary step toward simplified quality modelling. Work with this model may be useful in other drainage environments as well, due to its great flexibility. The interfacing of simulation models has been used to obtain a general approach to the analysis of urban water-quality problems. In the Winnipeg study, the first stages of storm runoff were predicted to contain greater pollutant concentrations in the combined sewage than those which would be found during dry-weather flow due to the scour of solids deposited in the trunk combined sewers during dry weather. The study concluded that separation was not the most effective abatement method for the existing combined system. Instead a system of total management involving storage, overflow treatment and nonstructural controls such as sewer flushing is both more effective and more economic. Studies in Edmonton illustrate the use of simulation techniques to assess overflow pollution in the context of all sources of pollutants affecting North Saskatchewan River quality. As a result of these studies, various combinations of storage, flow equalization, upgraded central treatment and source control are being investigated and evaluated in terms of simulated water quality and economics. (Baker-FRC)
W82-01200

URBAN RUNOFF AND COMBINED SEWER OVERFLOW,
Syearns and Wheeler, Cazenovia, NY.
For primary bibliographic entry see Field 5B.
W82-01254

COAL AND COAL MINE DRAINAGE,
Tennessee Valley Authority, Chattanooga.
H. Olem.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 814-824, June, 1981. 1 Tab, 158 Ref.

Descriptors: *Coal mining, *Mine wastes, *Water pollution effects, Water quality, Acid mine drainage, *Water pollution control, Regulations, Water pollution sources, Wastewater treatment, Path of pollutants, Aquatic life, Industrial wastewater.

The recent literature on the effects of the coal industry on water quality lists several government reports on this subject as well as regulatory developments since passage of 1977 legislation. About 15 abstract collections, bibliographies, and reviews on coal and the environment have been published in the last year. Formation of mine drainage is the

subject of work relating to bacterial and chemical actions on rocks and minerals. About 60 authors wrote papers on the impact of mine drainage on water quality in coal fields in Europe and the U.S. In one case, acidity was increased 580% by renewed mining activity. Mathematical models are featured in many papers. The differences between eastern and western U.S. coal mining are highlighted; mining activities in the west do not produce as much acidic drainage as in the east. However, western rivers are more susceptible to increased sedimentation and salt loadings. Groundwater quality was evaluated in mining areas throughout the U.S. There were severe effects in some locations in the northern Great Plains and lesser effects in eastern Ohio, Indiana, and Illinois. Several publications discuss the impact of mining on benthic invertebrates, zooplankton, and fish. Treatment methods for mine drainage water include lagoons for neutralization and iron removal, rotating disks for biological oxidation of ferrous iron, and lime neutralization with further treatment to enhance the municipal potable water supply, and sedimentation ponds. Prevention and control of mine slow-release anionic detergents on surface mines and coal refuse piles, recycling effluents, use of crushed limestone, and reclamation projects for surface-mined land. The effects of coal cleaning and coal transportation and storage on water quality are discussed. (Cassar-FRC)
W82-01261

EUTROPHICATION,
Colorado Univ. at Boulder.
For primary bibliographic entry see Field 2H.
W82-01271

DISSOLVED OXYGEN IN STREAMS AND RESERVOIRS,
Tennessee Valley Authority, Chattanooga.
C. E. Bohac.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 916-921, June, 1981. 65 Ref.

Descriptors: *Dissolved oxygen, *Literature review, Reviews, *Streams, Rivers, *Reservoirs, Standards, Surface runoff, Runoff, Water quality, Model studies, Oxygen demand, Oxygen transfer.

Current research dealing with dissolved oxygen in streams and reservoirs is cited in this review article. In reviewing standards which had been established for streams, it was concluded that the standards had been developed without enough information regarding their practical implementation. The Urban Runoff Pollution Control Program was studied with particular emphasis on receiving water quality models of three types: simplified or desktop models for preliminary planning; detailed models for planning and design; and operational models for supervisory control. Water quality was investigated in lakes and streams, with particular emphasis on winter oxygen depletion rates, severe hypolimnetic oxygen depletion in Canyon Lake, specific reference to two Yukon rivers where severe dissolved oxygen depressions during winter months were reported, and various hypolimnetic oxygen parameters. A reaction chamber was developed to study interactions of sediments or newly flooded soils with an overlying water column. In the area of improving water quality, the addition of hydrated lime to a lake, the treatment of water with alum resulting in a six-fold decrease in soluble phosphorus and a 17-fold decrease in orthophosphate, and aeration of a model lake system were studied. Water quality models were engineered which were used to determine wasteload allocations, to investigate alternative water quality policies in relation to waste discharges, to describe vertical and horizontal variability of a water body, to estimate economic benefit for water pollution control programs, and to predict the impact of storm loads on phosphorus, fecal coliforms, and dissolved oxygen. Oxygen demand was studied both from the general point of view and with emphasis on the effect of photosynthesis on oxygen demand. Oxygen transfer was also investigated. (Baker-FRC)
W82-01272

ANALYSIS OF NATIONAL WATER POLLUTION CONTROL POLICIES 1. A NATIONAL NETWORK MODEL,
Resources for the Future, Inc., Washington, DC.
For primary bibliographic entry see Field 6A.
W82-01292

ECONOMICS,
Clemson Univ., SC.
J. C. Hite.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 615-617, June, 1981. 20 Ref.

Descriptors: *Economic aspects, *Water pollution control, *Costs, *Reviews, Agriculture, Erosion control, Water quality.

The recent decline in number of papers concerning economics of water quality can be attributed to the perception that water scarcity is a more important consideration than environmental degradation. Several theoretical questions were addressed: the balance of resource protection vs. industrial development, effluent charges and market structure, an optimal pollution control program under conditions of imperfect information, and compensating payments in salary externality problems. Agricultural economists produced a variety of papers on tradeoffs between agricultural production costs and sediment damage, research needed on erosion and sedimentation problems, the effect of tenure arrangements vs. regional factors on erosion levels, converting noncropland to cropland in the Mississippi delta, and reaction of farmers to public programs on soil conservation. A series of articles investigated how transferable discharge rights might be used for phosphorus pollution control in Lake Michigan. A study of annualized costs of water pollution abatement by industry and by family income class showed that low-income families would bear a disproportionately high portion of pollution control costs. Real spending for all types of pollution abatement increased by 5% in 1978, and for water pollution abatement, by 9%. Reasons for economists' objections to technology-based effluent standards were stated in a definitive work. (Cassar-FRC)
W82-01304

THE WORKINGS OF THE CONTROL OF POLLUTION ACT IN TIDAL WATERS: A VIEW OF THE MINISTRY OF AGRICULTURE, FISHERIES AND FOOD,
Ministry of Agriculture, Fisheries and Food, Lowestoft (England). Fisheries Lab.
For primary bibliographic entry see Field 6E.
W82-01383

THOUGHTS ON THE NEED TO CONTROL DISCHARGES TO ESTUARIAL AND COASTAL WATERS,
Department of the Environment, London (England).
For primary bibliographic entry see Field 6E.
W82-01384

RURAL SANITATION IN DEVELOPING COUNTRIES,
Hawksley (Watson), High Wycombe (England).
For primary bibliographic entry see Field 5D.
W82-01392

USE OF THE CONTINGENCY FUND AT STRINGFELLOW HAZARDOUS WASTE DISPOSAL SITE,
Coast Guard, Hamilton AFB, CA. Pacific Strike Team.
G. A. Reiter, and R. M. Mandel.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980 Washington, DC, Environmental Protection Agency Report (1980). p 21-24, 2 Tab, 5 Ref.

Descriptors: *Waste disposal, *Land disposal, Flooding, *Water pollution control, Costs, Federal jurisdiction, Wastewater treatment, Berms, Planning, Water pollution prevention, State jurisdiction, *Stringfellow Quarry, *California.

Because of the repeated flooding and overflow of pollutants from the Stringfellow Quarry waste disposal site, and the exhaustion of local abatement funds, the California State Water Resources Control Board (RWQCB) petitioned the EPA for use of Section 311(k) funds of the Clean Water Act. Use of the funds was authorized and a number of actions were taken in March 1980. Three and a half million gallons of liquid wastes were removed and treated at the Palo Verde treatment site. The berms were strengthened to prevent collapse, and a pump was installed to remove accumulating liquids in pond No. 1. Pumping and aeration were continued by the RWQCB after the Federal activities ceased. The value of a coordinated response was demonstrated in dealing with hazardous waste site discharges. Effective planning from the time of notification to termination is possible, although the estimates of the immediacy of the threat and appropriate mitigation measures may differ among the agencies involved. (Brambley-SRC)
W82-01416

PRELIMINARY RISK EVALUATION FOR SUSPECTED HAZARDOUS WASTE DISPOSAL SITES IN CONNECTICUT,
TRC Environmental Consultants, Inc., Wethersfield, CT.
D. Unites, M. Possidento, and J. Housman.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980. Washington, DC, Environmental Protection Agency Report (1980). p 25-29, 3 Fig, 1 Tab, 3 Ref.

Descriptors: *Waste disposal, *Land disposal, *Hazardous materials, *Toxicity, Evaluation, Priorities, Water supply, *Water pollution prevention, Pollutants, Groundwater pollution, Polychlorinated biphenyls, Pesticides, Fishkill, Runoff, *Connecticut.

Connecticut Public Act No. 79-605 mandates the commissioner of environmental protection to inventory toxic or hazardous waste disposal sites and the types and amounts of wastes disposed therein. A four-phase program has been developed, which is in progress. The first phase resulted in the identifying of 3072 potentially hazardous sites, with 28 added later. The second phase resulted in giving priority for site investigation to those sites in towns with the largest populations using private wells, with low priority given to towns with public water supplies. The third phase is a preliminary evaluation using a flow chart which identifies seven critical conditions requiring immediate action. These are: improperly disposed liquid polychlorinated biphenyls; asbestos that can become airborne; improperly disposed pesticides; disposal within 200 ft of a drinking water supply; possible fire or explosion; fish kills; and discharge of hazardous materials to storm sewers or surface water. The final phase is a more detailed analysis based on a numerical scoring system. Approximately 30% by area of the state has been reviewed, with 10 sites referred for further study or enforcement action, and 20 notices of violation for minor problems have been issued. (Brambley-SRC)
W82-01417

RATING THE HAZARD POTENTIAL OF WASTE DISPOSAL FACILITIES,
JRB Associates, Inc., McLean, VA.
C. Kufs, D. Twedell, S. Paige, R. Wetzel, and P. Spooner.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC Environmental Protection Agency Report (1980). p 30-41, 4 Fig, 4 Tab, 10 Ref.

Descriptors: *Waste disposal, *Land disposal, *Hazardous materials, Waste management, Waste characteristics, Evaluation, Path of pollutants, Water quality control, Groundwater, Surface water, Environmental protection, Pollution rating systems.

A method has been developed for use by hazardous waste coordinators in the evaluation of the hazards posed by land disposal facilities to popula-

tions, ground and surface waters, and critical environments. The method has three elements: the rating factor system which rates the general hazard potential of the site; the additional points system which modifies the rating based on site-specific factors; and the scoring system which interprets the ratings in meaningful terms. There are 31 factors in the rating factor system, in four categories: receptors, pathways, waste characteristics, and waste management practices. By assigning a point score to each factor a numeric value may be obtained for each category, and when summed, for the overall score. Sites may be ranked for hazard by relative or absolute overall score, or by single category scores. The single category scores are appropriate when significant data are lacking about a particular site. The rating forms are presented, and scores are given for actual sites for sample site rankings. (Brambley-SRC)
W82-01418

THE NATIONAL ASSESSMENT OF THE GROUND-WATER CONTAMINATION POTENTIAL OF WASTEWATER IMPOUNDMENTS,
Environmental Protection Agency, Washington, DC.
L. R. Silka.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC. Environmental Protection Agency Report (1980). p 45-48, 3 Tab, 5 Ref.

Descriptors: *Waste disposal, *Land disposal, *Groundwater pollution, *Wastewater lagoons, *Industrial wastes, Linings, Monitoring, Hazardous materials, Water supply, Groundwater movement, Municipal wastes, Farm wastes, Mine wastes, Brines, Surveys.

The EPA assisted the states in conducting the Surface Impoundment Assessment with the aim of determining the number, location and potential effects of these sites on groundwater and of improving the information on impoundments and groundwater protection. A total of 77,678 sites were identified, 10,819 of which the were industrial sites, which were given highest priority in subsequent analyses. The industrial waste sites are estimated to cover about 430,000 acres and receive 50 billion gallons per day of influent. Fewer than 30% are lined, and more than 95% have no regular monitoring. About half the sites contain waste which may have potentially hazardous constituents. Thirty percent overlie usable aquifers and are underlain by zones which allow free movement of escaping wastes. About one third of these sites are within one mile of a water supply well which would be in the path of contaminated water flowing from the site. Similar lack of proper siting, design and monitoring is indicated in the information obtained for municipal, agricultural, mining, and oil and gas brine waste liquids sites. The industrial and municipal sites pose the greatest threat to drinking water resources, while the remainder threaten agricultural groundwater resources. The minimal monitoring of the waste sites results in discovery of contamination only after gross, noticeable environmental changes occur. (Brambley-SRC)
W82-01419

EVALUATION OF HYDROGEOLOGIC CONDITIONS,
Geraghty and Miller, Inc., Annapolis, MD.
J. J. Geraghty.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC. Environmental Protection Agency Report, (1980). p 49-52, 8 Ref.

Descriptors: *Hydrologic data, *Land disposal, *Waste disposal, *Hazardous materials, *Groundwater pollution, Evaluation, Monitoring, Water quality, Wells, Geophysics, Seismology, Groundwater movement, Plumes.

Current hazardous waste regulations contain requirements for monitoring the groundwater around disposal sites, and for investigating subsurface conditions if the groundwater has become contaminated. Some of the subsurface exploratory procedures used prior to monitoring or remedial action are described. The objectives of the exploration may differ, but in each case the geology, hydrology and the water quality will be investigated. Most investigations will require the drilling of wells, but preliminary studies can minimize their number and maximize the information they yield. This information may be obtained from geological records, site observations, past drilling records, and operational wells in the area. Geophysical surveys using seismic or electrical resistivity methods can provide information on the geology and hydrology and are most useful when some prior knowledge exists. Magnetometer surveys and temperature studies may also be useful. Hydrologic information is best obtained from test wells which can be logged, pumped and sampled, and they will give additional geologic information. Several wells may be necessary to determine the movement of water in an aquifer, and the contaminant plume dimensions. The information collected can then be used to predict possible changes in directions and rates of plume movement due to natural variations or human invervention. (Brambley-SRC)
W82-01420

PRACTICAL ASPECTS OF GROUND WATER MONITORING AT EXISTING DISPOSAL SITES,
Law Engineering Testing Co., Atlanta, GA.
J. R. Absalon, and R. C. Starr.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC, Environmental Protection Agency Report, (1980). p 53-58, 4 Fig, 4 Ref.

Descriptors: *Waste disposal, *Land disposal, *Monitoring, *Groundwater pollution, *Wells, Landfills, Aquifers, Waste characteristics, Sampling, Protection, Landfills, Wastewater lagoons, Water pollution control, Resource Conservation and Recovery Act.

The Resource Conservation and Recovery Act requires monitoring of ground water at surface impoundments, landfills and land treatment facilities to determine the impact of waste disposal on the quality of the water in the uppermost aquifer beneath the site. The site geology and waste facility characteristics are determined from available information, records, and field investigations. These investigations will aid in the most effective placement of monitoring wells. Monitoring wells should be installed using methods, equipment, and materials that minimize changes in the aquifer, introduction of foreign materials, and cross contamination betwen wells and aquifers. Aquifer changes can be prevented by sealing between aquifers and using appropriate drilling techniques. Foreign materials which may contaminate ground water include water and drilling muds from the boring process, contaminants adhering to the drilling equipment, and the well material itself, especially when PVC is used as the casing. Wells should be pumped or bailed before monitoring samples are taken, so as to obtain water unaffected by the drilling process. Samples must be treated or preserved to maintain their integrity before testing. In dealing with sites containing hazardous wastes, workers and the public must be protected from exposure, by the appropriate equipment and information. (Brambley-SRC)
W82-01421

SITE ASSESSMENT: IMPROVING CONFIDENCE LEVELS WITH SURFACE REMOTE SENSING,
Technos Inc., Miami, Florida.
R. C. Benson, and R. A. Glaccum.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC, Environmental Protection Agency Report (1980). p 59-65, 9 Fig, 3 Ref.

Descriptors: *Waste disposal, *Land disposal, *Hazardous materials, *Groundwater contamination, Surveys, Groundwater movement, Leachates, *Remote sensing, Radar, Magnetic studies, Water pollution control, Plumes, Geologic formations, Subsurface mapping.

Remote sensing of hazardous wastes sites allows a great deal of information to be gained about the geology of the site, materials in the site, and movement of leachate from the site. The four most useful methods available are found penetrating radar, electromagnetics, magnetometry, and metal detection, frequently used in combination with each other. Electromagnetic conductivity data can be used to locate geological details such as fractures, paleosinks, and pockets through which contaminants may move, and also contaminant plumes. Radar can be used to locate and estimate the size of trenches. Metal detectors are used to locate metal objects such as drums, while the ferrous or non-ferrous nature of the metal can be determined by magnetometry. Continuously measuring instruments have been designed to produce a continuous record from a pass over a site. By running closely spaced parallel survey lines information can be mapped over the entire site area, quickly and inexpensively in comparison with direct sampling methods. (Brambley-SRC)
W82-01422

MAPPING CONTAMINATED SOIL PLUMES BY KRIGING,
Resources Management Associates, Lafayette, CA.
S. F. Moore, and D. B. McLaughlin.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC, Environmental Protection Agency Report, (1980). p 66-70, 5 Fig, 1 Tab, 8 Ref.

Descriptors: *Hazardous materials, *Plumes, *Subsurface mapping, *Soil contamination, Spatial distribution, Mathematical models, Groundwater pollution, Groundwater movement, Monitoring.

Data on the distribution of hazardous waste contaminants in soils are inherently uncertain and incomplete. An effective mapping method was developed to study the contaminant plumes in the soil at the Hanford, Washington, nuclear waste site. Statistical formulation of the problem led to the choice of kriging as an appropriate estimation procedure to facilitate computer mapping. Kriging is based on assumptions about the variation in spatial differences of a variable, rather than absolute values. A kriging model partitions observed variability between a local drift function and a random process which has a spatial correlation structure represented by the variogram. Solution of the contaminant mapping problem consists of: setting up a grid of points at which contaminant values are to be estimated; forming the 'kriging equations' at each grid point and solving for the weighting factors; computing the estimate and its variance at each grid point; and drawing in smooth contour lines delineating the contaminant distribution throughout the area of interest. The method was used to determine ruthenium-106 movement at a tank farm. Some locations of higher values are identified; these represent priority candidate sites for additional sampling wells. (Brambley-SRC)
W82-01423

GEOLOGICAL STUDIES OF INDUSTRIALLY-RELATED CONTAMINATION: SOIL AND GROUND WATER INVESTIGATIONS,
Metcalf and Eddy, Inc., Boston, MA.
For primary bibliographic entry see Field 5B.
W82-01425

REMEDIAL OPTIONS FOR GROUND WATER PROTECTION AT ABANDONED SOLID WASTE DISPOSAL FACILITIES,
Penn Environmental Consultants, Inc., Pittsburgh, PA.
D. Threlfall, and N. J. Dowiak.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC. Environmental Protection Agency Report, (1980). p 131-134, 2 Tab, 5 Ref.

Descriptors: *Waste disposal, *Land disposal, *Groundwater pollution, *Water quality control, Infiltration, Leachates, Drainage, Cost analysis, Soil compaction, Impervious soils.

Remedial measures to protect ground water will depend on the subsurface conditions and the characteristics of the waste. Limited remedial measures such as site covering or controlling the flow of surface water may be sufficient if there are geologic barriers to leachate migration, little or no ground water is affected, or the waste has a low-hazard potential. Extensive measures such as leachate collection systems, ground water collection systems, slurry walls or covers may be required if there are no geologic barriers, usable ground water is affected, or if the waste is significantly hazardous. An evaluation was performed at an abandoned strip mine pit, 10 acres in area and 60 ft deep, which had been used for the disposal of neutralized acid waste sludges. Significant infiltration was occurring from the surface into the ground water which flowed into good quality surface water. A drainage collection network was designed to intercept leachate as it emerged downstream from the site, and it was conveyed to a water treatment plant. An impermeable cover was necessary to prevent leachate formation. Bentonite soil additives, PVC membranes and compacted local soil were considered. Compacted local soil was the least expensive option, and, once the sludge had dried out, sufficient compaction was possible to obtain the necessary impermeability. This approach combined economic and technical feasibility, but leachate collection and treatment must be continued until the cover is in place. (Brambley-SRC)
W82-01426

TOP-SEALING TO MINIMIZE LEACHATE GENERATION, CASE STUDY OF THE WINDHAM, CONNECTICUT, LANDFILL,
SMC-MARTIN, King of Prussia, PA.
G. H. Emrich, and W. W. Beck, Jr.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC, Environmental Protection Agency Report, (1980). p 135-140, 6 Fig, 2 Ref.

Descriptors: *Landfills, *Groundwater pollution, *Water pollution control, *Leachates, Municipal wastes, Grading, Monitoring, Lysimeters, Water quality, Plumes, Water pollution prevention, Case studies, *Windham, Connecticut.

The Windham, Connecticut, Landfill was selected to demonstrate remedial actions to abate or minimize pollution from closed landfills. The system of remedial actions used at this site included regrading, covering at a minimum depth of 15 cm with local sand and gravel and a minimum of 10 cm of fine-grained sand washings, the application of a 20-mil PVC cover and a final 46-cm vegetated cover. A monitoring system has been installed consisting of suction lysimeters and pan lysimeters to determine the movement of moisture through the refuse, a ground water monitoring system consisting of wells to determine fluctuations in the water table as well as the rate and movement of leachate in the ground water, and surface water monitoring system consisting of staff gages in nearby ponds. Monitoring of the landfills has continued for several years established complete baseline data, and will continue for two years following the installation of the remedial action alternatives to determine their effectiveness. In the seven months since the implementation of the remedial action, the groundwater quality has improved and the leachate plume has retreated to the landfill. (Brambley-SRC)
W82-01427

REMEDIAL TECHNIQUE OF CONTROLLING AND TREATING LOW VOLUME LEACHATE DISCHARGE,
Nassaux-Hemsley, Inc., Chambersburg, PA.
W. T. Hemsley, and W. C. Koster.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980. Washington, DC, Environmental Protection Agency Report (1980). p 141-146, 3 Fig, 6 Tab.

Descriptors: *Landfills, *Leachates, *Water pollution control, *Waste disposal, *Wastewater treatment, Wells, Drains, Heavy metals, Coagulation, Carbon adsorption, Chlorination, Sludge disposal, Water quality standards, Suspended solids, Pollution load, *Franklin County, Pennsylvania.

The remedial measures installed to control leachate at a landfill after closure are described. The site has an area of 15 acres on a steeply bedded shale in Franklin County, Pennsylvania. The newer part of the site is graded to provide good surface drainage but was the source of the leachate to be controlled. Piezometers were used to produce a groundwater map, and determine infiltration and horizontal permeability. Based on these figures, it was recommended that collection wells, with connections to a collection drain, be installed around the perimeter, and that the leachate be treated chemically before discharge. Four collection wells were dug, with a total leachate yield of 8.15 gpm. The leachate exceeded the state discharge requirements in suspended solids, BOD, ammonia-nitrogen, iron, lead, mercury and copper. Laboratory tests indicated that alum would be the most effective coagulant, but that activated carbon filtration was necessary to remove metals. The final leachate treatment is chlorination. The sludge is taken to an approved landfill, and the discharge meets the Pennsylvania requirements. (Brambley-SRC)
W82-01428

SURFACE WATER MANAGEMENT AT HAZARDOUS WASTE SITES,
Dames and Moore, Atlanta, GA.
T. J. Doyle.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC, Environmental Protection Agency Report (1980). p 152-159, 7 Fig, 1 Tab, 4 Ref.

Descriptors: *Land disposal, *Waste disposal, *Water pollution prevention, *Hazardous materials, *Regulations, Environmental protection, Runoff, Floods, Flood control, Spillways, Water pollution sources, Surface water management.

The regulations applicable to hazardous waste sites and water resource protection are reviewed. A site may not be located in regulatory floodways, coastal high hazard areas, the 500-yr floodplan, or wetlands. In some cases permission may be granted for a site in an environmentally sensitive area, if it is designed, constructed, operated and maintained so that it would not be inundated by a specific flood or storm event. In order to protect surface waters from contamination it must be shown that runoff will not enter the facility, or diversion structures must be provided. These may include interceptor ditches, underflow systems, or diversion ditches, pipelines and tunnels. The use of diversion facilities can be reduced by installing floodwater detention basins, to reduce the peak discharge from any storm. Liquid or semi-liquid storage impoundments must have an adequate freeboard or an emergency spillway, sufficient to withstand the Probable Maximum Flood. Hazardous waste facilities must operate in compliance with the Clean Water Act in respect to point and non-point pollutant sources. They must have a closure plan which will be implemented for at least 30 yrs from the date of closure, to prevent soil erosion and exposure of hazardous waste to the environment. (Brambley-SRC)
W82-01429

BENCH SCALE ASSESSMENT OF TECHNOLOGIES FOR CONTAMINATED GROUND WATER TREATMENT,
Touhill, Shuckrow and Associates, Inc., Pittsburgh, PA.
A. J. Shuckrow, A. P. Pajak, J. W. Osheka, and S. C. James.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC, Environmental Protection Agency Report, (1980). p 184-191, 9 Fig, 2 Tab, 3 Ref.

Descriptors: *Groundwater pollution, *Water treatment, *Waste dumps, *Pollutants, *Organic compounds, Biological treatment, Activitated carbon, Adsorption, Chemical coagulation, Resins, Membrane processes, Stripping, Continuous flow.

Contaminated groundwater is a consequence of uncontrolled industrial waste sites which may need treatment to remove the contaminants. An initial study reduced 18 potential technologies for removing 500 compounds in 12 classes to six - biological treatment, chemical coagulation, carbon adsorption, membrane processes, resin adsorption, and stripping. It was recognized that no single treatment would be effective so five processtrains were designed: biological/carbon sorption, carbon/biological, biophysical, membrane/biological, stripping/carbon sorption. Bench scale studies were conducted with an actual contaminated ground water. It contained over 70 organic pollutants, primarily priority pollutants, but heavy metals were not believed to be a problem. Carbon adsorption was most effective in removing organic pollutants, with resin sorption and air stripping somewhat less effective, although significant residual total organic carbon (TOC) remained in all samples. Continuous flow studies were then conducted using stream stripping and granular activated carbon. Small scale biological reactors were also tested, first to acclimate the organisms to the contaminated water, then to test their effectiveness in removing TOC. Up to 60-80% TOC removal was achieved. These studies will continue; biophysical treatment and pretreatment methods will be studied. (Brambley-SRC)
W82-01433

EVALUATION OF REMEDIAL TREATMENT, DETOXIFICATION AND STABILIZATION ALTERNATIVES,
Anderson-Nichols and Co., Inc., Boston, MA
For primary bibliographic entry see Field 5D.
W82-01434

PRELIMINARY DESIGN AND COST ESTIMATES FOR REMEDIAL ACTIONS AT HAZARDOUS WASTE DISPOSAL SITES,
JRB Associates, Inc., McLean, VA. Waste Management and Resource Recovery Div.
S. F. Paige, C. H. Morgan, H. C. Bryson, G. E. Hunt, and P. J. Rogoshewski.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC, Environmental Protection Agency Report (1980). p 202-207, 2 Fig, 2 Tab, 6 Ref.

Descriptors: *Waste disposal, *Water pollution control, *Groundwater pollution, *Hazardous materials, *Design criteria, Costs, Soil contamination, Land disposal, Waste characteristics, Capital costs, Maintenance costs, Financing, Budgeting.

Uncontrolled hazardous waste sites can cause contamination of the surface, groundwater, air, sewer and water lines, soils and sediments. Any remedial action must first consider the contaminated areas and then prepare a design plan and estimate its cost. The preliminary design will consider the remedial activities, the necessary equipment, wastes or residues that may be generated and their final disposition, land requirements, site characteristics, the dimensions of the techniques to be performed, and the time needed for each activity. The preliminary design information is used to estimate overall costs, which comprise immediate and longterm costs. The immediate costs are the capital, labor and other costs associated with the installation of the remedial action techniques. The long-term costs are those required for maintenance, monitoring and general operation of the equipment, and may be required in perpetuity. This very long-term financial requirement necessitates determinations of site costs, inflation, discount rate, the size of contingency funds, and the means of generating these funds. (Brambley-SRC)
W82-01435

IDENTIFICATION AND RECLAMATION OF CHROMIUM SLUDGE DISPOSAL SITES,
Maryland Office of Environmental Programs, Annapolis.
For primary bibliographic entry see Field 5E.
W82-01437

NEW OPPORTUNITIES FOR IN-PLANT REDUCTION OF POLLUTANTS THROUGH PROCESS CHANGES,
International Paper Co., Tuxedo Park, NY.
J. J. Renard, R. B. Phillips, H. Jameel, and A. W. Rudie.
Tappi, Vol 64, No 8, p 51-54, August, 1981. 1 Fig, 3 Tab, 14 Ref.

Descriptors: *Pulp and paper industry, *Pollution load, *Kraft mills, Water pollution prevention, *Water pollution control, Oxygenation, Process control, Chlorine dioxide, Anthraquinone, Costs.

The most significant effective option for reducing pollution from a beached kraft mill was oxygen delignification of the unbleached pulp. Application of oxygen in the caustic extraction stage was least effective. However, both oxygen-based options reduced product costs. The other two processes evaluated, cooking to lower kappa numbers with anthraquinone catalyst and use of chlorine dioxide in the first bleaching stage with hypochlorite in the extraction stage, were more costly. The four methods reduced pollution loads between 20% and 60%. For a new mill, oxygen delignification requires a sizable capital investment and is generally not recommended over the less complicated process using oxygen in the extraction stage. For an existing mill the two oxygen-based options are preferred. (Cassar-FRC)
W82-01559

REMEDIAL ACTION CONTROLS GROUNDWATER CONTAMINATION AT A PAPER MILL SLUDGE DISPOSAL SITE,
Soil Testing Services of Wisconsin, Inc., Green Bay.
J. A. Senger.
Tappi, Vol 64, No 8, p 41-43, August, 1981. 5 Fig.

Descriptors: *Pulp and paper industry, *Leachates, *Landfills, Industrial wastes, Sludge disposal, Water quality, Groundwater, *Water pollution prevention, Water pollution control.

Leachate from an abandoned primary sludge landfill at a paper mill was controlled by taking advantage of existing hydrogeological conditions. Three problems contributed to the seepage: the site received discharge from a city storm sewer pipe, sandy soils directly underneath the sludge fill contained groundwater, and pore water was released during sludge consolidation. Corrective measures included diverting the sewer pipe away from the landfill; construction of a retaining dike, a clay cutoff wall downgradient, a collection pipe and two 20,000 gal storage tanks (from which leachage is routed to the treatment plant; and deposition of 2 feet of sand and 6 inches of topsoil as a final cover, which was then seeded and planted with grass and shrubs. These measures have greatly improved groundwater quality. Currently sludge is disposed of in two cells lined with clay. A sand blanket confines the sludge and allows leachage to drain into the cell for collection and transport to the treatment plant. (Cassar-FRC)
W82-01582

SITING AND DESIGN OF TAILINGS IMPOUNDMENTS,
Klohn Leonoff Inc., Denver, CO.
For primary bibliographic entry see Field 8A.
W82-01588

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

AN EXAMPLE OF THE APPLICATION OF STATISTICAL TECHNIQUES TO PREDICT LAKE LEVEL ELEVATIONS,
Department of the Environment, Edmonton. Div. of Design and Construction.
S. D. Koppula.
Canadian Journal of Civil Engineering, Vol 8, No 2, p 114-121, June, 1981. 3 Fig, 7 Tab, 10 Ref.

Descriptors: *Predictions, *Water levels, *Lakes, *Mathematical models, Statistical methods, Land use, Flood control, Storm water, Water level fluctuations, Management planning, Statistical models.

Advance knowledge of the magnitude of the temporal variations of future lake levels can assist the development of optimum stormwater management strategies relating to flood control, land use measures, and budgeting. Knowledge of future lake levels is very important, since these lake levels will determine the type of objectives and strategies which management must develop. The use of two statistical methods to examine available data on monthly lake water levels is reported. The Box-Jenkins forecasting technique consists of fitting a mixed autoregressive integrated moving average (ARIMA) model to the data and extracting conditional expectations. Harmonic analysis involves fitting a sine-cosine curve which possessed the property of regular undulating oscillations to data when the cyclical movements of a time series composed of seasonal variations, cyclic fluctuations, and random variations cover the same time span. These two statistical models are used to predict future lake levels in Lesser Slave Lake in Alberta, Canada, using monthly water level data, and these predictions are compared with actual observations. The predictions made by the Box-Jenkins model were found to be closer to the recorded observations than those made by harmonic analysis. Combination of the results from the two independent models to develop a composite forecast gave results which were slightly better than those given by either of the independent models alone. The composite model permitted consideration of the inherent cycles of periodicity greater than 12 months, resulting in improved forecasts. (Carroll-FRC)
W82-01111

WATER MULTIPLIERS--REGIONAL IMPACT ANALYSIS,
Hawaii Univ., Honolulu. Dept. of Agricultural and Resource Economics.
C. T. K. Ching.
Water Resources Bulletin, Vol 17, No 3, p 454-457, June, 1981. 3 Tab, 10 Ref.

Descriptors: *Regional planning, *Water demand, *Input-output analysis, Planning, Water resources development, Economic aspects, Moel studies, Water multipliers, *Nevada, Leontief models, Employment, Income.

The Leontief input/output model is typical of methods for assessing the impacts of changes in regional economy produced by growth and/or decline. Sales, income or value added, and employment are the economic variables commonly used. This paper suggests that resource multipliers be added to the analysis. Direct water coefficients (acre-feet per $1000) and water multipliers for Humboldt and Lander Counties, Nevada, are devised for each of 22 sectors of the input/output model. Direct water coefficients vary from 0.001 for Communication to 12.8240 for Alfalfa and Other Hay. Water multipliers vary from 154.5250 for the Food Processing industry to the order of 1 for half of the sectors such as Service Station, Transportation, Health Services, and Local Government. This means that for each unit (acre-feet) change in direct water use by the Food Processing industry, total water use in the economy would change by 154.525 units. However, the shock to the economy is measured, not by unit change in direct water use, but by a change in final demand for the commodities. A table lists the estimated changes in output, income, employment, and water use for a $100,000 change in final demand in each sector. In the case of the Food Processing industry, these figures are $177,489, $22,772, 3.0 FTE, and 216.34 acre ft, respectively. (Cassar-FRC)
W82-01138

COMPUTER MODELING OF LOS ANGELES WATER RESOURCES,
Los Angeles City Dept. of Water and Power, CA.
B. W. Kuebler.
Journal of the American Water Works Association, Vol 73, No 7, p 341-345, July, 1981.

Descriptors: *Computer models, *Water resources development, *Water level fluctuations, Groundwater, Surface water, Groundwater recharge, Pumping, *Los Angeles, California.

Computer models for surface water and groundwater were developed to aid in the scheduling of operations and in planning for the future. The Owens-Mono surface water model is used to model the Mono and Owens River basins, which have four major reservoirs with a combined capacity of 288,000 acre-feet. The model schedules operations for the runoff year (April through March). Also, this model has been used to simulate the operations of the aqueduct system over a 31-year base period as part of a study of the environmental impact of groundwater pumping. The Los Angeles groundwater model is used to predict water level changes due to groundwater recharge and variations in the amount of pumping. The Owens Valley groundwater model is used to give a rough estimate of how the basin responds to various recharge and extraction schemes with existing and proposed wells. Developing or updating a computer model is a good way to comprehend how a resource functions, even if the model is not the best way of arriving at decisions on how to use that water resource. (Small-FRC)
W82-01168

DESIGN AND MERIT OF A RIVER-AQUIFER MODEL FOR OPTIMAL USE OF AGRICULTURAL WATER,
Colorado State Univ., Fort Collins. Engineering Research Center.
H. J. Morel-Seytoux, C. J. Daly, T. Illangasekare, and A. Bazaraa.
Journal of Hydrology, Vol 51, No 1-4, p 17-27, May, 1981. 5 Fig, 9 Ref.

Descriptors: *Irrigation programs, *Design criteria, Planning, Drought, Rivers, Aquifers, Groundwater, Wells, Surface water, *South Platte River, *Colorado, Agriculture, Model studies, Simulation, *Surface-groundwater relations.

Important steps in the design of a river-aquifer model for optimal use of agricultural water are discussed. The area under study consisted of a 90 mile reach of the South Platte River in the eastern plains of Colorado and of its associated alluvial aquifer. Irrigated agriculture is widely practiced in this area, with the major crops being corn, sugar beets, beans and alfalfa. Irrigation water comes mainly from surface water supplied by three reservoirs and an extensive system of distribution canals. Groundwater is used as a supplementary source through pumped wells. The study was made to find an optimum strategy of managing the river-aquifer system under drought conditions. Considerations to be included in the model design included system size and geometry, length of time steps and the total time horizon, lumping of parameters and variables, water allocation, and water rights. Once designed, the model was successfully applied to the field problem. The design procedures used made it possible to apply the model at a very moderate cost of $350 (US) for a simulation and still maintain very high accuracies in simulating the physical behavior. (Baker-FRC)
W82-01193

ANALYSIS OF NATIONAL WATER POLLUTION CONTROL POLICIES 1. A NATIONAL NETWORK MODEL,
Resources for the Future, Inc., Washington, DC.
L. P. Gianessi, and H. M. Peskin.
Water Resources Research, Vol 17, No 4, p 796-801, August, 1981. 1 Fig, 1 Tab, 27 Ref.

Descriptors: *Water quality, *Path of pollutants, *Water pollution control, Model studies, Network design, Mathematical models, Water pollution sources, Rivers, Lakes, Reservoirs, Bays, Urban runoff, Nonpoint pollution sources.

A water pollution network model was developed to study the implication of federal water pollution control policies on a national level. It consists of a water network, a set of assignment functions for injecting pollutants into the network, and equa-

tions or rules for transmitting the pollutants throughout the network. Bodies of water with average flows of 1000 cu ft per sec or greater and receptors of pollutants from major urban areas or two or more counties were chosen for inclusion in the model. However, some small, polluted rivers were included, and some large, pristine, rivers and short polluted tributaries were excluded. In all, the network contains 304 rivers, 175 lakes and reservoirs, 37 bays, 10 sections of Great Lakes shoreline, and 26 ocean shoreline segments. Nodes (1051 river and 249 other) were established at: major population centers, entrances of major tributaries, beginnings of estuaries, entrances to reservoirs, river mouths, and within very long river sections without other nodes. Each county, except for 13 completely arid counties, is assigned at least one node. Point discharges and urban runoff are assumed to enter the network at nodes; and nonpoint sources, between the nodes. Hydrodynamic data and geographical data were obtained from U.S. Geologic Survey publications and other sources. The pollution transport functions are used to convert injections of pollutants at the nodes to concentrations of pollutants at and between nodes. Although no formal testing of the model has been done, a deficiency is noticeable. Leaving out many small tributaries underrates the flow at the next downstream node. (Cassar-FRC)
W82-01292

ANALYSIS OF NATIONAL WATER POLLUTION CONTROL POLICIES 2. AGRICULTURAL SEDIMENT CONTROL,
Resources for the Future, Inc., Washington, DC.
L. P. Gianessi, and H. M. Peskin.
Water Resources Research, Vol 17, No 4, p 803-821, August, 1981. 5 Fig, 11 Tab, 30 Ref.

Descriptors: *Agricultural runoff, *Sediment control, *Water pollution control, *Path of pollutants, Model studies, Mathematical models, Water quality, Phosphates, Dissolved oxygen, Nitrogen, Biological oxygen demand, Nonpoint pollution sources.

A national water network model was used to predict the effects of several agricultural sediment control policies on water quality. The most widespread violations were found for total Kjeldahl nitrogen (TKN) and total phosphorus (TP), with fewer for BOD5 and dissolved oxygen. Three policies were simulated: (1) a point source control policy, (2) a cropland sediment control policy, and (3) full implementation of both policies. Model results suggest that the third alternative would result in significant improvement on water quality in about one-third of the river points in the country. Water quality violations would be reduced 31% for BOD5, 24% for TKN, 25% for TP, and 44% for dissolved oxygen. However, even with full implementation of point source and sediment control about half of the nation's rivers would violate TP and TKN standards. Maps depict which of the 105 regions of the country would have significantly fewer violations of each pollutant if a cropland sediment control policy were implemented. (Cassar-FRC)
W82-01293

A SURVEY OF MATHEMATICAL OPTIMIZATION MODELS AND ALGORITHMS FOR DESIGNING AND EXTENDING IRRIGATION AND WASTEWATER NETWORKS,
Massachusetts Inst. of Tech., Cambridge. Operations Research Center.
C. E. Mandl.
Water Resources Research, Vol 17, No 4, p 769-775, August, 1981. 6 Fig, 28 Ref.

Descriptors: *Model studies, *Irrigation design, *Wastewater facilities, Network design, Mathematical models, Algorithms, Water conveyance, Water quality, Design criteria, Experimental design, Costs, Construction costs, Operating costs, Linear programming, Sensitivity analysis, Optimization.

Network models and algorithms useful in designing and expansion of irrigation and wastewater systems are reviewed. No one model dominates on the basis of both computational efficiency and quality of solution. Trying to minimize construction and/or operating costs typically results in a concave cost (objective) function due to economies of scale. For large networks (200 or more nodes) linear or piecemeal linear (separable) programming plus sensitivity analysis should be tried first. For smaller networks an integer programming approach described by several authors may be successful. If the network is a tree structure, the Polymeris (1978) or Converse (1972) algorithms are more efficient. However, none of the models considers water quality constraints, only optimal network design in terms of construction and/or operating costs. (Cassar-FRC)
W82-01296

POTENTIAL USE OF A STREAM-AQUIFER MODEL FOR MANAGEMENT OF A RIVER BASIN: CASE OF THE SOUTH PLATTE RIVER IN COLORADO,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
H. J. Morel-Seytoux, T. Illangasekare, M. W. Bittinger, and N. A. Evans.
Water Science and Technology, Vol 13, No 3, p 175-187, 1981. 5 Fig, 7 Ref. OWRT-B-076-COLO(6), OWRT-B-109-COLO(9), and OWRT-B-144-COLO(8).

Descriptors: *Water management, *Irrigation water, *Drought, *River basins, Water allocation, Agriculture, Aquifer management, Canal linings, Irrigation efficiency, Model studies, *South Platte River, Colorado, *Computer models, Simulation analysis.

A computer simulation study was conducted to determine the best water management strategy, particularly under drought conditions, for conjunctive use of surface and groundwaters for a 90-mile section of the South Platte River. Five runs of the model were made. The Historical Run used data for 1952-1961. Calculated river flow at Julesburg agreed with recorded flows. The Lined Canals Run proposed lining canals with seepage losses of 25% or more. Water allocation strategy consisted of allowing the diversion of the minimum of four quantities: water need, water right, legal water availability, and historical diversion. The Farm Efficiency Run assumed that irrigation efficiency improved from a historical value of 40-50% to 75% under the same water allocation strategy as the Lined Canals Run. The Pumping-as Needed Run allocated surface water as before, but allowed pumping up to existing capacity to meet crop needs unsatisfied by surface water supplies. The fifth run was a Combination Run. The best remedy for water supplies was to draw supplemental water from the aquifer wherever and whenever needed during drought. The resulting lowering of the water table would reach an equilibrium state within two years if no more land is put into production. Canal lining and increased farm efficiency, depending on surface water, would save only small amounts of water in times of drought when surface water supplies are small. This model study confirms previous work which concluded that wells should be pumped during dry years and allowed to recharge during years with normal stream flow. (Cassar-FRC)
W82-01301

SYSTEMS ANALYSIS,
Cornell Univ., Ithaca, NY.
J. R. Stedinger, and D. Pei.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 612-615, June, 1981. 56 Ref.

Descriptors: *Systems analysis, *Water pollution control, *Planning, *Water management, Regional planning, Storm water, Monitoring, Water quality, Model studies, Reviews, Nonpoint source pollution, Urban runoff, Eutrophication, Lakes, Wastewater treatment, Clean Water Act, *Literature review.

Literature on systems analysis applied to water management included methods useful in regional planning and development. Several papers concerned EPA Section 208 (Clean Water Act) studies and the differences in program implementation in similar areas. Marketable discharge permits, a tiered permit system, and taxation schemes to achieve desired pollutant abatement levels were discussed. Water quality models were developed, refined, and used in new applications. Some of the conclusions of these studies were: nitrification was the dominant cause of dissolved oxygen depletion in the Willamette River, Oregon; and low-flow augmentation was less costly than water treatment. Three models predicted different degrees of eutrophication in Lake LaFarge, Wisconsin. Models were applied to Great Lakes eutrophication and phosphorus loading. Books on water quality modeling, especially for rivers, were published. Nonpoint source pollution research concerned combined sewer overflows, the problems of STORM and SWMM models, a decomposition dynamic programming algorithm for determining optimal control of storm water, and a critique of current nonpoint pollution source models. Systems analysis and computers in wastewater treatment operation improved performance and efficiency, minimized costs, and helped choose optimum expansion designs. Decentralized treatment facilities produced higher dissolved oxygen concentrations than centalized facilities. Water quality monitoring and network design were reviewed and evaluated. Intervention analysis was used to determine the effects of wastewater treatment in phosphorus reduction and for estimating missing data. (Cassar-FRC)
W82-01303

STUDY OF A COMPLEX WATER RESOURCES SYSTEM WITH SCREENING AND SIMULATION MODELS,
Indian Inst. of Tech., New Delhi.
M. C. Chaturvedi, and D. K. Srivastava.
Water Resources Research, Vol 17, No 4, p 783-794, August, 1981. 6 Fig, 9 Tab, 15 Ref.

Descriptors: *Systems analysis, *Water resources development, *Linear programming, Model studies, Dams, Reservoirs, *Narmada River, *India, River basin development, Simulation, Planning, Multipurpose projects.

The Narmada River basin, India, was studied using a combination of a mathematical programming screening model and a simulation model. The screening models were used to find a reasonably small set of optimal design alternatives for a large complex multipurpose water resources system which includes six major dams. Two linear programming deterministic models were used, one continuous (LPDC) and one discontinuous (LPDD). Simulation analysis then supplied the near-optimum solution in terms of objective function. The LPDC model produced realistic and improved results when compared with values obtained by conventional design methods. The LPDC also specified output targets and capacities for better regulation of mean monthly flows at all sites. The LPDD model predicted excess reservoir capacity needed for drought and wet years and helped in selecting the range of variables for simulation by random sampling for the alternative selected by the LPDC model. (Cassar-FRC)
W82-01309

DAILY OPTIMIZATION OF POWER GENERATION IN CASCADE HYDROSYSTEMS (A STOCHASTIC APPROACH),
Institutul Politehnic din Bucuresti (Romania). Power Div.
A. Diacon, I. Seteanu, and R. Popa.
Journal of Hydrology, Vol 51, No 1/4, p 57-65, May, 1981. 5 Fig, 5 Tab, 4 Ref.

Descriptors: *Powerplants, *Optimization, Systems analysis, Planning, Model studies, Hydroelectric power, Electric power, Electric power production, Resources development.

A general model is proposed with the probability density functions of stochastic variables estimated according to hydrological conditions and operational practice of a cascade hydrosystem. The system considered is comprised of a cascade containing hydroelectric facilities and associated

buffer reservoirs located downstream of a major, multiannual regulating reservoir. Daily optimization of power generation for such a hydrosystem is very advantageous. Releasing of water through turbines during on-peak hours of the load-curve is desirable, while during off peak hours it is more suitable to store the inflow discharges in such a way that a more favorable energy production is obtained. The inflow discharges and the discharges for water supply uses of water storages are considered as random variables, with their probability density functions being estimated according to both hydrological conditions and operational practice. The reliability of the proposed model is proved by an actual numerical case study; the input-output data as well as the optimization algorithm are presented in detail. (Baker-FRC)
W82-01320

HYDROELECTRICAL MODEL FOR OPTIMAL OPERATION OF A SINGLE MULTIPURPOSE RESERVOIR,
National Water Plan Commission, Mexico City.
A. Guitron.
Journal of Hydrology, Vol 51, No 1/4, p 67-73, May, 1981. 2 Fig, 2 Tab, 5 Ref.

Descriptors: *Reservoirs, *Model studies, Irrigation practices, Stochastic models, Electric power production, Hydroelectric power, Operating policies, Administration, *Mexico.

A dynamic programming model is described in its application to the construction of a projected reservoir in the northwest zone of Mexico. The purposes to which the water in the reservoir is to be put include irrigation, electric energy production, flood control and water quality control. The operation policy is obtained for a fixed design, the physical objectives of the analysis being to determine the optimal releases and water storage of the reservoir during the operation period. Irrigation water volumes are treated in parametric form, establishing in this way a production function for energy and water, while satisfying the other restrictions on withdrawals and storage levels. The model which was developed was applied to a projected reservoir located on the Fuerte River in northwest Mexico. The historical mean annual stream-flow of Fuerte River at Huites station is 3.733 times 10 to the 9th power cubic meters, the useful capacity 3.91 times 10 to the 9th power cubic meters, and the dead capacity 0.28 times 10 to the 9th power cubic meters. The model results indicate the maximum peak energy that it is possible to produce for several levels of firm irrigation water. The mean secondary energy produced is also indicated. While the model is applicable to an operating policy for a single reservoir, the Huites project is part of a complex system requiring the integral operation of multiple reservoirs and irrigation areas. However, the model will be helpful in defining initial points for the search for an optimal operation policy of the total system. (Baker-FRC)
W82-01329

RURAL WATER SUPPLY AND RELATED SERVICES IN DEVELOPING COUNTRIES-COMPARATIVE ANALYSIS OF SEVERAL APPROACHES,
Bajard (Y.) Associates Ltd., Vancouver (British Columbia).
Y. Bajard, M. Draper, and P. Viens.
Journal of Hydrology, Vol 51, No 1/4, p 75-88, May, 1981. 3 Ref.

Descriptors: *Water resources development, *Planning, Resources development, Rural areas, Water supply development, Water requirements, Sanitation, Water demand, Africa, Tropical regions, *Developing countries.

Technical and educational aspects of rural water supply and sanitation programs are reviewed for Kenya, Cameroon, Senegal, The Gambia, Mali, Ivory Coast, Ghana, Benin and Ethiopia. Water availability and distribution in tropical Africa are generally poor. Several problems come to light on examining the various development schemes either proposed or underway. There is a general lack of recognition by host countries and donor agencies that water supplies and sanitation are inseparable aspects of development which must be tackled together. There is, in general, a reluctance to give due consideration to non-technical aspects of the problem. It is not widely realized that western technology, while efficient on the short term but sociologically brutal, may not be the best solution to the water problem. Training is lacking in both operation and management areas. There is a general lack of recognition that the projects must be seen within an overall framework, usually the country as a whole, even though action may be limited to a small part of that country. The projects are often conceived at a distance without sufficient reference to the local context. A plan is presented to take each of these shortcomings and devise a system of overcoming them. (Baker-FRC)
W82-01330

PREDICTING STREAM SALINITY CHANGES IN SOUTH-WESTERN AUSTRALIA,
Perth Public Works Dept. (Australia).
I. C. Loh, and R. A. Stokes.
Agricultural Water Management, Vol 4, No 1/3, p 227-254, 1981.

Descriptors: *Salinity, *Water pollution sources, Groundwater pollution, Land management, Farming, Solute transport, Model studies, Catchments, Reforestation, Water supply, *Agricultural runoff, *Forest watersheds, Streams, Inflow, *Australia.

The range of hydrologic responses and salinity variations of rivers and streams which drain forested and agricultural land in the Darling Range of south-western Western Australia are described. Appropriate approaches to modeling stream salinity changes to solve different problems are discussed, and a model is described which can be used to predict the annual salinity and flow of a large river system subject to a long history of permanent clearing. The geology of the Darling Range is dominated by the Archean Shield, a granitic basement underlying the lateritic soil profiles of the region. Soil associations have generally formed in situ and are characterized by lateritic gravels and duricrust overlying pallid zones of sandy clays or clay and a zone of weathered bedrock. Natural forest vegetation is characterized by a variety of Eucalyptus species with deep roots extended into the subsoils and weathering profile. The regional model described predicts the flow and salinity from a 2830 km square catchment, the Wellington Reservoir Catchment, subject to a long clearing history, and is designed to assist planning for long term catchment management. The model is based on a general quantitative knowledge of the hydrologic characteristics of small catchments within different rainfall zones across the catchment and represents the compilation of results from 10 years of study. Low salinities of the Darling Range prior to clearing were seen to dramatically increase in salt load following clearing. Current findings suggest that the mostl is overpredicting salinities in dry years. Improvements could be gained by further study of groundwater discharge to streams from year to year and a more careful study of effects of different geometric patterns of clearing and aquifer dimensions on groundwater discharge. (Baker-FRC)
W82-01350

METHODS FOR GENERATING ALTERNATIVE SOLUTIONS TO WATER RESOURCES PLANNING PROBLEMS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
S-Y. Chang, E. D. Brill, Jr., and L. D. Hopkins.
Water Resources Center, University of Illinois, Research Report No 160, July, 1981. 114 p, 17 Tab, 14 Fig, 29 Ref. S-078-ILL.

Descriptors: *Model studies, *Optimization, Resources development, Alternative planning, Multiobjective planning, *Water resources development, Mathematical models, System analysis, Wastewater treatment, Planning, Comprehensive planning, Project planning.

An optimization model is generally not a perfect representation of a complex water resources planning problem because not all important issues can be captured in a model. However, optimization models can be used to generate planning alternatives that are good and different, though not optimal, so that the decision maker can examine a wide range of alternatives. This approach is called modeling to generate alternatives (MGA). Several MGA methods--a random method, a branch and bound/screening (BBS) method, a Hop-Skip-Jump (HSJ) and a Fuzzy HSJ method--are described, and the potential use of these methods for generating good and different alternative solutions is assessed. The methods are illustrated using a wastewater treatment system planning problem, which is formulated as a mixed integer programming (MIP) model. The results suggest that all four MGA methods can be used in a complex water resource planning process to generate planning alternatives that are good and different. The common disadvantage of the quantitative methods of measuring differences among alternatives is that they cannot measure how far, in the spatial sense, the changes are made. With the HSJ method, the differences among alternatives are greater for the first several alternatives and decrease for additional alternatives. The Fuzzy HSJ method generates alternatives with the same general trend as HSJ. With the random generation method, the possibility of generating the same alternative is larger for a small planning problem than for a large one. The two-step BBS method uses the APEX code, then a screening process to select solutions that are different from each other. (Garrison-Omniplan)
W82-01449

GENERATING ALTERNATIVE SOLUTIONS FOR DYNAMIC PROGRAMMING MODELS OF WATER RESOURCES PROBLEMS,
Illinois Univ. at Urbana-Champaign. Dept. of Landscape Architecture.
L. D. Hopkins, E. D. Brill, Jr., and B. Wong.
Water Resources Center, University of Illinois, Research Report No 163. August, 1981. 31 p, 9 Fig, 2 Tab, 11 Ref. Append. S-078-ILL.

Descriptors: *Alternative planning, *Model studies, *Multiobjective planning, Flood plain management, Management planning, Mathematical models, Model testing, Land use, Long-term planning, Flood plains, Bottomland, Projections, *Water management.

Using modeling to generate alternative (MGA) techniques, three methods to identify different, feasible alternative solutions to dynamic programming problems concerning water resources are evaluated. The methods, which differ in the procedure for identifying different alternatives, are: (1) adapting the kTH best policy method based on a difference constraint; (2) generalizing this method by treating difference and the known objective as two components to be weighted; and (3) searching a modified trace-back for solutions of maximum difference. Applying the second technique to a floodplain management model resulted in a solution in which all land use decisions, except one non-floodplain land use and one floodplain land use, were different from the decisions in the original solution. The economic rent objective was 11 percent lower than in the original solution. The outflow at the base of the watershed was approximately 26,000 cubic feet per second, compared with 20,000 cubic feet per second in the original solution. This illustrates that for a realistic problem, a variety of alternatives can be obtained without greatly reducing the economic rent from the optimal solution to a model of the problem. The intent to obtain alternatives that are perceivable as different with respect to implicit knowledge is, therefore, satisfied. This analysis could be used as a mental blockbuster to confront the analyst with policy options that are suggested by consideration of alternatives rather than by the original solution or past experience. The weighted difference approach is the most promising among the approaches considered. (Garrison-Omniplan)
W82-01450

PERFORMANCE EVALUATION OF A STOCHASTIC OPTIMIZATION MODEL FOR RESERVOIR DESIGN AND MANAGEMENT WITH EXPLICIT RELIABILITY CRITERIA,

Group 6A—Techniques Of Planning

Purdue Univ., Lafatette IN. School of Civil Engineering.
For primary bibliographic entry see Field 8A.
W82-01462

ON IDENTIFICATION AND VALIDATION OF SOME GEOTHERMAL MODELS,
Department of Scienfitic and Industrial Research, Lower Hutt (New Zealand). Physics and Engineering Lab.
L. J. Fradkin, M. L. Sorey, and A. McNabb.
Water Resources Research, Vol 17, No 4, p 929-936, August, 1981. 2 Fig, 24 Ref.

Descriptors: *Geothermal studies, *Model studies, *Well hydralics, Groundwater movement, Wairakei, *New Zealand, Thermal water, Mathematical models, Deep wells, *Geothermal resources.

The best of several models for production in the Wairakei geothermal field, New Zealand, was a lumped parameter model identified as a slow drainage model in which the upper two-phase portion of the reservoir serves mainly as a source of liquid for the underlying liquid region from which most of the production is obtained. This study also considered general models, reduced models, distributed parameter models, and combinations of these. Models were validated by comparing their forecasting powers with identified parameter values and by testing these identified values against additional data. Although the chosen slow drainage model gives a significantly simple conception of the reservoir, it is quite adequate for describing the production field's response with a minimum of parameters. It also provides good estimates of field parameters such as porosity, permeability, and recharge-storage ratio. (Cassar-FRC)
W82-01467

MANAGEMENT CONCERNS FOR SWIMMING, TUBING, AND WADING IN THE GREAT SMOKY MOUNTAINS NATIONAL PARK,
Great Smoky Mountains National Park, Gatlinburg, TN. Uplands Field Research Lab.
G. L. Larson, and W. E. Hammitt.
Environmental Management, Vol 5, No 4, p 353-362, July, 1981. 8 Fig, 1 Tab, 12 Ref.

Descriptors: *Recreation demand, *Water sports, *Environmental effects, Swimming, Parks, Soil compaction, Erosion, Stream banks, Streams, *Great Smoky Mountain National Park.

The great abundance of swimmers and innertube floaters along streams in the Great Smoky Mountains National Park made necessary this study on potential resource impacts. The main types of aquatic use other than fishing are described. The following were determined: the amount of each use, patterns of use, site use at each location, and potential impacts and user conflicts. Sampling was conducted at several sites on three streams. Use was concentrated during the afternoons and at certain streams and study sites most appropriate for the activity. Major impacts were soil compaction and erosion along the streambanks and the physical disturbance of the stream bottoms due to moving stones to construct temporary dams and raceways. Management objectives for the area will have to be specified, and the amount and character of chage permitted to occur in these streams because of recreational use must be determined. Further study is needed to determine that level of aquatic use that a stream can support without excessive damage. (Small-FRC)
W82-01475

SIMULATION OF DAILY WEATHER DATA USING THEORETICAL PROBABILITY DISTRIBUTIONS,
Cornell Univ., Ithaca, NY. Dept. of Plant Pathology.
For primary bibliographic entry see Field 2B.
W82-01526

INTERDISCIPLINARY ENVIRONMENTAL ANALYSIS FOR TIMBER SALE PLANNING,
Klamath National Forest, Yreka, CA.
F. H. Jackson.
Water Resources Bulletin, Vol 17, No 2, p 301-306, April, 1981. 1 Fig, 3 Tab, 3 Ref.

Descriptors: *Planning, *Interdisciplinary studies, Water resources development, *Forestry, Environmental control, Environmental policy, Decision making, Administrative decisions, *California, Klamath National Park.

The systematic interdisciplinary process currently used for the development, evaluation, and selection of alternatives for timber harvest projects on the Happy Camp Ranger District of Klamath National Forest in northern California is described. The process begins with an inventory of resources and a team of specialists headed by a decision-maker, as well as a set of management objectives and constraints. It uses a mechanism which will set up conditions conducive to identification of appropriate alternatives reflecting the degree to which single alternatives can fulfill all objectives. A decision package of effectively displayed information is prepared, and a decision is made and documented. An impact matrix sheet is prepared, listing all resource factors and all alternatives for a given area on one sheet. Hydrologic resource factors considered are stream stability, stream temperature and stormflow turbidity. The specialists involved, including a water resources specialist, identify problem areas, predict impacts of proposed treatments, and help to develop management strategies. The team includes a decision-maker who is ultimately responsible for the project. (Baker-FRC)
W82-01539

MANAGING LAND TO MEET WATER QUALITY GOALS,
Economics and Statistics Service, Washington, DC. Natural Resource Economics Div.
For primary bibliographic entry see Field 4D.
W82-01557

6B. Evaluation Process

HYDROPOWER LOSSES FROM NAVIGATION IN THE SNAKE-COLUMBIA RIVERS: 1978-79,
Washington State Univ., Pullman. Dept. of Environmental Science.
For primary bibliographic entry see Field 6D.
W82-01139

A SURVEY OF MATHEMATICAL OPTIMIZATION MODELS AND ALGORITHMS FOR DESIGNING AND EXTENDING IRRIGATION AND WASTEWATER NETWORKS,
Massachusetts Inst. of Tech., Cambridge. Operations Research Center.
For primary bibliographic entry see Field 6A.
W82-01296

EFFECT OF INVESTMENTS IN WATER SUPPLY AND SANITATION ON HEALTH STATUS: A THRESHOLD-SATURATION THEORY,
Michigan Univ., Ann Arbor. School of Public Health.
H. I. Shuval, R. L. Tilden, B. H. Perry, and R. N. Grosse.
Bulletin of the World Health Organization, Vol 59, No 2, p 243-248, 1981. 6 Fig, 13 Ref.

Descriptors: *Public health, *Cost-benefit analysis, *Water supply development, Developing countries, Threshold-saturation theory, Planning, Waste disposal, Social aspects, Economic aspects, Water resources development.

The threshold-saturation theory is proposed to relate investments in sanitation and water supply to health. Three variables are considered: health status, socioeconomic status, and sanitation level. The two-tiered S-shaped logistic form assumes that at the lower end of the socioeconomic spectrum there is a threshold below which investments in community water supplies or sanitation alone result in little improvement in health status. At the other end of the socioeconomic scale, there is a point of saturation beyond which investments in conventional community sanitation facilities produce no further health benefits. Preliminary support for this theory was obtained by using published data on sanitation level, life expectancy, and adult literacy rates for 65 developing countries. (Cassar-FRC)
W82-01331

EXPANSION OF EFFLUENT CONSTRAINED TREATMENT PLANTS,
Newcastle Univ., New South Wales (Australia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W82-01355

PRELIMINARY DESIGN AND COST ESTIMATES FOR REMEDIAL ACTIONS AT HAZARDOUS WASTE DISPOSAL SITES,
JRB Associates, Inc., McLean, VA. Waste Management and Resource Recovery Div.
For primary bibliographic entry see Field 5G.
W82-01435

INPUT AND OUTPUT CONSTRAINTS AFFECTING IRRIGATION DEVELOPMENT,
Michigan Univ., Ann Arbor. School of Natural Resources.
G. Schramm.
Journal of Hydrology, Vol 51, No 1-4, p 1-16, May, 1981. 1 Fig, 5 Tab, 17 Ref.

Descriptors: *Irrigation design, *Planning, Design criteria, Irrigation practices, Irrigation programs, Farming, Agriculture, Decision making, Administrative decisions, *Mexico.

The development of an extensive irrigation project in Mexico for the purposes of increasing agricultural output and alleviating rural poverty and unemployment is reviewed, with emphasis on the manner in which shifting projections and parameters change the overall benefits initially expected from such a long term project. Government allocations to the agricultural sector increased 7-fold from 1970 to 1975. However, other supports were also needed, such as short- and long-term credit, availability of fertilizers, seeds and insecticides, and accessibility to markets and marketing facilities. These factors are termed input constraints. Output constraints are basically market related. They occur because hoped-for, predicted markets for certain crops do not materialize or are available only at prices far below those predicted in the project planning stage. It is suggested that, in countries where conditions are such that a wide variety of crops will fluorish, new projects should generally be evaluated on the basis of low-value crop production only. When high value are included in this evaluation, there must be specific reasons to believe that this product will be superior to already existing ones. Expected price levels for all specialty crops should be based on observed price levels in the local or regional markets to be served. Studies should be undertaken on an ongoing basis to estimate yearly the likely growth in demand for higher value crops. The necessary inputs, including education and demonstration plots, must be figured into the cost-benefit analysis of the project from the beginning. (Baker-FRC)
W82-01476

EXTRACTION TIMING AND ECONOMIC INCENTIVES FOR GEOTHERMAL RESERVOIR MANAGEMENT,
Woodward-Clyde Consultants, San Francisco, CA.
For primary bibliographic entry see Field 4B.
W82-01504

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

ON WATER TARIFF EQUALIZATION POLICIES,

Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Applied Engineering.
S. H. Hanke.
Water/Engineering and Management, Vol 128, No 8, p 33-34, August, 1981. 12 Ref.

Descriptors: *User charges, *Water policy, *Policy making, Water costs, Public policy, Pricing, Administrative decisions, Regional planning, Economic aspects, Investment.

Intra-system water tariff equalization policies based on forward-looking costs are discussed. This type of policy requires all customers in a certain customer class to pay the same price per unit volume and the same fixed charge per period regardless of which local system they are in. This type of system has been proposed in France and the United Kingdom and is believed to be necessary for the development of an equitable regional or national strategy for water development. Equalization policies mean that users in low-cost systems subsidize users in high-cost systems. One disadvantage is that since price and charges are not related to the real cost of water, inefficiency may be encouraged. Where the political power of the low-cost and high-cost users is equal, or where the power of the high-cost users dominates, overinvestment will occur in the high-cost systems and underinvestment in the low-cost systems. (Small-FRC)
W82-01175

SUPPLY-DEMAND COORDINATION IN WATER RESOURCES MANAGEMENT,
Centro Teoria dei Sistemi, Milano (Italy).
G. Guariso, D. Maidment, S. Rinaldi, and R. Soncini-Sessa.
Water Resources Research, Vol 17, No 4, p 776-782, August, 1981. 5 Fig, 3 Tab, 10 Ref.

Descriptors: *Water supply, *Water demand, *Interbasin transfers, *Water resources management, Optimization, Water management, Irrigation, Water transfer, Water delivery, Benefits, Cost-benefit analysis, Algorithms, Marginal costs, Northwest Water Plan, *Mexico, Pricing.

Optimal water supplies and demands in a network were determined by an iterative algorithm which combines the results of models for each supply and demand unit. It works with marginal benefits and costs rather than total benefits and costs. The key idea is that the cost of delivering a unit of water must be equal to the benefit generated at that point. Some simplifying assumptions made are: water quality is not considered, all flows are available at the same time, and all supplies have the same reliability. The method is applied to the proposed Northwest Water Plan in Mexico, involving transfer of water from south to north along the Mexican coast of the Gulf of California. Declining groundwater levels and seawater intrusion are the problems behind this proposed transfer. The system consists of four supplies (one groundwater system and three reservoirs) and four irrigation demand areas. If the transfer scheme is built according to plan, the annual total net benefit from crop production in the region would increase by 6% to $784.2 million; construction and maintenance costs are estimated at $16.1 million per year; and the benefit-cost ratio is 2.7. The water price in the source region would rise from 4 cents to 9 cents per cu meter and fall from 24 cents to 10.5 cents in the receiving area. Solving the problem by classical price coordination methods requires an eight-dimensional search, while the method presented in this paper is one-dimensional. (Cassar-FRC)
W82-01299

ECONOMICS,
Clemson Univ., SC.
For primary bibliographic entry see Field 5G.
W82-01304

6D. Water Demand

WATER MULTIPLIERS--REGIONAL IMPACT ANALYSIS,
Hawaii Univ., Honolulu. Dept. of Agricultural and Resource Economics.
For primary bibliographic entry see Field 6A.
W82-01138

HYDROPOWER LOSSES FROM NAVIGATION IN THE SNAKE-COLUMBIA RIVERS: 1978-79,
Washington State Univ., Pullman. Dept. of Environmental Science.
C. F. Culver, and C. B. Millham.
Water Resources Bulletin, Vol 17, No 3, p 501-503, June, 1981. 1 Tab, 7 Ref.

Descriptors: *Energy loss, *Electric power, *Locks, Dams, Hydroelectric power, Powerplants, Dams, Recreation, Transportation, *Navigation, Rivers, *Snake River, *Columbia River, Washington, Boating, Water use, Water demand.

Power losses from commercial and recreational lockages on the Snake-Columbia River complex were, respectively, 100,206,000 and 14,900,000 kWH in 1977 (a year of low flow), 125,958,000 and 28,748,000 kWH in 1978, and 127,483,000 and 34,259,000 kWH in 1979. Losses for 1978-79 would have met power requirements for 10,500 Washington State households for 2 years (at an annual rate of 15,000 kWH per household). Any boat traveling from Portland, Oregon, to Lewiston, Idaho, and back uses a minimum of 8 lockages at a total energy loss of 77,000 kWH or replacement cost of $3,000. Planned low-head hydropower development sites in the State of Washington would produce energy quantities comparable to the losses due to pleasure boat lockages at the present dams. The authors question whether commercial towboats should continue to enjoy cost-free passage and whether there are more energy-conserving methods of transporting recreational boats over dams. (Cassar-FRC)
W82-01139

PREFERENCES FOR ALLOCATING RIVER RECREATION USE,
Montana Univ., Missoula. School of Forestry.
S. F. McCool, and J. Utter.
Water Resources Bulletin, Vol 17, No 3, p 431-437, June, 1981. 6 Tab, 18 Ref.

Descriptors: *Recreation demand, *White water, *Allotments, Surveys, Middle Fork, *Salmon River, *Idaho, Allocation of resources, Resource allocation, Rivers, Permits, Water management, Water policy, Regulations.

Allocation of white water stream recreational use between commercial and private sectors was the subject of a questionnaire to which 1,166 individuals responded during the 1978 river floating season at Middle Fork of the Salmon River, Idaho. The 3 groups (commercial users, private users, and those whose applications for a trip permit were rejected) most preferred the Even-Pool allotment technique (a 50-50 split with leftover allotments going to the other sector). The Middle Fork System (46% for commercial use, 54% for private use) was also highly favored. As a group, the commercial users liked Advance Reservation first and Knowledge and Skill Requirements, second. Private users and rejectees ranked Lottery first, and Knowledge and Skill Requirements, second. There appeared to be no relationship of the importance of stress release/escape scale to the allocation techniques. The results of this study show that river managers may have considerable latitude in selecting allocation techniques. Users appear to prefer allocation techniques which they have experienced favorably in the past, which seem fair, and which do not intrude on the activities on-site. Other methods which received more than 50% approval from any one of the groups were: Historical Use, Even Split (50-50), Percentage of Disappointment (a certain percentage of applicants from each sector), Treat Everyone the Same, and Lottery-Reservation. (Cassar-FRC)
W82-01181

SUPPLY-DEMAND COORDINATION IN WATER RESOURCES MANAGEMENT,
Centro Teoria dei Sistemi, Milano (Italy).
For primary bibliographic entry see Field 6C.
W82-01299

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING; BRAZOS RIVER BASIN, TEXAS-NEW MEXICO.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Available from the National Technical Information Service, Springfield, VA 22161 as FERC-0059, Price codes: A02 in paper copy, A01 in microfiche. Planning Status Report FERC-0059, Revised 1980. 14 p, 3 Fig, 6 Tab.

Descriptors: *Water resources development, *Hydroelectric power, Flood control, Cooling water, *Reservoirs, Storage reservoirs, Thermal powerplants, Consumptive use, Saline water, *Multipurpose reservoirs, *Brazos River basin, Texas, New Mexico.

The Brazos River basin heads in eastern New Mexico about 25 miles northwest of the city of Clovis and extends in a southeasterly direction diagonally across Texas to the Gulf of Mexico, with an associated area that includes the coastal drainage north and east of the Brazos River to Galveston Bay. Average annual precipitation in the basin varies from 17 inches in the extreme headwater area to 46 inches near the Gulf of Mexico. There are 38 reservoirs in the basin (existing or under construction) with storage capacities in excess of 5,000 acre-feet. Nine of these are Federal projects, and two existing reservoirs support hydroelectric facilities. All of the Federal and one of the non-Federal reservoirs have space allocated for storage of floodwaters. There are 242 flood-water retarding structures with about 1,400 sq mi of drainage area. Water withdrawn for cooling purposes was estimated to be 1,547 million gallons per day with an estimated consumption rate of 38 million gallons per day. Potential hydroelectric projects in the Brazos River basin include Wynn Mountain, Inspiration Point, Hightower, DeCordova Bend, Bee Mountain, Belton, and a third unit at Possum Kingdom. There are twelve potential storage reservoirs in the basin. There may be 20 steam-electric generating plants in operation with generating capacities of 25 megawatts or greater located in the area by 1985. Fresh and saline water withdrawals for cooling purposes are estimated at 111 and 1,242 million gallons per day, respectively. The consumption rates for fresh and saline water are estimated at 74 and 8 million gallons per day, respectively. (Moore-SRC)
W82-01439

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING; SAVANNAH AND EDISTO RIVER BASINS AREA; GEORGIA-SOUTH CAROLINA-NORTH CAROLINA.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Available from the National Technical Information Service, Springfield, VA 22161 as FERC-0075, Price codes: A02 in paper copy, A01 in microfiche. Planning Status Report FERC-0075, Revised February 1981. 19 p, 3 Fig, 6 Tab.

Descriptors: *Water resources development, *Hydroelectric plants, *Savannah River basin, *Edisto River basin, Reservoirs, Flood control, Recreation, Navigation, Cooling water, Wild rivers, Harbors, Water supply, Planning, *Multipurpose reservoirs, Georgia, South Carolina, North Carolina.

This revised report presents updated information on the water resources of the Savannah and Edisto River Basins, and information on new and planned developments. There are 17 hydroelectric developments in the Savannah basin, existing or nearing completion, and none in the Edisto basin. The total installed capacity will be 1,712,830 kw. The reservoirs also provide flood-control storage capacity, and recreation. Below Augusta, a channel 9 ft deep and 90 ft wide is maintained. There are five steam-electric generating plants which withdraw a total of 2,363 mgd of water for cooling purposes. In the two basins 14 sites have been identified for potential hydroelectric projects. The Chattooga River is

the only river in the basin presently included in the National Wild and Scenic Rivers System; several others are being considered for inclusion. Fifteen retired hydroelectric projects have the potential for redevelopment. The steam-electric cooling water requirements are projected to be 599 mgd in 2000. Major studies are in progress to determine if any modifications should be made to the existing Savannah Harbor project, and to investigate the water supply, flood control, drainage and storm runoff, recreation, navigation, beach erosion, and fish and wildlife of the Savannah area. (Brambley-SRC)
W82-01440

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING; AMERICAN RIVER BASIN, CALIFORNIA.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Available from the National Technical Information Service, Springfield, VA 22161 as FERC-0076, Price codes: A02 in paper copy, A01 in microfiche. Planning Status Report FERC-0076, Revised March 1981. 18 p, 3 Fig, 5 Tab.

Descriptors: *Water resources development, *Hydroelectric plants, *American River, California, Reservoirs, Irrigation, Cooling water, Flood control, Storage capacity, Wild rivers, Diversion channels, Water demand, Planning, *Multipurpose reservoirs.

This revised report presents updated information on the water resources of the American River Basin and information on new and planned developments. There are 15 hydroelectric plants existing or under construction, and three license applications are pending. Total installed capacity is 1,046,715 kw, and the reservoirs also provide water for irrigation, power plant cooling, and municipal and industrial uses, and provide storage capacity for flood control. The only steam-electric plant is a nuclear plant which draws 8 mgd of water from the river for cooling purposes. This is expected to increase to 59 mgd by 2000. A segment of the North Fork of the American River is included in the National Wild and Scenic Rivers System, and a segment of the South Fork is being considered. Thirteen sites have been identified as having potential for hydroelectric development. Some of these sites may become part of multi-site projects, involving diversion pipelines and tunnels. Development will be subject to other water demands, including municipal and industrial supplies, flood control, water quality, and fish and wildlife, and to regulations specifying minimum flows in the river. (Brambley-SRC)
W82-01441

ORGANIC CONTAMINATION OF GROUND WATER: TELL IT ALL,
Dedham Water Co., MA.
For primary bibliographic entry see Field 5C.
W82-01474

HYDROPOWER--AN OLD TECHNOLOGY FOR A NEW ERA,
Worldwatch Inst., Washington, DC.
For primary bibliographic entry see Field 4A.
W82-01593

6E. Water Law and Institutions

NEBRASKA GROUND WATER LAW AND ADMINISTRATION,
J. D. Aiken.
Nebraska Law Review, Vol 59, No 4, p 917-1000, 1980. 448 Ref.

Descriptors: *Nebraska, *Water law, *Groundwater management, Water policy, Legal aspects, Groundwater, Water rights, Water quality, Groundwater mining, Irrigation, Legislation.

Nebraska is rich in groundwater when compared to other western states. In spite of this, groundwater is in short supply in many parts of the state. Although 87 percent of the groundwater used in Nebraska in 1975 was for irrigation, groundwater also supplied 99 percent of total municipal water use, 83 percent of rural domestic and stock watering use, 78 percent of cooling water for power plants, and 100 percent of self-supplied industrial water use. The historical development of Nebraska groundwater law is discussed decade by decade, beginning with the windmill era existing prior to 1930, and including descriptions of the technological and historical conditions affecting groundwater development and use and discussion of the effects of these conditions on the evolution of Nebraska groundwater law. Finally, Nebraska groundwater law and policy are examined with respect to the institutional framework, rights of use, groundwater transfers, well interference conflicts, groundwater mining, conflicts between surface and groundwater users, and groundwater quality. While well interference conflicts in Nebraska are resolved through a combination of common law doctrines of reasonable use and correlative rights and of statutory preferences, there is no clear basis for the resolution of surface-groundwater disputes. The status of groundwater transfers is also unclear. State groundwater management objectives are lacking, and groundwater quality protection is limited. Continued groundwater development and mining can be expected to force legislators and judges to address groundwater policy issues in the future. (Carroll-FRC)
W82-01236

LAW,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
W. E. Cox, and W. R. Walker.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 617-619, June, 1981. 41 Ref.

Descriptors: *Water law, *Legal aspects, *Water pollution control, Legislation, Reviews, Water quality standards, Planning, Effluent limitations, Nonpoint pollution sources, Enforcement, Judicial decisions, Wastewater treatment, *Literature review.

The recent reduction in significant additions to water quality legislation has produced a reduction in literature on the legal aspects of water pollution. Some recent papers concerned institutional structures for water quality protection and the lack of coordination between water quality and quantity planning. Congress was accused of turning decision making over to the public and the courts. Several authors discussed the Clean Water Act, the nonpoint source pollution problem in the Great Lakes, and effluent limitation and water quality standards. Some of the court cases reviewed concerned challenges to effluent limitations in the crushed stone and mining industries, a carbon tetrachloride spill in the Ohio River basin, interpretation of the Clean Water Act covering oil and hazardous waste spills, and spill penalties. Other subjects discussed were: the impact of Safe Drinking Water Act control measures on drinking water suppliers, whether the consumer or polluter should bear costs of treatment, proposed Safe Drinking Water Act amendments and their effect on groundwater quality, EPA enforcement activities, and marine pollution on the international scale. (Cassar-FRC)
W82-01302

FEDERAL COMMON LAW OF NUISANCE EXPANDS,
E. M. Sommer.
Natural Resources Journal, Vol 21, No 2, p 419-423, April, 1981. 22 Ref.

Descriptors: *Common law, *Judicial decisions, *State jurisdiction, Legal aspects, *Water pollution control, Industrial wastes, Polychlorinated biphenyls, *Illinois.

The case of Illinois v. Outboard Marine Corporation is reviewed, in which Illinois filed action against the company for allegedly discharging highly toxic polychlorinated biphenyls (PCBs) from its Waukegan, Illinois plant into North Ditch, Waukegan Harbor, and Lake Michigan. The federal government also filed a complaint under the Refuse Act, the Federal Water Pollution Control Act, and the federal common law of nuisance. The courts significantly expanded the federal common law of nuisance by holding that Illinois had a federal common law cause of action in nuisance against an in-state pollution source. As a result of the litigation, the federal common law of nuisance now appears to extend to navigable waters that are purely intrastate. Thus, there is now an additional tool for combatting pollution within territorial boundaries. Also, states can now sue intrastate polluters on the basis of federal common law without satisfying the federal jurisdictional requirement of diversity. (Small-FRC)
W82-01337

THE WORKINGS OF THE CONTROL OF POLLUTION ACT IN TIDAL WATERS: A VIEW OF THE MINISTRY OF AGRICULTURE, FISHERIES AND FOOD,
Ministry of Agriculture, Fisheries and Food, Lowestoft (England). Fisheries Lab.
P. C. Wood.
Water Pollution Control, Vol 80, No 2, p 180-188, 1981. 4 Ref.

Descriptors: *Pollution control, *Legal aspects, Regulations, Permits, Law enforcement, Estuaries, Planning, *United Kingdom, *Tidewater, Effluents, Discharge permits, Fisheries.

The probable future involvement of the British Ministry of Agriculture, Fisheries and Food (MAFF) with the part of the Control of Pollution Act 1974 related to tidal waters is considered. Some of the technical problems of relevance to the MAFF which are likely to be encountered by the authorities are also considered. Under Part II of the Act, water authorities will be required to issue consents for new and existing discharges. This should be based on the application of quality objectives which, among other things, will require the designation of the use of estuaries or parts of estuaries. Environmental quality standards needed to meet these quality objectives must be established. The application of discharge control based on quality objectives requires experience with the complexity of marine ecosystems, and with conditions in the specific area. The setting of consent conditions for new or existing discharges will require the MAFF to give its views to the Secretary of State within six weeks of publication of proposed conditions. (Baker-FRC)
W82-01383

THOUGHTS ON THE NEED TO CONTROL DISCHARGES TO ESTUARIAL AND COASTAL WATERS,
Department of the Environment, London (England).
P. H. Garnett.
Water Pollution Control, Vol 80, No 2, p 172-179, 1981. 6 Ref.

Descriptors: *Estuarine environment, *Pollution control, Legal aspects, Planning, Coastal waters, International waters, Organizations, Management, International agreements, Estuaries, *United Kingdom.

Public opinion has begun to manifest itself in England toward desiring cleanup of polluted estuaries and coastal waters. This attitude is reflected in the Third Report of the Royal Commission on Environmental Pollution and in the report of the Ministry of Housing and Local Government Working Party on Sewage Disposal, 1970. Part II of the Control of Pollution Act calls for control of all discharges of sewage and industrial effluent to all non-tidal and tidal rivers, estuaries and coastal waters. In order that tidal water quality objectives may be met, a first step would be to establish a classification of tidal-water quality. There also are international legislative concerns which influence the implementation of Part II of the Control of Pollution Act. In particular, the Paris Convention is of concern, which seeks to eliminate pollution from land-based sources. The cost of implementation is briefly considered. (Baker-FRC)
W82-01384

USE OF THE CONTINGENCY FUND AT STRINGFELLOW HAZARDOUS WASTE DISPOSAL SITE,
Coast Guard, Hamilton AFB, CA. Pacific Strike Team.
For primary bibliographic entry see Field 5G.
W82-01416

PRACTICAL ASPECTS OF GROUND WATER MONITORING AT EXISTING DISPOSAL SITES,
Law Engineering Testing Co., Atlanta, GA.
For primary bibliographic entry see Field 5G.
W82-01421

SURFACE WATER MANAGEMENT AT HAZARDOUS WASTE SITES,
Dames and Moore, Atlanta, GA.
For primary bibliographic entry see Field 5G.
W82-01429

MIDDLESEX COUNTY SEWERAGE AUTHORITY V. NATIONAL SEA CLAMMERS ASSOCIATION: IMPLIED PRIVATE RIGHTS OF ACTION FOR DAMAGES UNDER THE FEDERAL WATER POLLUTION CONTROL ACT AMENDMENTS OF 1972,
Lewis and Clark Coll., Portland, OR. Northwestern School of Law.
P. J. Manning.
Environmental Law, Vol 12, No 1, p 197-229, Fall, 1981. 265 Ref.

Descriptors: *Water law, *Judicial decisions, *Private rights, Legal aspects, *Water pollution control, Water pollution effects, Federal Water Pollution Control Act, *Shellfish, Middlesex County Sewerage Authority, National Sea Clammers Association.

The Supreme Court's opinion on the Middlesex County Sewerage Authority v. National Sea Clammers Association case did not settle the question of implied private rights of action under federal statutes. The Association filed suit in federal district court, complaining that various government officials had permitted toxic waste dishcarges into waters entering the Atlantic Ocean, where a massive algal bloom and subsequent collapse killed large numbers of shellfish. The case was dismissed in the district court for lack of jurisdiction. The Third Circuit Court of Appeals ruled that individuals injured by pollution violations of the Federal Water Pollution Control Act could seek damages. On appeal, the Supreme court rejected the Appeals Court conclusion, holding that Congress intended that private remedies in addition to those expressly provided should not be implied. Although this decision was correct, the haphazard use of the Cort v. Ash test in the analysis resulted in confusion in lower court rulings. Federal acts to control water pollution are reviewed, as well as the courts' analyses of this case and pertinent precedents. (Cassar-FRC)
W82-01455

AVOYELLES SPORTSMEN'S LEAGUE V. ALEXANDER,
K. L. Rosenbaum.
Environmental Law, Vol 12, No 1, p 231-242, Fall, 1981. 66 Ref.

Descriptors: *Wetlands, *Judicial decisions, *Land clearing, Water pollution prevention, Dredging, Legal aspects, Clean Water Act, Water law, Avoyelles Sportsmen's League v. Alexander, Farming, Lake Long, *Louisiana, Bayous.

The court ruled that clearing trees and shrubs from 20,000 acres of bottomland hardwoods in the Natchitoches basin, Louisiana (Lake Long tract) for soybeans farming was a violation of the Clean Water Act. In Avoyelles Sportsmen's League v. Alexander, the June 1979 decision ruled that land clearing operations were point sources of pollution under section 301, that the activities did produce dredged or fill materials (the cleared vegetation), that section 404 exemptions for normal farming and silviculture activities did not apply, and that the clearing activities would alter drainage and circulation patterns of the waters. In March 1981 the court ruled that this tract was a part of the waters of the U. S. as defined in the Clean Water Act. Although this decision was strongly in favor of environmentalists, its effectiveness in preserving wetlands may be lessened by budget cuts, lack of enforcement, and recent rulings that denial of a section 404 permit can be interpreted as taking of property without just compensation. (Cassar-FRC)
W82-01456

THE WATER DECADE (1981-1990).
UNESCO Courier, Vol 34, No 2, p 11-15, February, 1981.

Descriptors: *Developing countries, *Water supply development, *Public health, International Drinking Water Supply and Sanitation Decade, United Nations, Planning, Costs, Rural areas, Waste disposal.

The International Drinking Water Supply and Sanitation Decade is a worldwide cooperative effort to provide clean water and sanitation for all by the year 1990. The 1975 data indicate that fewer than 500 million of the 2000 million people in developing countries (not including China) have adequate water and sanitation. About 80% of sickness and disease can be attributed to these inadequacies. Widely varying cost estimates have been proposed for implementing the Decade's goals. The costliest option, $600 billion 1978 dollars for 100% coverage, assumes that urban households will all have water taps and be connected to sewer systems, rural households, standpipes or handpumps and individual latrines. Using acceptable but less sophisticated, lower cost technology, an 80% coverage could be reached for $300 billion. Participants in the Decade will be governments of both developed and developing countries, industry, educational institutions, and United Nations agencies. (Cassar-FRC)
W82-01534

A WATER RIGHTS STRATEGY FOR MINING OPERATIONS IN THE WESTERN US,
J. C. Green.
Mining Engineering, Vol, 33, No 8, p 1220-1222, August, 1981. 1 Fig.

Descriptors: *Water rights, *Mineral industry, *Water law, Legal aspects, Consumptive use, Environmental effects, Colorado, Western United States.

Legal and engineering issues in mining water rights in the semi-arid West are discussed. Water rights can be transferred by drying up historically irrigated lands to develop a new industrial water supply in an over-appropriated basin. An augmentation plan allows a new use of water by compensating the river system with various resources, sometimes at other locations. Before a mine begins operation, the water rights in the area must be reviewed, and the possible impacts of the operation on ground and surface waters must be assessed. The amount of consumptive use is important. Water rights must often be acquired, and it may take from one to three years to complete the augmentation plan. Most of the examples in this article deal with policies of the state of Colorado, but the concepts and principles used in other western states are similar. Early planning of a water rights strategy is often crucial to the mine planning process. (Small-FRC)
W82-01587

COMPELLED SELF-INCRIMINATION AND THE FEDERAL WATER POLLUTION CONTROL ACT,
J. McVey.
Natural Resources Journal, Vol 21, No 3, p 599-606, July, 1981. 61 Ref.

Descriptors: *Water law, *Judicial decisions, *Oil spills, Legal aspects, Constitutional law, Regulations, Federal Water Pollution Control Act, United States v. Ward, Arkansas River basin.

Ward, lessor of an Oklahoma drilling facility, was assessed a $500 civil penalty by the Coast Guard upon reporting, as required under the Federal Water Pollution Control Act, an oil spill into a tributary of the Arkansas River. Ward claimed, and the Tenth Circuit Court of Appeals agreed, that the act of reporting the spill was self-incriminating under the Fifth Amendment. The majority opinion of the U.S. Supreme Court found that the proceedings for assessment of a civil penalty was not a criminal or quasi-criminal proceeding, and therefore the Fifth Amendment privilege could not be invoked. The dissenting opinion stated that the reporting requirement is a form of compelled self-incrimination. (Cassar-FRC)
W82-01600

6F. Nonstructural Alternatives

THE PROBLEMS OF NON-RETURN AND THE USE OF VALVES IN DRINKING WATER PROTECTION AGAINST WASTE WATER RETURN, APPLYING THE REGULATIONS IN FORCE,
For primary bibliographic entry see Field 5F.
W82-01142

PREFERENCES FOR ALLOCATING RIVER RECREATION USE,
Montana Univ., Missoula. School of Forestry.
For primary bibliographic entry see Field 6D.
W82-01181

SANITATION SERVICE MANAGEMENT IN FRANCE (LA GESTION DES SERVICES D'ASSAINISSEMENT EN FRANCE),
Ingenieurs a la Societe Lyonnaise des Eaux et de l'Eclairage, Paris (France).
B. Auclair, and J-F. Bost.
Aqua, No 2, p 17-19, 21, 1981. 4 Fig.

Descriptors: *Wastewater treatment, *Maintenance, *France, Water treatment facilities, Management, Planning, Decision making, *Water pollution control.

An economic incentives program was instituted in an effort to curb water pollution in France. Highly effective municipal and industrial purification plants and sewerage systems have since been developed. Capital expenditures for maintaining the operation come from taxation and from fees charged directly to the user, based either on his water consumption or on the quantities of pollutants discharged. Organization and maintenance operations are conducted by the people or districts served by the facilities or can be handled through a firm of specialists on a contract basis. La Lyonnaise des Eaux handles cleansing services for some 600 townships throughout France. Different operation and maintenance problems are posed by each community, naturally influenced by the specific pollutants contained in the waste, Distinctions must be made between preventative maintenance, emergency services, and operation and upkeep, as all these activities have widely differing needs both in equipment and in human resources. The role of the operator must also take into account surveillance of connections with existing networks and ensure that discharges comply with prescribed standards. These tasks are more easily fulfilled by a company specializing in this area of operation and maintenance than by a municipal department. (Baker-FRC)
W82-01351

6G. Ecologic Impact Of Water Development

AN EMPIRICAL METHODOLOGY FOR ESTIMATING ENTRAINMENT LOSSES AT POWER PLANTS SITED ON ESTUARIES,
National Power Plant Team, Ann Arbor, MI.
J. Boreman, C. P. Goodyear, and S. W. Christensen.
Transactions of the American Fisheries Society, Vol 110, No 2, p 253-260, March, 1981. 3 Tab, 10 Ref.

Descriptors: *Entrainment, *Larvae, *Powerplants, *Estuaries, Fish, Shellfish, Eggs, Juvenile growth stage, Aquatic animals, Cooling water, Electric powerplants, Mortality, *Model studies, Mathematical equations, Potomac River, Rivers, Bass, Spawning, Forecasting, Planning, Nuclear powerplants, Potomac River estuary, *Douglas Point Nuclear Plant.

The Empirical Transport Model is a generalized mathematical equation for estimating the conditional entrainment mortality rate of aquatic organisms (especially fish and shellfish) due to water withdrawal from an estuary by one or more powerplants. The model is based on empirically derived age-, time-, and space-variant entrainment susceptibility data. There are two forms of the equation: the single-cohort approach (entrainable organisms are placed in the water body at the same time, e.g., by spawning over a short time interval) and the multiple-cohort approach (entrainable organisms introduced into the water body over an extended period). Model application requires data on water body morphometry, powerplant flow rates, probability of entrainment survival, and the duration, distribution, and abundance of entrainable age groups. The model was used to estimate the entrainment mortality of early stages of striped bass for the proposed Douglas Point Nuclear Plant on the Potomac River. Mortality rates obtained were 0.142% for eggs, 0.234% for yolk-sac larvae, 0.22% for fin-fold larvae, and total rate through the fin-fold stage, 0.398%. (Cassar-FRC)
W82-01173

ENTRAINMENT AND IMPINGEMENT IN POWER PLANT COOLING SYSTEMS,
Electric Power Research Inst., Palo Alto, CA.
W. Chow, I. P. Murarka, and R. W. Brocksen.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 965-973, June, 1981. 143 Ref.

Descriptors: *Powerplants, *Aquatic life, Plankton, Hydroelectric plants, Electric powerplants, Cooling, Design considerations, Entrainment, Fish, *Cooling water, *Ecological effects.

Current research is reviewed on developments to define and control the characteristics of cooling water from the biological as well as the engineering standpoint. The biological view deals with advances in ecological concerns and findings on entrainment and impingement at power plants. Plant design aspects deal with advances in engineering designs to meet biological criteria. Entrainment mortalities to eggs larvae and small fish directly affect fish communities. Whether irreversible damage is done through impingement and entrainment is still being debated. Counts and estimates of fish losses are carried out at most cooling water intake locations. Findings of numerous studies in this field suggest that entrainment and impingement of organisms depends to a large extent on the schooling behavior of fish, including fish migrations. Entrainment of eggs and larvae occurred only during periods when the particular species was spawning and hatching. To assess the impacts and make a biological evaluation of the significance of entrainment and impingement mortality, it is necessary to have an accurate estimate of the fish population being impacted. The population level modeling approach is frequently employed to assess the fraction of a given population suffering mortality losses from entrainment and impingement. Plant design aspects considered include the intake structure design, offshore studies on fish mortality, use of barriers and screens, and collection, removal and return systems. (Baker-FRC)
W82-01276

HOLLAND'S EASTERN SCHELDT ESTUARY BARRIER SCHEME: SOME ECOLOGICAL CONSIDERATIONS,
Shell Internationale Research Maatshcappij N.V., The Hague (Netherlands). Group Toxicology Div.
For primary bibliographic entry see Field 2L.
W82-01375

PHYTOPLANKTON OF FOUR RIVERS, THE TYNE, WEAR, TEES AND SWALE,
Durham Univ. (England). Dept. of Botany.
For primary bibliographic entry see Field 2E.
W82-01376

ECOLOGY OF LARVAL FISHES IN LAKE OAHE, SOUTH DAKOTA,
Fish and Wildlife Service, Pierre, SD. North Central Reservoir Investigations.
W. R. Nelson.
Technical Papers of the U.S. Fish and Wildlife Service, No 101, 1980. 20 p, 7 Fig, 20 Tab, 29 Ref.

Descriptors: *Reservoirs, *Spawning, *Larval growth stage, *Aquatic habitats, *Water level fluctuations, *Fish, Reservoir operation, Fish food, Vegetation, Flooding, Shores, Ecology, Lake Oahe, *South Dakota.

In reservoir environments, which are less stable than those of natural lakes, characteristics such as water level fluctuation, shoreline erosion, and sedimentation often have profound effects on fish reproduction. Before existing water management programs are altered, the spawning and nursery area requirements for the predominant species must be understood. The time and location of spawning, food of larvae, and habitats used as nursery areas by young of the year fishes were studied from 1972 to 1975 in South Dakota waters of Lake Oahe, a main stem Missouri River reservoir. Sampling locations were in the tributary rivers and their embayments. The most heavily used spawning areas were in the rivers, which were the exclusive spawning ground for five fishes (goldeneye, walleye, sauger, white sucker, and minnows), and the major spawning ground of three others (white bass, buffalo, and carp). The upper reaches of the embayments were the preferred spawning locations of crappies and the preferred nursery areas of most young fishes. The lower reaches were the primary spawning grounds of yellow perch, burbot, shiners and darters. Year-class strength of river-spawning species was primarily dependent on above average water levels, which inundated terrestrial vegetation to provide a substrate for egg deposition and cover for larvae. Preserving adequate streamflow and enhancing reservoir shoreline areas by managing water levels, seeding vegetation, and eliminating grazing alongshore would probably ensure adequate reproduction of most species. (Moore-SRC)
W82-01444

7. RESOURCES DATA

7A. Network Design

REGIONALIZATION OF THE UPPER GREAT LAKES WITH RESPECT TO SURVEILLANCE EUTROPHICATION DATA,
Canada Centre for Inland Waters, Burlington (Ontario).
R. E. Kwiatkowski.
Journal of Great Lakes Reserch, Vol 6, No 1, p 38-46, 1980. 3 Fig, 3 Tab, 22 Ref.

Descriptors: *Monitoring, *Great Lakes, *Regional analysis, Lakes, Water quality, Water temperature, Chlorides, Nutrients, Lake Superior, Lake Huron, Sampling, *Eutrophication, International Joint Commission.

Lake Superior, Lake Huron, and the Georgian Bay-North Channel were divided into regions using a regression model developed by El-Shaarawi and Kwiatkowski (1977). Water quality parameters considered were: chloride, temperature, nitrate-nitrite, silica, total P, and chlorophyll a. The zones obtained in this study were similar to those proposed by the International Joint Commission for Lake Huron and the North Channel-Georgian Bay. However, results for Lake Superior indicate fewer zones than previously designated. Water temperature and chloride (from road salt) appeared to be the most reliable parameters for delineating zones. Inputs and currents were important factors in the size and shape of the regions. These studies are a step toward establishing a cost effective surveillance program for the Great Lakes by reducing the frequency of whole-lake surveys. (Cassar-FRC)
W82-01150

NEARSHORE SPATIAL DISTRIBUTION OF FISHES IN GILL NET SAMPLES, CAYUGA LAKE, NEW YORK,
Department of Energy, Pittsburgh, PA. Pittsburgh Energy Technology Center.
M. D. Dahlberg.
Journal of Great Lakes Research, Vol 7, No 1, p 7-14, 1981. 5 Fig, 1 Tab, 14 Ref.

Descriptors: *Fish populations, *Spatial distribution, Lakes, Seasonal variation, *Cayuga Lake, *New York, Temperature effects, Distribution, Trout, Northern pike, Bass, White sucker, Alewife, Yellow perch, Carp.

Nylon gill nets were set for 24 hr at monthly intervals at a proposed sampling site at Cayuga Station during December 1975 through December 1976. Gill nets were set on the bottom, and at the surface, middle and bottom layers. Water temperature during testing ranged from about 2 to about 22 degrees C at the surface, and from 2 to 13.6 degrees C at the 100 ft depth. Dissolved oxygen was at or near saturation in all weekly observations. The findings indicated that temperature was the most important factor in controlling the depth distribution of fish in Lake Cayuga. Warmwater species such as alewife, northern pike, spottail shiner, trout-perch and yellow perch concentrated in inshore and surface waters during the summer. Coldwater species such as rainbow smelt and lake trout concentrated in hypolimnetic waters during the summer. A limited number of Atlantic salmon were captured, at a maximum temperature of 13.9 degrees C. A direct relationship was noted between catch size and water temperature for yellow perch, alewife, and three other species which were captured in small numbers. The effect of water temperature on fish activity appears to be the primary factor in the seasonal vulnerability to the passive netting, at least for those species which are present year round in this study area. (Baker-FRC)
W82-01195

LIMNETIC LARVAL FISH OF THE MAUMEE AND SANDUSKY RIVER ESTUARIES,
Ohio State Univ., Put-in-Bay. Center for Lake Erie Area Research.
C. L. Cooper, W. C. Bartholomew, C. E. Herdendorf, J. M. Reutter, and F. L. Snyder.
Journal of Great Lakes Research, Vol 7, No 1, p 51-54, 1981. 2 Tab, 13 Ref.

Descriptors: *Estuaries, *Fish populations, Rivers, *Maumee River, *Sandusky River, Fish, Lake Erie basin, *Ohio.

A series of studies conducted in the Maumee River and Sandusky River estuaries on Lake Erie between 1975 and 1977 is summarized. The Maumee River study area encompassed a 14 sq km zone extending from the river mouth to the riffles above the head the estuary at Perrysburg, Ohio. The Sandusky River study area encompassed a 2 sq km zone extending from the river mouth at the head of Sandusky Bay to the upper limit of the estuary at the Fremont, Ohio, riffle, a distance of 24.9 km. Collections were made during daylight hours with conventional plankton nets. A limited number of samples were taken at night. A total of 17 taxa of larval fish was reported from the Maumee River estuary oer the three year sampling period. Greater carp larvae densities were indicated in the littoral areas and may have resulted in an overall underestimate of their abundance in the study areas. During periods of high densities, more larval gizzard shad and white bass were found in sheltered low flow portions than in the mid-channel portion of the midestuary sampling location. The predominant number of rainbow smelt and yellow perch larvae were collected at the Maumee River mouth location. Only limited numbers were collected farther upstream, and neither species was collected in the Sandusky River estuary. The study indicated a patchy, or nonrandom, distribution of walleye eggs, while larvae were randomly distrib-

uted. Overall, larval walleye densities decreased from relatively high densities upstream to relatively low densities downstream. (Baker-FRC)
W82-01197

REGIONAL FLOOD FREQUENCY ESTIMATION AND NETWORK DESIGN,
Princeton Univ., NJ. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W82-01294

WATER-QUALITY MONITORING: A GLOBAL APPROACH,
United Nations Environment Program, Geneva (Switzerland). Regional Seas Programme Activity Center.
R. Helmer.
Nature and Resources, Vol 17, No 1, p 7-13, January-March, 1981. 2 Fig.

Descriptors: *Monitoring, *Water analysis, *Global Environmental Monitoring System, Water quality, World Health Organization, International commissions, Water pollution, Network design.

The Global Environmental Monitoring System includes a World Health Organization project on Global Water Quality Monitoring (GEMS/WATER) established in 1976 with the following purposes: to strengthen existing water monitoring systems and establish new ones, to define and improve the validity and comparability of water quality data within and among member states, and to assess the incidence and long term trends of water pollution by certain persistent, hazardous substances. The ultimate goal is 1200 monitoring stations. To date, 388 have been identified in 62 countries: 227 on rivers, 74 on lakes, and 87 in aquifers. Data is routinely produced from 87 of the 236 recently-activated stations. Three categories of parameters have been established: basic (pH, dissolved oxygen, etc.), optional (total organic carbon, phytoplankton, etc.), and globally significant (heavy metals, pesticides, etc.). A concern for the immediate future is analytical quality control. (Cassar-FRC)
W82-01339

IMMEDIATE DETECTION OF HETEROGENEITIES IN CONTINUOUS MULTIVARIATE, OCEANOGRAPHIC RECORDINGS. APPLICATION TO TIME SERIES ANALYSIS OF CHANGES IN THE BAY OF VILLEFRANCHE SUR MER,
Biochimie Marine, Villefranche-sur-Mer (France). Station Zoologique.
F. Ibanez.
Limnology and Oceanography, Vol 26, No 2, p 336-349, March, 1981. 11 Fig, 3 Tab, 16 Ref.

Descriptors: *Sampling, *Multivariate analysis, *Heterogeneity, Time series analysis, Oceanography, Salinity, Monitoring, Water quality, Villefranche sur Mer, France, *Marine environment.

This paper presents an index that can be used in water sampling aboard ship to immediately detect discontinuities in continuously monitored, multivariate recordings of many physical and chemical variables. At every sampling point, the generalized distance is computed between the new multivariate observation and the centroid of the n previously recorded observations. These n points form a window, whose width determines the sensitivity of the index. By its mathematical formulation the distance takes into account the variations in range of the variables and their correlations. The validity of the index was first tested on simulated series into which different types of changes were arbitrarily introduced. The index is applied to a 4-year temperature and salinity series of weekly observations at a station in the bay of Villefranche sur Mer, France. (Cassar-FRC)
W82-01393

MAPPING CONTAMINATED SOIL PLUMES BY KRIGING,
Resources Management Associates, Lafayette, CA.
For primary bibliographic entry see Field 5G.
W82-01423

METHODS FOR GENERATING ALTERNATIVE SOLUTIONS TO WATER RESOURCES PLANNING PROBLEMS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W82-01449

GENERATING ALTERNATIVE SOLUTIONS FOR DYNAMIC PROGRAMMING MODELS OF WATER RESOURCES PROBLEMS,
Illinois Univ. at Urbana-Champaign. Dept. of Landscape Architecture.
For primary bibliographic entry see Field 6A.
W82-01450

A ONE-DIMENSIONAL, FINITE ELEMENT SALT WATER INTRUSION MODEL,
Guam Univ., Agana. Water Resources Research Center.
D. N. Contractor.
Technical Report No 20, February, 1981. 20 p, 9 Fig, 10 Ref, 4 Append.

Descriptors: *Coastal aquifers, *Model studies, Mathematical models, Computer models, *Aquifer management, Seawater, Fortran, Saline water, Aquifer characteristics, Model testing, Prediction, Computers, Computer programs, Saline water intrusion.

Groundwater resources near the coastline and on islands should be managed in such a way that salt water intrusion into an aquifer does not jeopardize the quality of the water resource. Management of the salt water intrusion includes knowing the location of the wedge and predicting its response to changes in aquifer recharge and pumpage so that its future location can be controlled. A model is needed to make these predictions. The model may be analytical in nature for simple geometries, or numerical for more complicated aquifers. This report describes a one-dimensional, finite element salt water intrusion model, which can be very useful in understanding local features of an extensive aquifer system. A one-dimensional model can be an appropriate tool when first-cut results are necessary in a limited time. Two-dimensional models can be used to provide one-dimensional results, but only by using twice the number of nodes used in a one-dimensional model. Two-dimensional models should be used whenever the necessary data, computer facilities, and budget are available. A one-dimensional model's advantages are its simplicity, low cost of data aquisition, low computer time, and low total cost, as well as its versatility. Confined and unconfined aquifers can be handled, and time-dependent situations can be taken into account. In addition, non-homogeneities can be specified in the longitudinal direction. The computer program was written in Fortran. The nodes are numbered consecutively from left to right and the elements are numbered so that they are the same as the node number at the left-hand end of the element. A pump can be located at any node in the system. (Garrison-Omniplan)
W82-01452

COMPATIBILITY OF CANADIAN SNOWFALL AND SNOW COVER DATA,
Atmospheric Environment Service, Downsview (Ontario).
For primary bibliographic entry see Field 2C.
W82-01466

7B. Data Acquisition

FIXED ENDPOINT ALKALINITY DETERMINATION,
California Univ., Berkeley, Sanitary Engineering Research Lab.
F. Pearson.
Journal of the Water Pollution Control Federation, Vol 53, No 7, p 1243-1252, July, 1981. 4 Fig, 3 Tab, 7 Ref.

Descriptors: *Water analysis, *Alkalinity, *Acidity, Chemical properties, Chemical analysis, Volumetric analysis, Water quality, Laboratory tests, Analytical techniques, *Hydrogen ion concentration.

A theoretically developed procedure for alkalinity determination is proposed which offers the advantage over existing methods of requiring less analytical manipulation of the sample when both alkalinity and acidity are to be determined. It also has the ability to take into account the contribution to alkalinity and/or acidity by noncarbonate weak electrolytes which cannot be accomplished by existing methods without determining the entire titration curve. The theoretical development of the procedure is presented, and examples are given of the use of the first two equations. Also, experiments to test the validity of the procedure are summarized. Titrations to pH 4.5 and 8.3 can be used to calculate alkalinity and acidity values to equivalence endpoints. Manual titrations are performed rapidly, and automated determination of alkalinity or acidity is feasible with the new system. The validity of the procedure was confirmed for a limited range of conditions, and anomalous results were found to occur in some waters such as those of high ionic strength. More verification testing is required before the procedure can be adopted unequivocally for an unknown water type. (Small-FRC)
W82-01187

EFFECT OF GRAIN SIZE AND SNOWPACK WATER EQUIVALENCE ON VISIBLE AND NEAR-INFRARED SATELLITE OBSERVATIONS OF SNOW,
California Univ., Santa Barbara. Dept. of Geography.
J. Dozier, S. R. Schneider, and D. F. McGinnis, Jr.
Water Resources Research, Vol 17, No 4, p 1213-1221, August, 1981. 10 Fig, 1 Tab, 24 Ref.

Descriptors: *Snow cover, *Albedo, *Satellite technology, Remote sensing, Snow surveys, Water content, *Snowmelt, Snow water equivalence, Particle size, Snowpack, Wavelengths.

A model for spectral snow albedo by Wiscombe and Warren shows that visible reflectance is sensitive to snow water equivalence and contamination by aerosols, but near-infrared reflectance is sensitive to grain size and not to other variables. Therefore, satellite radiometric data can be used to infer snow water equivalence and snow grain size. When grain size is large (500-1000 micrometers), visible wavelengths may also estimate snow water equivalence. The TIROS-N series satellites' infrared channel is not in the range most sensitive to grain size. A shift of channel near infrared wavelengths from 0.7-1.0 micrometers to 1.0-1.2 micrometers would improve sensitivity to grain size and decrease sensitivity to snow water equivalence. Satellite data collected on April 12, and 27, 1980, over Lake Winnipeg, Manitoba, and over 3 lakes in central Saskatchewan were compared with ground observations at these locations. (Cassar-FRC)
W82-01311

AUTOMATIC CLASS-A PAN-FILLING SYSTEM,
Science and Education Administration, Boise, ID. Northwest Watershed Research Center.
M. D. Burgess, and C. L. Hanson.
Journal of Hydrology, Vol 50, No 1-3, p 389-392, March, 1981. 1 Fig, 1 Tab.

Descriptors: *Evaporation pans, *Control systems, *Automation, Pan evaporation, Electrical equipment, Evaporation rate.

The National Weather Service Class-A pan is the standard evaporation measuring device in the United States and several other countries. A low-cost battery-operated system to automatically fill Class A evaporation pans from stored water was developed using integrated circuit technology. The system is suitable for use in remote areas where batteries are used for power to maintain the water level between 5.08 and 7.62 cm below the top of the pan. Trials at four locations near Boise, Idaho, in 1979 revealed no electronics or battery prob-

lems. The system can operate for 6 months on a 20-A-hour low self-discharge battery. (Cassar-FRC)
W82-01326

SITES OF RIVER-DERIVED SEDIMENTATION IN THE OCEAN,
Delaware Univ., Newark. Coll. of Marine Studies.
R. J. Gibbs.
Geology, Vol 9, No 2, p 77-80, February, 1981. 3 Fig, 1 Tab, 11 Ref.

Descriptors: *Sediment deposition, *Rivers, *Remote sensing, Mississippi River, Colorado River, Delaware Bay, Chesapeake Bay, Deltas, Sea level, Alluvial fans, Amazon River.

Landsat satellite imagery (Band 4) was used to identify the seaward boundary of turbid waters for 22 of the world's large rivers. At the Amazon River mouth, surface water samples for suspended matter analysis were collected at the time the imagery was made. It was concluded that rivers are depositing suspended sediments on the shelf areas or in estuaries, not on the vast submarine fans created during a lower sea level era. Assuming no changes in the present rates of sediment deposition, the calculated times to fill the present sediment areas range from 2630-3406 years for the Ganges-Brahmaputra system to 936,000 - 1.2 million for the Yenisei-Ob system. The higher values account for compaction and subsidence. Values for some U. S. rivers were (in years): Mississippi, 79,242-102,619; Colorado, 8,515-11,027; Delaware Bay, 80,772-104,600; Chesapeake Bay, 109-963-142,403; and the Delaware Shelf, which includes the Chesapeake and Delaware Bays, 464,538-601,577. Only the Ganges, Yellow, and Indus Rivers are likely to fill their shelves before significant sea level changes occur. (Cassar-FRC)
W82-01332

AN ALL-TEFLON BAILER AND AN AIR-DRIVEN PUMP FOR EVACUATING SMALL-DIAMETER GROUND-WATER WELLS,
Camp, Dresser and McKee, Inc., Milwaukee, WI. Environmental Sciences Div.
D. F. Buss, and K. E. Bandt.
Ground Water, Vol 19, No 4, p 429-431, July/August, 1981. 1 Fig, 3 Ref.

Descriptors: *Well data, *Water sampling, *Pumps, Sampling, Groundwater, Monitoring, Water quality, Small-diameter wells.

Sampling of small diameter wells (2 inches) was facilitated by use of an all-teflon bailer and an air-driven pump with a teflon ball. This apparatus, which can purge 18.5 liters from a 2 inch diameter well in 6-8 minutes (vs. raising and lowering a 0.5 liter conventional bailer 37 times), minimizes contamination of the sample and is very easy to disassemble and clean. The pump was effective to 100 ft, the greatest depth tested. Construction materials, readily available from hardware and plastic piping supply stores, cost less than $25, excluding the tygon tubing. (Cassar-FRC)
W82-01333

REMOTE SENSING OF SOIL MOISTURE CONTENT OVER BARE FIELD AT 1.4 GHZ FREQUENCY,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
J. R. Wang, and B. J. Choudhury.
Journal of Geophysical Research, Vol 86, No C6, p 5277-5282, June, 1981. 6 Fig, 18 Ref.

Descriptors: *Soil moisture, *Microwaves, *Radiometery, Model studies, Moisture content, *Remote sensing.

An algorithm for estimating moisture content of a bare soil from the observed brightness temperatures at 1.4 GHz is based on a radiative transfer model calculation (Wilheit, 1978). Some modifications are made to account for the effects of surface roughness. Besides the brightness temperatures, additional inputs required are effective soil thermodynamic temperature, precise relation between moisture content and the smooth field brightness temperature, and two parameters related to surface roughness. The algorithm is applied to two series of radiometer observations, truck mounted and airborne. The estimated moisture contents compare favorably to those observed in the top 2 cm layer of soil. (Cassar-FRC)
W82-01345

WATER FROST AND ICE: THE NEAR-INFRARED SPECTRAL REFLECTANCE 0.65-2.5 MICRONS,
Hawaii Univ., Honolulu. Inst. for Astronomy.
For primary bibliographic entry see Field 2C.
W82-01346

MULTIFREQUENCY RADIOMETER DETECTION OF SUBMARINE FRESHWATER SOURCES ALONG THE PUERTO RICAN COASTLINE,
National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
For primary bibliographic entry see Field 3B.
W82-01349

SITE ASSESSMENT: IMPROVING CONFIDENCE LEVELS WITH SURFACE REMOTE SENSING,
Technos Inc., Miami, Florida.
For primary bibliographic entry see Field 5G.
W82-01422

THE INFERENCE OF GATE CONVECTIVE RAINFALL FROM SMS-1 IMAGERY,
National Hurricane and Experimental Meteorology Lab., Coral Gables, FL.
W. L. Woodley, C. G. Griffith, J. S. Griffin, and S. C. Stromatt.
Journal of Applied Meteorology, Vol 19, No 4, p 388-408, April, 1980. 19 Fig, 7 Tab, 7 Ref.

Descriptors: *Rainfall distribution, *Remote sensing, *Satellite technology, Measuring instruments, Diurnal distribution, Temperature effects, Precipitation, Rainfall area, Rainstorms, *Atlantic Ocean, *Africa.

An automated technique making use of geosynchronous, infrared satellite imagery and a set of empirical relationships has been employed to estimate rainfall in the eastern Atlantic and western Africa during the Global Atmospheric Research Program's Atlantic Tropical Experiment (GATE). The satellite-derived rain estimates are low for the Atlantic and high for Africa when compared with radar and raingage estimates of precipitation. The daily satellite-derived maps of rainfall were generally similar to the radar products, but have lower point maxima. This difference is primarily caused by the method of rainfall apportionment and secondarily by the differences in resolution of the radar and satellite. Based on satellite-derived rain estimates, the rainfall in the eastern Atlantic appears to be of lesser magnitude, but about equal in coverage to the western Pacific. Most of the significant convective activity occurs in the Intertropical Convergence Zone (ITCZ), stretching west-southwest from Africa. Rain maxima showed a close association with the sea surface temperature. A disproportionate amount of rainfall occurs over the water areas during the day and over the land areas during the late evening. The diurnal rainfall studies suggest a midday maximum of rainfall over the water areas and a late evening maximum over Africa and the northern part of South America. The center of action for cloud formation, merger and dissipation, and the area of maximum rainfall occur along the southwest African coast near 11 degrees N. (Baker-FRC)
W82-01519

ICE NUCLEUS CONCENTRATIONS MEASURED DURING THE 1975 FLORIDA AREA CUMULUS EXPERIMENT (FACE),
MITRE Corp., McLean, VA.
J. Wisniewski, and G. Langer.
Journal of Applied Meteorology, Vol 19, No 6, p 676-682, June, 1980. 5 Fig, 16 Ref.

Descriptors: *Ice, *Cloud seeding, Weather modification, Artificial precipitation, Tropical regions, Florida, Measuring instruments, Remote sensing, Nucleation.

Ice nuclei concentrations over Florida were obtained by two techniques. First, about 390 membrane samples were collected using a sequential membrane filter system. The second method called for continuous ice nuclei concentrations to be obtained by the NCAR acoustical ice nucleus counter. The technique using collection membranes gave concentrations of ice nuclei about two orders of magnitude lower than those obtained by the NCAR acoustical counter, with both sets of samples obtained at identical time periods. It is recommended that the membrane technique should not be used alone in maritime studies. The ice nuclei concentrations obtained with the NCAR acoustical counter were shown to naturally increase by a factor of 2 to 3 during the course of normal afternoon convective activity; these factors are reasonable compared to observed glacation. These increases are probably due to turbulence within the storm areas stirring up soil particles from the ground and increasing ice nuclei concentrations or to ice nuclei being released by evaporation of small precipitation particles between the cloud base and the surface or in the downdraft. In certain cloud seeding experiments, these natural ice nuclei increases may make seeding less effective. It is suggested that a spectrum of ice nuclei concentrations be obtained to measure nucleation activities at several specified temperatures. This can be achieved by varying the cloud chamber temperature and glycol gravity of the NCAR counter. (Baker-FRC)
W82-01522

AN IMPROVED METHOD FOR OBTAINING THE WATER CONTENT VALUES OF ICE HYDROMETEORS FROM AIRCRAFT AND RADAR DATA,
Air Force Geophysics Lab., Hanscom AFB, MA.
V. G. Plank, R. O. Berthel, and A. A. Barnes, Jr.
Journal of Applied Meteorology, Vol 19, No 11, p 1293-1299, November, 1980. 5 Fig, 3 Ref.

Descriptors: *Snow, Rain, *Hydrometeorology, *Meteorological data collection, Data collections, *Ice, Clouds, Precipitation, Aircraft, Radar, Weather forecasting, *Water content.

The spectral parameter k (equal to M divided by the square root of Z) computed from aircraft size distribution for single samples of ice hydrometeors (snow and ice crystals) is a much more stable parameter, under L (physical size) and D (equivalent melted diameter) conversion assumption, than is either spectral M (spectral liquid water content) or spectral Z (spectral radar reflectivity factor). Using k rather than Z sub R, more accuracy is possible in correlating multiple-sample aircraft data with simultaneously acquired, independent radar measurements of A and Z sub R. Spectral k is also useful as a reference parameter to differentiate between cloud conditions on different days or between different clouds, and applies also to water hydrometeors (rain). The k value appears to be primarily dependent on total number of hydrometeors and secondarily dependent on the form factor of the distribution (most observed distributions being quasi-exponential). (Cassar-FRC)
W82-01523

A BALLOONBORNE INSTRUMENT FOR THE MEASUREMENT OF VERTICAL PROFILES OF SUPERCOOLED LIQUID WATER CONCENTRATION,
Utah Water Research Lab., Logan.
G. E. Hill, and D. S. Woffinden.
Journal of Applied Meteorology, Vol 19, No 11, p 1285-1292, November, 1980. 8 Fig, 1 Tab, 8 Ref.

Descriptors: *Clouds, *Supercooling, *Remote sensing, Measuring instruments, *Water content.

Vertical profiles of the concentration of supercooled liquid water in clouds were measured by a vibrating wire placed in the humidity duct of a standard U.S. rawinsonde. As ice collects on the

wire, the natural frequency of vibration varies. The supercooled water concentrations are obtained from this wire frequency measurement and the air velocity relative to the instrument. Vibration frequency may be monitored on the ground for remote readings. Calibration of the frequency change vs. ice mass accumulation is done both theoretically and experimentally in a wind tunnel in the presence of supercooled water. For further verification, paint sprayed on the upwind side of the wire was used to simulate ice mass. The method is illustrated by a description of sounding at 0010 GMT February 8, 1980, in a stratocumulus deck above Richmond, Utah. In this case the cloud thickness was estimated at 350 meters with a 409 meter maximum. The supercooled liquid water concentration was 0.1 g per cu meter. This method is well suited for studies of winter orographic clouds. (Cassar-FRC)
W82-01524

EXPERIMENTAL VERIFICATION OF THE LINEAR RELATIONSHIP BETWEEN IR EXTINCTION AND LIQUID WATER CONTENT OF CLOUDS,
Nevada Univ. System, Reno. Desert Research Inst.
A. W. Gertler, and R. L. Steele.
Journal of Applied Meteorology, Vol 19, No 11, p 1314-1317, November, 1980. 3 Fig, 6 Ref.

Descriptors: *Clouds, *Remote sensing, *Lasers, Fog, Meteorological data collection, *Water content.

A CO2 laser extinction transmissometer was used to measure the IR extinction of clouds and fogs. Using an established linear relationship (based on the Chylek approximation to the Mie theory) between extinction and liquid water content, the liquid water content of clouds of varying droplet size (2.3-8.7 micrometers) and concentrations (up to 3 g per cu meter) have been determined. The values agreed well (correlation coefficient 0.98) with liquid water contents derived from a simultaneous cloud collection. There was little difference between monodisperse and polydisperse droplets. This method is adaptable for airborne measurements. (Cassar-FRC)
W82-01525

A COMPARISON OF TWO SATELLITE RAINFALL ESTIMATES FOR GATE,
Hawaii Univ., Honolulu. Joint Inst. for Marine and Atmospheric Research.
O. Garcia.
Journal of Applied Meteorology, Vol 20, No 4, p 430-438, April, 1981. 11 Fig, 4 Tab, 6 Ref.

Descriptors: *Rainfall, *Remote sensing, *Satellite technology, Precipitation, Sensors, Estimating, Tropical regions, Africa, Comparison studies.

Rainfall estimate comparisons derived from two satellite rainfall estimation techniques for the GATE experiment are made. One technique, the Kilonsky-Ramage technique, uses polar orbiting satellites for 1 degree resolution rainfall estimates over the tropics. The second technique used, the Griffith-Woodley technique, uses geostationary satellite data to generate much higher resolution estimates. The two techniques showed good correspondence between the A scale isohyetal patterns and rainfall volumes estimated for periods ranging from 1 to 80 days. Over African and nearby ocean areas the largest discrepancies were noted. In these cases the Griffith-Woodley estimates were higher. When only oceanic points are compared, correlation coefficients between the two estimates are higher, ranging up to 0.92 for the entire GATE period. Including continental areas of the A scale brings about a lowering of the correlation coefficients, reaching 0.66 for phase 2. Large discrepancies over Africa and oceanic areas are associated with a nocturnal peak of rainfall not detected by the daytime passes of the polar orbiting satellite used in the Kilonsky-Ramage calculations. It is concluded that the Kilonsky-Ramage technique can provide a low cost and fairly reliable estimate of monthly rainfall over the tropical oceans. This technique can also identify on a daily basis areas of significant rainfall and can estimate daily rainfall volumes over large areas. (Baker-FRC)
W82-01533

DETERMINATION OF MOISTURE FROM NOAA POLAR ORBITING SATELLITE SOUNDING RADIANCES,
National Earth Satellite Service, Washington, DC.
For primary bibliographic entry see Field 2B.
W82-01535

APPLICATION OF AERIAL PHOTOGRAPHS AND SURFICIAL GEOLOGIC MAPS TO THE DETERMINATION OF SUITABILITY OF LAND FOR SEPTIC TANK SYSTEMS,
Federal Energy Regulatory Commission, Washington, DC.
S. D. Connors.
Bulletin of the Association of Engineering Geologists, Vol 17, No 3, p 153-162, Summer, 1980. 3 Fig, 2 Tab.

Descriptors: *Septic tanks, *Aerial photography, Wastewater treatment, Permeability, Bedrock, Water table, Geological formations, Photography, Glacial sediments, Remote sensing, Planning, Wyoming County, New York.

Aerial photographs, surficial geology, grain size analysis and permeability tests were used to determine the suitability of the area around the town of Arcade, Wyoming County, New York for septic tank systems. Based on topography and type of surficial deposits, the study area can be divided into three regions readily discernible on aerial photographs and topographic maps. These are: upland till area, wide valley areas and areas of glacial outwash deposits, and an undulating, hilly morainal area. Bedrock underlying the town of Arcade consists of Upper Devonian gray to black shales, gray siltstones and brown sandstone. Surficial deposits in the area consist of glacial till, outwash, ice contact deposits, lake deposits and recent alluvium. Four soil associations, based on the parent glacial material, are recognized in the town of Arcade. These are: Erie-Landford, developed on glacial till; Bath-Valois and Howard-Madrid, developed on contrasting glacial deposits; and Chenango-Howard-Castile, developed on glacial outwash deposits. Septic tank fields in the first association need careful design due to slow permeability, seasonal high water table and shallow depth to bedrock. The Chenango-Howard-Castile soils tend to provide good septic tank fields. Use of the Bath-Valois and Howard-Madrid associations requires careful investigation due to the extreme variability of physical properties within short distances and with depth. Laboratory testing indicated that soils in the town of Arcade were generally unsuited for septic tank systems. The best suited area occurs in the village of Arcade, which has a sewer system. The upland till area is considered the least favorable area. (Baker-FRC)
W82-01569

7C. Evaluation, Processing and Publication

ABUNDANCE OF ORGANIC COMPOUNDS IN WATER,
Illinois Environmental Protection Agency, Springfield.
For primary bibliographic entry see Field 5A.
W82-01162

WATER RESOURCES DATA FOR TEXAS, WATER YEAR 1980--VOLUME 1. ARKANSAS RIVER BASIN, RED RIVER BASIN, SABINE RIVER BASIN, NECHES RIVER BASIN, TRINITY RIVER BASIN AND INTERVENING COASTAL BASINS.
Geological Survey, Austin, TX. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-123670, Price codes: A99 ($42.00) in paper copy, A01 in microfiche. Geological Survey Water-Data Report TX-80-1, 1981. 595 p, 1 Fig.

Descriptors: *Hydrologic data, *Surface water, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Data collections, Sites, *Texas, Arkansas River basin, Red River basin, Sabine River basin, Neches River basin, Trinity River basin.

Surface-water data for the 1980 water year for Texas are presented in three volumes, appropriately identified as to content by river basins. Data in each volume consist of records of stage, discharge, and water quality of streams and canals; and stage, contents, and water quality of lakes and reservoirs. Also included are crest-stage and flood-hydrograph partial-record stations, reconnaissance partial-record stations, and low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering States are also included. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Texas. (USGS)
W82-01201

WATER RESOURCES DATA FOR TEXAS, WATER YEAR 1980--VOLUME 2. SAN JACINTO RIVER BASIN, BRAZOS RIVER BASIN, SAN BERNARD RIVER BASIN AND INTERVENING COASTAL BASINS.
Geological Survey, Austin, TX. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-123464, Price codes: A21 in paper copy, A01 in microfiche. Geological Survey Water-Data Report TX-80-2, 1981. 472 p, 1 Fig.

Descriptors: *Hydrologic data, *Surface water, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Data collections, Sites, *Texas, San Jacinto River basin, Brazos River basin, San Bernard River basin.

Surface-water data for the 1980 water year for Texas are presented in three volumes, appropriately identified as to content by river basins. Data in each volume consist of records of stage, discharge, and water quality of streams and canals; and stage, contents, and water quality of lakes and reservoirs. Also included are crest-stage and flood-hydrograph partial-record stations, reconnaissance partial-record stations, and low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering States are also included. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Texas. (USGS)
W82-01202

WATER RESOURCES DATA FOR TEXAS, WATER YEAR 1980--VOLUME 3. COLORADO RIVER BASIN, LAVACA RIVER BASIN, GUADALUPE RIVER BASIN, NUECES RIVER BASIN, RIO GRANDE BASIN AND INTERVENING COASTAL BASINS.
Geological Survey, Austin, TX. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-123472, Price codes: A25 in paper copy, A01 in microfiche. Geological Survey, Water-Data Report TX-80-3, 1981. 583 p, 1 Fig.

Descriptors: *Hydrologic data, *Surface water, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Data collections, Sites, *Texas, Colorado River basin, Lavaca River basin, Guadalupe River basin, Nueces River basin, Rio Grande basin.

Surface-water data for the 1980 water year for Texas are presented in three volumes, appropriately identified as to content by river basins. Data in each volume consist of records of stage, discharge, and water quality of streams and canals; and stage, contents, and water quality of lakes and reservoirs. Also included are crest-stage and flood-hydrograph partial-record stations, reconnaissance partial-record stations, and low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering States are also included. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Texas. (USGS)
W82-01203

WATER RESOURCES DATA FOR CALIFORNIA, WATER YEAR 1980--VOLUME 1. COLORADO RIVER BASIN, SOUTHERN GREAT BASIN FROM MEXICAN BORDER TO MONO LAKE BASIN, AND PACIFIC SLOPE BASINS FROM TIJUANA RIVER TO SANTA MARIA RIVER.
Geological Survey, Menlo Park, CA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-116997, Price codes: A20 in paper copy, A01 in microfiche. Geological Survey Water-Data Report CA-80-1, 1981. 451 p, 5 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *California, Colorado River basin, Southern Great Basin, Pacific slope basins.

Volume 1 of water resources data for the 1980 water year for California consists of records of stage, discharge, and water quality of streams; stage and contents in lake and reservoirs; and water levels in wells. This report contains discharge records for 174 gaging stations, stage and contents for 18 lakes and reservoirs, water quality for 51 stations and water levels for 165 observation wells. Also included are 9 crest-stage partial-record stations. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in California. (USGS)
W82-01204

WATER RESOURCES DATA FOR CALIFORNIA, WATER YEAR 1980--VOLUME 2. PACIFIC SLOPE BASINS FROM ARROYO GRANDE TO OREGON STATE LINE EXCEPT CENTRAL VALLEY.
Geological Survey, Menlo Park, CA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-122243, Price codes: A23 in paper copy, A01 in microfiche. Geological Survey Water-Data Report CA-80-2, 1981. 521 p, 3 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes Reservoir, Wells, Water level, Data collections, Sites, *California, Pacific slope basins.

Volume 2 of water resources data for the 1980 water year for California consists of records of stage, discharge, and water quality of streams and wells; stage, contents, and water quality in lakes and reservoirs; and water levels in wells. This report contains discharge records for 159 gaging stations, stage and contents for 19 lakes and reservoirs, water quality for 116 stations and 32 wells, and water levels for 85 observation wells. Also included are 4 crest-stage partial-record stations and 3 low-flow partial-record stations. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in California. (USGS)
W82-01205

WATER RESOURCES DATA FOR CALIFORNIA, WATER YEAR 1980--VOLUME 3. SOUTHERN CENTRAL VALLEY BASINS AND THE GREAT BASIN FROM WALKER RIVER TO TRUCKEE RIVER.
Geological Survey, Menlo Park, CA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-117003, Price codes: A19 in paper copy, A01 in microfiche. Geological Survey Water-Data Report CA-80-3, 1981. 429 p, 12 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *California, Southern central valley basins, The Great Basin.

Volume 3 of water resources data for the 1980 water year for California consists of records of stage, discharge, gage-height, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; water levels and water quality of wells. This report contains discharge records for 185 gaging stations, stage and contents for 39 lakes and reservoirs, gage-height records for 2 lakes, water quality for 62 stations, and water levels for 56 observation wells. Also included are 11 crest-stage partial-record stations and one water-quality partial-record station. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in California. (USGS)
W82-01206

WATER RESOURCES DATA FOR CALIFORNIA, WATER YEAR 1980--VOLUME 4. NORTHERN CENTRAL VALLEY BASINS AND THE GREAT BASIN FROM HONEY LAKE BASIN TO OREGON STATE LINE.
Geological Survey, Menlo Park, CA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-117011, Price codes: A20 in paper copy, A01 in microfiche. Geological Survey Water-Data Report CA-80-4, 1981. 451 p, 12 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *California, Northern central valley basins, The Great Basin, Sacramento River basin.

Volume 4 of the water resources data for the 1980 water year for California consists of records of stage, discharge, and water quality of streams; stage, contents, and water quality in lakes and reservoirs; and water levels in wells. This report contains discharge records for 199 gaging stations, stage and contents for 34 lakes and reservoirs, precipitation data for stations, water quality for stations, water levels for 54 observation wells and water quality for 26 wells. Also included are 16 crest-stage partial-record stations and 7 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as special investigations. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in California. (USGS)
W82-01207

WATER RESOURCES DATA FOR HAWAII AND OTHER PACIFIC AREAS, WATER YEAR 1980 - VOLUME 1. HAWAII.
Geological Survey, Honolulu, HI. Water Resources Div.
Geological Survey Water-Data Report HI-80-1, 1981. 270 p, 15 Fig, 1 Tab.

Descriptors: *Hydrologic data, *Surface water, Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Hawaii.

Volume 1 of water resources data for the 1980 water year for Hawaii and other Pacific areas consist of records of stage, discharge, and water quality of streams; and water levels and water quality in wells and springs. This report contains discharge records for 109 gaging stations; water quality for 10 gaging stations, 103 partial-record flow stations, and 156 wells; and water levels for 22 observation wells. Also included are 109 crest-stage partial-record stations and 19 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, Federal, and other agencies in Hawaii. (USGS)
W82-01208

WATER RESOURCES DATA FOR HAWAII AND OTHER PACIFIC AREAS, WATER YEAR 1980 - VOLUME 2. TRUST TERRITORY OF THE PACIFIC ISLANDS, GUAM, AMERICAN SAMOA, AND NORTHERN MARIANA ISLANDS.
Geological Survey, Honolulu, HI. Water Resources Div.
Geological Survey Water-Data Report HI-80-2, 1981. 158 p, 16 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Hawaii, Mariana Islands, Carolina Islands, Samoa Islands.

Volume 2 of water resources data for the 1980 water year for other Pacific areas consist of records of stage, discharge, and water quality of streams; stage of a reservoir; and water levels in wells and springs. This report contains discharge records for 41 gaging stations, stage only record for 1 gaging station, water quality for 1 gaging station and 49 partial-record stations, water temperature for 23 gaging stations, water levels for 13 observation wells, tide level for 1 tide station, and 7 water level less tide level tables. Also included are 33 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating Governments and Federal agencies in other Pacific areas. (USGS)
W82-01209

WATER RESOURCES DATA FOR SOUTH CAROLINA, WATER YEAR 1980.
Geological Survey, Columbia, SC. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-127127, Price codes: A15 in paper copy, A01 in microfiche. Geological Survey Water-Data Report SC-80-1, 1981. 319 p, 5 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *South Carolina.

Water resources data for the 1980 water year for South Carolina consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels in wells. This report contains discharge records for 74 gaging stations, stage-only records for 10 gaging stations, stage and contents

for 11 lakes and reservoirs, water quality for 33 gaging stations, and water levels for 45 observation wells. Also included are 41 crest-stage partial-record stations. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in South Carolina. (USGS)
W82-01211

WATER RESOURCES DATA FOR PENNSYLVANIA, WATER YEAR 1980--VOLUME 2. SUSQUEHANNA AND POTOMAC RIVER BASINS.
Geological Survey, Harrisburg, PA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-115908, Price codes: A16 in paper copy, A01 in microfiche. Geological Survey Water-Data Report PA-80-2, 1981. 353 p, 7 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Pennsylvania, Susquehanna River basin, Potomac River basin.

Water resources data for the 1980 water year for Pennsylvania consist of records of discharge and water quality of streams; contents of lakes and reservoirs; and water levels of ground-water wells. This volume contains records for water discharge at 100 stations, contents at 13 lakes and reservoirs, water quality at 35 gaging stations, and water levels at 25 observation wells. Also included are data for 21 crest-stage, 15 low-flow, and 129 water-quality partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analysis. These data together with the data in Volumes 1 and 3 represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local, and Federal agencies in Pennsylvania. (USGS)
W82-01212

WATER RESOURCES DATA FOR MONTANA, WATER YEAR 1980--VOLUME 1. HUDSON BAY BASIN, MISSOURI RIVER BASIN.
Geological Survey, Helena, MT. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-127713, Price codes: A99 ($45.00) in paper copy, A01 in microfiche. Geological Survey Water-Data Report MT-80-1, 1981. 651 p, 9 Fig, 4 Tab.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Montana, Hudson Bay, Missouri River basin.

Water resources data for the 1980 water year for Montana consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels in wells. Volume 1 of this report contains discharge records for 176 gaging stations, stage only records for 1 lake station, stage and contents for 6 lakes and reservoirs, water quality for 118 stations, and water lvels for 9 observation wells. Also included are 141 crest-stage partial-record stations and 23 smaller reservoirs. Additional water data were collected at various sites, not part of the systematic data-collection programs, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Montana. (USGS)
W82-01213

WATER RESOURCES DATA FOR MONTANA, WATER YEAR 1980--VOLUME 2. UPPER COLUMBIA RIVER BASIN.
Geological Survey, Helena, MT. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-127721, Price codes: A09 in paper copy, A01 in microfiche. Geological Survey Water-Data Report MT-80-2, 1981. 184 p, 6 Fig, 4 Tab.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Resevoirs, Wells, Water level, Data collections, Sites, *Montana, Columbia River basin.

Water resources data for the 1980 water year for Montana consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water lvels in wells. Volume 2 of this report contains discharge records for 48 gaging stations, stage and contents for 3 lakes and reservoirs, water quality for 22 stations and 3 lakes, and water levels for 14 observation wells. Also included are 24 crest-stage partial-record stations and 20 smaller reservoirs. Additional water data were collected at various sites, not part of the systematic data-collection programs, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Montana. (USGS)
W82-01214

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1980--VOLUME 3A: SOUTHWEST FLORIDA SURFACE WATER.
Geological Survey, Tallahassee, FL. Water Resources Division.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131186, Price codes: A25 in paper copy, A01 in microfiche. Geological Survey Water-Data Report FL-80-3A, 1981. 576 p, 15 Fig, 1 Tab, 16 Ref.

Descriptors: *Hydrologic data, *Surface water, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Data collections, Sites, *Florida, Southwest Florida.

Water resources data for the 1980 water year in Florida consist of continuous or daily discharge for 271 streams, periodic discharge for 47 streams, continuous or daily stage for 67 streams, periodic stage for 49 streams, peak discharge for 76 streams and peak stage for 23 streams; continuous or daily elevations for 75 lakes and periodic elevations for 128 lakes; continuous ground water levels for 483 wells, periodic ground water levels for 661 wells, and miscellaneous water level measurements for 2,807 wells; and quality of water data for 301 surface water sites and 842 wells. The surface-water data in this volume for southwest Florida includes continuous or daily discharge for 68 streams, periodic discharge for 24 streams, peak dicharge for 16 streams, continuous or daily stage for 18 streams and periodic stage for 9 streams; continuous elevations for 35 lakes and periodic elevations for 78 lakes; and quality of water for 100 surface water sites. These data represent the National Water Data System records collected by the U.S. Geological Survey and cooperating local, State and Federal agencies in Florida. (USGS)
W82-01215

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1980--VOLUME 3B: SOUTHWEST FLORIDA GROUND WATER.
Geological Survey, Tallahassee, FL. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131194, Price codes: A25 in paper copy, A01 in microfiche. Geological Survey Water-Data Report FL-80-3B, 1981. 560 p, 19 Fig, 1 Tab, 16 Ref.

Descriptors: *Hydrologic data, *Groundwater, *Water quality, Water analysis, Water temperature, Chemical analysis, Wells, Water level, Data collections, Sites, *Florida, Southwest Florida.

Water resources data for the 1980 water year in Florida consist of continuous or daily discharge for 271 streams, periodic discharge for 47 streams, continuous or daily stage for 67 streams, periodic stage for 49 streams, peak discharge for 76 streams and peak stage for 23 streams; continuous or daily elevations for 75 lakes and periodic elevations for 128 lakes; continuous ground water levels for 483 wells, periodic ground water levels for 661 wells, and miscellaneous water level measurements for 2,807 wells; and quality of water data for 301 surface water sites and 842 wells. The groundwater data in this volume for southwest Florida includes continuous ground water levels for 236 wells, periodic ground water levels for 250 wells, and miscellaneous water level measurements for 1119 wells; and quality of water for 242 wells. These data represent the National Water Data System records collected by the U.S. Geological Survey and cooperating local, State and Federal agencies in Florida. (USGS)
W82-01216

WATER RESOURCES DATA FOR COLORADO, WATER YEAR 1980--VOLUME 2. COLORADO RIVER BASIN ABOVE DOLORES RIVER.
Geological Survey, Lakewood, CO. Water Resources Div.
Geological Survey Water-Data Report CO-80-2, 1981. 387 p, 4 Fig, 4 Tab, 40 Ref.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Colorado, Colorado River basin.

Water-resources data for Colorado for the 1980 water year consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs, and water levels and water quality of wells and springs. This report (Volumes 1, 2, and 3) contains discharge records for about 460 gaging stations, stage and contents of 22 lakes and reservoirs, 4 partial-record low-flow stations, 30 crest-stage partial-record stations, and 50 miscellaneous sites; water quality for 163 gaging stations and 300 miscellaneous sites; and water levels for 55 observation wells. A few pertinent stations in bordering States also are included. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in Colorado. (USGS)
W82-01217

8. ENGINEERING WORKS

8A. Structures

REDESIGN CONTROLS MANHOLE LEAKAGE,
For primary bibliographic entry see Field 8G.
W82-01237

RISK MODELS FOR FLOOD LEVEE DESIGN,
Nevada Univ. Systems, Reno. Dept. of Civil Engineering.
Y. K. Tung, and L. W. Mays.
Water Resources Research, Vol 17, No 4, p 833-841, August, 1981. 6 Fig, 5 Tab, 29 Ref.

Descriptors: *Levees, *Risks, *Flood protection, Safety, *Design criteria, Flood damage, Flood recurrence interval, Model studies, Hydraulic structures, Hydraulic engineering, Hydraulic models, Hydraulic design, Flood control.

Both hydrologic and hydraulic uncertainties are considered in development of risk models for overtopping in flood levee design. This is a refinement over conventional procedures, which consider only the hydrologic variables (such as flood flows)

and use a safety factor to account for all other uncertainties. Models systematically analyze hydrologic uncertainties (inherent, model, and parametric) and hydraulic uncertainties (model, construction and material, and flow operational conditions) and define the risk and reliability of overtopping. Both static and time dependent risk models are presented. Results show that the simple return period method can underestimate risk by 10-50%. It is best to use composite models for risk analysis because the risk-safety factor relationships are very sensitive to the hydrologic loading probability model used. The risk-safety factor relationships can be used to design new flood levee systems or analyze old systems; to determine risk factors; to evaluate expected damage; and to determine minimum costs, either construction or damage. (Cassar-FRC)
W82-01307

HYDROELECTRICAL MODEL FOR OPTIMAL OPERATION OF A SINGLE MULTIPURPOSE RESERVOIR,
National Water Plan Commission, Mexico City.
For primary bibliographic entry see Field 6A.
W82-01329

YANGTZE GORGES SCHEME COULD YIELD 110 TWH/YEAR.
International Water Power and Dam Construction, Vol 33, No 4, p 21-23, April, 1981.

Descriptors: *People's Republic of China, *Hydroelectric power, *Hydroelectric plants, Powerplants, Electric power production, *Yangtze River, Site selection, Flood control, Navigable rivers, Navigation, Planning, *Dam construction, Asia, China.

A massive hydroelectric plant is currently being planned for the Yangtze River in the People's Republic of China. The proposed 200-meter high prestressed concrete dam will include a hydroelectric power station, which will have a 25 GW capacity and will generate 110 TWh per year. Two sites for the dam are under consideration, both of which are located at the end of the Xiling Gorge on the Yangtze River. The Yangtze River, which is 6380 kilometers long, has an estimated total power potential of 230 GW, which is 2.5 times that of all the rivers in the United States. The Gezhouba dam, currently under consturction, is a first step towards building a power project on the river. Although the lake behind the Gezhouba dam will raise the water level of the Yangtze by more than 20 meters, the proposed project will still involve one of the biggest lock systems in the world. Located at the vital intersection of north and south and east and west, the proposed project will provide electricity for industries in many river ports, coastal cities, And mining areas. The lake behind the proposed project will also facilitate navigation of the three gorges upstream from the dam, which are currently hazardous, and eliminate the necessity to switch cargo to navigation channel. The new reservoir will also be able to control flooding in downstream areas. (Carroll-FRC)
W82-01394

HYDRAULIC MODEL STUDY OF DAULE-PERIPA SPILLWAY AND OUTLET WORKS,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
K. L. Houston.
Report GR-81-9, June, 1981. 83 p, 61 Fig, 13 Tab.

Descriptors: *Hydraulic models, *Spillways, *Outlets, *Model studies, Erosion, Flow discharge, Hydroelectric plants, River beds, Stilling basins, Daule-Peripa spillway, Daule River, *Ecuador.

Two hydraulic models were built and studied to verify the original design of the Daule-Peripa spillway and outlet works to be constructed on the Daule River in Ecuador. The 1:80-scale spillway model included the approach channel, spillway, outlet works, powerplant, and downstream river channel. The model showed that excavation was not necessary in the spillway approach channel. A discharge curve and gate opening combinations were derived from the model. The flow over the crest was satisfactory with the piers shortened; however, it impinged upon the gate trunnion pins at higher discharges. On the spillway chute, all offsets greater than 3 mm should be ground to a 1:10 chamber. The stilling basin walls were overtopped for discharges greater than 2300 cu m/s; however, pressures indicated that they would remain stable. The velocities downstream of the stilling basin were within the design range; however, the riverbed eroded for about 24 m downstream of the apron. The 1:50.65-scale outlet works model included two 9-m-diameter concrete-lined tunnels with intakes for either diversion flow or for flow through the penstock and permanent outlet works. The model provided discharge information for the uncontrolled diversion flow and the gated permanent outlet works. Flow through the tunnel bends and velocities downstream of the stilling basins were satisfactory. No erosion occurred downstream of the outlet works or the powerplant. The penstock intake with the trashrack installed passed all discharges without vortices being formed.
W82-01446

PERFORMANCE EVALUATION OF A STOCHASTIC OPTIMIZATION MODEL FOR RESERVOIR DESIGN AND MANAGEMENT WITH EXPLICIT RELIABILITY CRITERIA,
Purdue Univ., Lafatette IN. School of Civil Engineering.
M. H. Houck, and B. Datta.
Water Resources Research, Vol 17, No 4, p 827-832, August, 1981. 4 Tab, 23 Ref.

Descriptors: *Reservoir design, *Reservoir operation, Reservoir releases, Reservoir capacity, Stochastic process, Linear programming, *Model studies, Mathematical models, Planning.

A multiple linear decision rule (LDR) model for reservoir design and operation proved superior to a single-LDR model in an application to a hypothetical reservoir on the Gunpowder River, Maryland. Under identical operating requirements the multiple LDR models designated smaller reservoir capacities and more closely simulated expected performance criteria than did single-LDR models. As the number of LDR's in a season (each conditioned on the previous season's streamflow) increased, the optimal capacity decreased. The multiple-LDR models require more data and manipulation of numbers and are slightly larger than single-LDR models, but remain within reasonable computability limits. (Cassar-FRC)
W82-01462

NORTHFIELD MOUNTAIN PUMPED STORAGE PROJECT: PERFORMANCE,
Stone and Webster Engineering Corp., Boston, MA.
W. F. Swiger, P. A. Wild, and T. J. Lamb.
Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No GT6, p 673-689, June, 1980. 9 Fig, 16 Ref.

Descriptors: *Dam construction, Dam stability, Performance evaluation, Dams, Dam design, *Design criteria, Civil engineering, Leakage, *Powerplants, Seepage, Cooling water, Water storage, Reservoirs, Surge tanks, Northfield Mountain Project, *Massachusetts.

The performance of civil works at the Northfield Mountain Pumped Storage Project has met design standards. Minimal leakage occurs from the upper reservoir, and the amount of seepage into the powerhouse and underground works is also small. The vertical ventilation shaft collects leakage from the pressure shaft occurring along a bedding plane shear. Part of this water is used in cooling equipment, while the remainder is discharged to the tailrace tunnel. During excavation, elastic movements of the roof and walls of the powerhouse cavern occurred. Since the excavation has been completed, no additional movements have been observed in 8 years. The dam of the upper reservoir has settled at a faster rate, probably due to the rapid cycling of water of a pumped storage facility. Tiltmeter studies during start-up and initial operation showed small elastic rock motions consistent with directions and character of load applications. No detailed analytical predictions of movement were made with which to compare measured values. (Geiger-FRC)
W82-01517

SITING AND DESIGN OF TAILINGS IMPOUNDMENTS,
Klohn Leonoff Inc., Denver, CO.
S. G. Vick.
Mining Engineering, Vol 33, No 6, p 653-657, June, 1981. 4 Fig.

Descriptors: *Tailings, *Wastewater treatment, *Dam design, Mine wastes, Waste disposal, Dam construction, Gravity dams, Separation techniques, Mine drainage, Dam sites, Metals, Underground waste disposal, Ocean dumping.

Some major factors to be considered in the design of tailings disposal facilities and some available methods for this purpose are discussed. The site characteristics which should be examined are topography, drainage area, geology/seismicity, precipitation and evaporation. The tailings' graduation, physical and chemical properties and clay content should be known for possible use as dam fill material. The pH, metallic cations and anions and othe toxic materials of the effluent must be characteristized along with its oxidation or leaching potential. Essential features of the mine or mill to be studied are the tailings and effluent output, recirculation capacity, and amount of sand tailings that may be used for backfilling. The advantages and disadvantages of three dam designs, the upstream, downstream and centerline methods, are presented. Other underground tailings disposal options include slope backfilling and 'below grade' disposal, which is required for the disposal of uranium tailings. The possibilities of thickened discharge methods and offshore disposal of tailings are also considered. (Geiger-FRC)
W82-01588

ROSARIO DOMINICANA'S CYANIDE TAILINGS DAM CONSTRUCTION AND OPERATION.
Martiki Coal Corp., Denver, CO.
For primary bibliographic entry see Field 5D.
W82-01589

8B. Hydraulics

EVALUATION OF EFFECTIVE BOUNDARY ROUGHNESS FOR GRAVEL-BED RIVERS,
New Brunswick Univ., Fredericton. Dept. of Civil Engineering.
D. I. Bray.
Canadian Journal of Civil Engineering, Vol 7, No 2, p 392-397, 1980. 4 Fig, 1 Tab, 7 Ref.

Descriptors: *Boundary process, *Gravel, *River beds, Rivers, River flow, *Flow velocity, Mathematical studies, Estimating equations, *Hydraulic roughness.

An optimum means for estimating the effective boundary roughness for the Keulegan equations was evaluated using data for 67 Alberta gravel-bed river reaches. The value of C (coefficient equal to effective boundary roughness over bed material size) decreased with an increase in the characteristic bed material size used to evaluate the effective boundary roughness. The characteristic bed material size must be multiplied by a constant when determining the effective boundary roughness. When using the Keulegan equation, errors in the estimation of the average velocity may range from 20 to 100% when the optimum measure of effective boundary layer is not used. For values of relative smoothness greater than 3.5, the Keulegan equation should be used. When relative smoothness is less than 3.5, the energy degradation results more from a jet than a wake process, and a jet process represents a different class of energy degradation than that assumed in the Keulegan method. (Small-FRC)
W82-01161

VERTICAL VELOCITY PROFILES IN STRATIFIED FLOWS,
Geological Survey, NSTL Station, MS. Gulf Coast Hydroscience Center.
S. C. McCutcheon.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY8, p 973-988, August, 1981. 6 Fig, 3 Tab, 21 Ref.

Descriptors: *Flow characteristics, *Velocity distribution, *Stratified flow, Flow velocity, Monin-Obukhov equation, Prandtl-von Karman equation, Boundary layers, Open-channel flow, Turbulent flow.

A study was conducted on the shape of the vertical velocity profile in a unidirectional, two-dimensional, turbulent, fully developed, continuously stratified flow. Turbulence was produced by movement of fluid over a rough boundary. Flows in laboratory flumes stratified by salt were used to verify the predicted results. The Prandtl-von Karman velocity law was not applicable to stratified flows, but the velocity profile expressions, modified with the Monin-Obukhov scaling length, described velocity gradients and vertical profiles in stably stratified flows. The coefficient for a linear approximation of the Monin-Obukhov function was 5.8 + or - 0.3, comparable to the accepted value of 5.2 + or - 0.5 for atmospheric boundary layer flows. The importance of the width to depth ratio in stratified flow, noted in previous studies, was confirmed. If the width to depth ratio is 4.3 or less, stratified flows in flumes are characterized by peculiar vertical velocity profiles. Previous work by French (1978) was declared non-valid for two-dimensional flows because the Monin-Obukhov scaling length was incorrectly defined. (Cassar-FRC)
W82-01171

OPTIMAL RISK-BASED DESIGN OF FLOOD LEVEE SYSTEMS,
Nevada Univ. System, Reno. Dept. of Civil Engineering.
Y. K. Tung, and L. W. Mays.
Water Resources Research, Vol 17, No 4, p 843-852, August, 1981. 8 Fig, 9 Tab, 6 Ref.

Descriptors: *Levees, *Risks, *Flood protection, Flood damage, Flood control, *Design criteria, Model studies, Hydraulic structures, Hydraulic engineering, Hydraulic models, Hydraulic design, Optimization.

Optimal design procedures for flood levee systems are determined using methods of risk analysis which include both hydraulic and hydrologic uncertainties. The objective is to find the best flood levee system design for the least total cost. Two models are developed for this purpose: dynamic programming (DP) and discrete differential dynamic programming (DDDP). The 3 design philosophies examined considered 3 degrees of risk; no risk, only inherent hydrologic risk, and both hydrologic and hydraulic risks. The DDDP approach produced more accurate results with much less computer time and storage than did DP in an example using data from the Guadalupe River, Texas. (Cassar-FRC)
W82-01313

DEVELOPMENT OF UPTON INTAKE WORKS, RIVER SEVERN SUPPLY SCHEME, WITH THE AID OF A MODEL,
Severn-Trent Water Authority, Birmingham (England).
M. S. Kothari.
Journal of the Institution of Water Engineers and Scientists, Vol 35, No 3, p 245-258, May, 1981. 5 Fig, 1 Tab, 4 Ref.

Descriptors: *Intakes, *Model testing, *Hydraulics, Water treatment facilities, Upton, *Severn River, Rivers, Sumps, Screens, Tunnels, *Great Britain.

A 1:5 scale model was used to determine the maximum reliable abstraction rate for the existing Upton intake for the River Severn. The model confirmed that the present abstraction rate of 182 million liters per day produces no evident surface or submerged vortices. Therefore, no baffles in sumps or increased submergence of pumps are necessary. To reduce energy losses at the connection between the main and interconnecting tunnels and to avoid a hydraulic jump, a smooth concrete connecting piece was installed. If an abstraction rate of 200 million liters per day (projected for 2001) or greater is required, an extra tunnel would be essential between the common bandscreen chamber and the new sump. The model predicts that replacement of two bandscreens (1200 mm) would allow an abstraction rate of 170 million liters per day, lower than the calculated 182 million liters per day. Replacement of all three bandscreens would allow a reliable abstraction rate of 200 million liters per day, according to both model and calculated results. (Cassar-FRC)
W82-01395

8C. Hydraulic Machinery

TRICKLE IRRIGATION LATERAL DESIGN ON SLOPING FIELDS,
Louisiana State Univ., Baton Rouge. Dept. of Agricultural Engineering.
H. J. Braud, and A. M. Soom.
Transactions of the ASAE, Vol 24, No 4, p 941-944, 950, July/August, 1981. 7 Fig, 1 Tab, 14 Ref.

Descriptors: *Trickle irrigation, *Slopes, Design criteria, Irrigation, Irrigation practices, Hydraulics, *Irrigation design.

New analytical expressions are presented to relate the physical variables in lateral line hydraulics. Design equations are offered in implicit form, relating the variables in trickle lateral hydraulics. They are: length, diameter, operating pressure, emitter flow characteristics, tube friction, discharge uniformity coefficient, emitter discharge exponent, emitter spacing requirement, and land slope. The equations are in such a form that they can be inserted into many programmable digital calculators and are very convenient for direct application to field use. The equations eliminate the need for design charts or tables. Both the Hazen-Williams and the Blasius fraction equations are used and compared through graphic solutions for limiting lateral length. (Baker-FRC)
W82-01537

SIGNIFICANT FEATURES OF EMITTER FLUSHING MODE CHARACTERISTICS,
Rain Bird Western Sales Corp., Glendora, CA.
For primary bibliographic entry see Field 3F.
W82-01576

8D. Soil Mechanics

LIQUEFACTION ANALYSIS FOR MULTIDIRECTIONAL SHAKING,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
J. Ghaboussi, and S. U. Dikmen.
Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No GT5, p 605-627, May, 1981. 16 Fig, 16 Ref.

Descriptors: *Liquefaction, *Seismic waves, *Earthquakes, Waves, Soil mechanics, Model studies, Computers, Soil engineering, Soil water, Interstitial water, Stability analysis, Construction.

A new method of analysis is presented for computing the response and the liquefaction potential of horizontally-layered ground subjected to three components of earthquake base acceleration. The theoretical basis of the proposed method of analysis is described, and the main aspects of the response to multidirectional shaking are demonstrated through a series of case studies. These case studies were performed by using a new computer program, LASS-III, which was developed for analysis of multidirectional shaking of horizontally-layered ground. The results of the analyses indicate that the vertical component of base acceleration has only a minor influence on the development and pattern of liquefaction, that interaction between the two horizontal components of shaking significantly influences the development and pattern of liquefaction, that increasing the amplitude of the base acceleration in a one-directional analysis such that the peak base acceleration equals the resultant of the peak base accelerations in two directions does not completely reproduce the major effects present in a two-directional analysis, and that interaction between the two horizontal components of shaking produced surface response spectra which were somehow different from those of one-directional analysis. (Baker-FRC)
W82-01169

CYCLIC STRENGTHS COMPARED FOR TWO SAMPLING TECHNIQUES,
Ertec Western Inc., Long Beach, CA.
C. Espana, R. C. Chaney, and D. Duffy.
Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No GT5, p 563-576, May, 1981. 9 Fig, 2 Tab, 6 Ref.

Descriptors: *Sampling, *Liquefaction, Nuclear powerplants, Powerplants, Soil properties, Soil engineering, Soil water, Water pollution prevention, Construction, Soil strength, Soil tests.

Cyclic triaxial liquefaction test results have been compared for soil samples obtained by two different sampling and laboratory preparation techniques. Results indicate a reduced cyclic strength for samples that were obtained by Pitcher barrel sampling followed by tube cutting and trimming by mechanical extrusion into a mold. Significantly higher cyclic strengths were obtained for large-diameter, hand-carved, block samples which were further hand-trimmed into test-size specimens by either further hand-trimming, saturation and trimming, or freezing and trimming. The lower cyclic strengths noted for the tube samples were believed to be caused by the destruction of adhesion bonds that existed between soil particles in situ. Soil sampling by block-sampling techniques minimized the destruction of these bonds. The formation of the adhesion bonds in granular material can be caused by the consolidation of a sand material under high effective stresses for a short time, or under low effect stresses for a long time. The process of Pitcher barrel sampling and subsequent laboratory preparation combined to cause disturbance. Block sampling into clear large-diameter plastic cylinders allowed retention of a reasonably undisturbed sample. The laboratory preparation techniques where block samples were saturated, drained, and then further hand-carved, or frozen with liquid nitrogen and hand-carved, were effective in minimizing disturbance. (Baker-FRC)
W82-01170

SOIL-BENTONITE SUPPLY TRENCH CUTOFFS,
Engineered Construction International, Inc., Pittsburg, PA.
D. J. D'Appolonia.
Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No GT4, p 399-417, April, 1980. 15 Fig, 1 Tab.

Descriptors: *Slurries, *Cutoffs, *Bentonite, *Backfill, Trenches, Soil filters, Barriers, Viscosity, Permeability, Earthworks, Soil water, Soil compaction, *Seepage control, *Structural engineering.

Cutoff walls using the soil-bentonite backfill method of slurry trench construction are used for seepage control in excavating, water retaining structures, and preventing pollutant seepage from contaminating ground water. Many of the slurry trench cutoff walls in the United States were not designed to meet project specifications. Similar requirements are often assigned to totally different projects. Rational designing involves selecting engineering properties that meet specific properties of wall permeability, certain environmental criteria, and cutoff compressibility and strength. Specification provisions for slurry properties, trench

excavation, backfill placement, and backfill material for the project are recommended. The slurry should have a minimum viscosity of 40 sec-Marsh to assure trench stability and good filter cake formation. The unit weight of the slurry, as sampled near the bottom of the trench, should be at least 240 kilograms/cu meter lighter than the backfill for proper slurry displacement. The trench should have a minimum width of 610 mm. Trenches keyed in soil should have a minimum key depth of 0.6 m. The backfill material should have a uniform consistency corresponding to a slump of 50-150 mm at the time of placement. The backfill should be composed of granular material containing 20-40% fines to minimize permeability and compressibility. Plastic fines may be used to increase impermeability. Bentonite should be added to the mix and the water content of the soil should be controlled. When the contained fluid is a pollutant changes in permeability of the wall may be regulated by adjusting the content of the fines. (Geiger-FRC)
W82-01599

8F. Concrete

AN INVESTIGATION INTO THE EFFECTS OF THERMAL MOVEMENT IN THE WALLS OF SERVICE RESERVOIRS,
Severn-Trent Water Authority, Burmingham (England).
A. A. Redhead.
Journal of the Institution of Water Engineers and Scientists, Vol 35, No 3, p 203-214, May, 1981. 11 Fig, 6 Ref.

Descriptors: *Concrete construction, *Reservoir construction, *Cracks, *Ladbroke Service Reservoir, Thermal stress, *England.

The Ladbroke Service Reservoir, South Warwickshire, England, was constructed in two compartments of equal size using sulfate resisting Portland cement to reduce the effects of alkali attack, which had caused serious cracks in another reservoir built 14 years previously. This paper reports the results of an investigation of thermal cracks which occurred after the walls had been cast on site. Both single and fragmented cracks, usually vertical, developed 400 to 2400 mm from the base 4 or 5 days after pouring the concrete. Stress gages recorded movement as high as 1.66 mm per 10 C change on a cold morning. The single cracks that formed near the thickest part of the wall were closest to the area of greatest heat of hydration. The fragmented cracks were caused by one wall pulling on the adjacent wall. Cracks in this reservoir did not exceed those allowed in the design, and all mid-panel hairline cracks healed 10 days after the reservoir was filled. Suggestions to reduce the tendency to cracking were: use steel shuttering, cool the hottest portion of the wall with cold water sprays, use low heat cement, and cast the wall stem no more than 4 or 5 days after the wall base has been poured. (Cassar-FRC)
W82-01396

8G. Materials

REDESIGN CONTROLS MANHOLE LEAKAGE,
W. L. Sheppard.
Water and Sewage Works, Vol 127, No 2, p 50-52, February, 1980. 1 Fig, 9 Ref.

Descriptors: *Sewers, *Construction methods, Construction materials, Construction joints, Sewer systems, *Waterproofing, Sealants, Manhole construction.

Weaknesses of the most common designs for manhole construction are described, including the sewer connections made from them, and the redesign necessary to correct the weaknesses. The manhole that is to be liquid tight must be structurally strong, incorporate a liquid-tight membrane, and be protected from physical or other damage by an internal brick or tile lining. A liquid-tight precast manhole requires continuous water stops inserted at all junctures of all sections and at the connection with the bottom slab, if this is separate. All joints should be tooled and filled with a strong, water-tight adhesive such as epoxy. A manhole may also be fashioned completely from fiberglass-reinforced plastic, somewhat like a cylindrical tank. The selection of membrane and mortar materials for use in industrial waste sewers must take into consideration the range of chemical content and temperature of wastes to be passing through. (Baker-FRC)
W82-01237

8I. Fisheries Engineering

EVIDENCE OF NATURAL REPRODUCTION BY PLANTED LAKE TROUT IN LAKE MICHIGAN,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
D. J. Jude, S. A. Klinger, and M. D. Enk.
Journal of Great Lakes Research, Vol 7, No 1, p 57-61, 1981. 1 Fig, 1 Tab, 33 Ref.

Descriptors: *Fish populations, Lakes, *Lake Michigan, Great Lakes, Fish, *Trout, Powerplants, Fish management, *Fish establishment, Fish eggs.

Sampling for lake trout fry was performed near the J. H. Campbell Power Plant, in southeastern Lake Michigan, near Port Sheldon, Michigan, where new offshore intake and discharge pipelines were built. About 1296 meters of pipeline were covered with 10- to 20- cm diameter crushed limestone, 594 meters of which was overlaid with an incomplete layer of 1.2 to 1.5 meter diameter, 900 kg limestone boulders. An additional length of 360 meters had a complete 1.5 meter layer of large riprap covering a base of crushed limestone. Rocky substrate was therefore available at all depth contours from shore to 11 meters. Since 1965 over 34 million finclipped lake trout yearlings have been stocked in Lake Michigan in an effort to reestablish self-sustaining populations. Lake trout fry were first collected on 21 April, 1980, by the larval fish sled in 12 and 15 meters of water in the area of new riprap at the north transect. During 19-22 May, 1980, lake trout fry were widely dispersed. Appearance of lake trout fry at the south transect, 3.1 km south of the area in which they are believed to have hatched, suggests either extensive movements by these fish or drifting with currents or both. Successful spawning near the Campbell Plant was probably related to the newly placed riprap. (Baker-FRC)
W82-01194

COOLING WATER INTAKE SCREENING DEVICES USED TO REDUCE ENTRAINMENT AND IMPINGEMENT,
National Power Plant Team, Ann Arbor, MI.
E. S. Fritz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-116055, Price codes: A03 in paper copy, A01 in microfiche. Report FWS/OBS-76/20.9, July, 1980. 24 p, 12 Fig, 20 Ref.

Descriptors: *Entrainment, Impingement, *Intakes, *Screens, *Cooling water, Environmental effects, Mortality, Aquatic animals, Radial wells.

Closed cycle cooling systems reduce the volume of cooling water withdrawn from a water body at least 90% of that required for once-through cooling systems. To be considered an alternative to closed cycle cooling a once-through cooling system with its screening device must be shown to reduce impingement and entrainment mortality for aquatic organisms by 90% of that expected of a once-through system fitted with a vertical traveling screen. Cooling water intake screening devices evaluated include modified vertical traveling screens, single-entrance double-exit screens, horizontal traveling screens, passive intake screens, radial wells, artificial filter beds, and porous dikes. The intake technologies show some promise for reducing the impacts of entrainment and impingement. However, evidence is insufficient to demonstrate that any of these intake systems alone or in combination can afford the protection that is presently attainable by closed cycle cooling. The most effective systems, the radial well and artificial filter bed, can only provide enough water for make up water in closed cycle systems. The screening devices, both active and passive, do not yet have a sufficient data base to demonstrate effectiveness or reliability. More experience is needed operating and maintaining these devices before they can be considered as alternatives to closed cycle cooling for minimizing the adverse impact of cooling water intakes. (Moore-SRC)
W82-01442

SUBJECT INDEX

ABSORPTION
Open-Pore Polyurethane as a Medium for Coal Conversion Process Aqueous Effluent Cleanup,
W82-01577 5D

ACID MINE DRAINAGE
The Effect of Pollutants from the Coal Industry on the Fish Fauna of a Small River in the South Wales Coalfield,
W82-01389 5C

ACID PRECIPITATION
Water Characteristics,
W82-01305 5B

ACID RAIN
A Classification and Description of Some Northeastern Ontario Lakes Influenced by Acid Precipitation,
W82-01145 5B

Aluminum in Precipitation, Streams, and Shallow Groundwater in the New Jersey Pine Barrens,
W82-01297 5B

Water Characteristics,
W82-01305 5B

An Analysis of Acidic Precipitation in South-Central Ontario Using Air Parcel Trajectories,
W82-01513 5B

Recent Acidification of Precipitation in North America,
W82-01514 5B

Acid Precipitation: Basic Principles and Ecological Consequences,
W82-01586 5C

ACID STREAMS
Preliminary Report of Stream Sampling for Acidification Studies 1980,
W82-01453 5A

ACIDIC SOILS
Variations of pH with Annual Cumulative Precipitation in Acid Forest Soils,
W82-01118 2G

Infrared Spectroscopic Study of the Water-Soluble Fraction of Sewage Sludge-Soil Mixtures During Incubation,
W82-01130 5E

ACIDIC WATER
Aluminum in Precipitation, Streams, and Shallow Groundwater in the New Jersey Pine Barrens,
W82-01297 5B

Preliminary Report of Stream Sampling for Acidification Studies 1980,
W82-01453 5A

ACIDITY
Fixed Endpoint Alkalinity Determination,
W82-01187 7B

ACIDIZING
Results of Acidizing Water Wells in Arizona,
W82-01199 4B

ACTIVATED CARBON
Chemicals and Allied Products,
W82-01267 5D

Modeling of Activated Carbon and Coal Gasification Char Adsorbents in Single-Solute and Bisolute Systems,
W82-01447 1B

Anaerobic Carbon Filter for Degradation of Phenols,
W82-01454 5D

Investigation of Volatile Organics Removal,
W82-01490 5F

ACTIVATED SLUDGE
Activated Sludge,
W82-01243 5D

Effect of Copper on Nitrification in Activated Sludge,
W82-01497 5C

ACTIVATED SLUDGE PROCESS
Stability of Activated Sludge Processes Based on Statistical Measures,
W82-01489 5D

Factors Affecting the Fate of Heavy Metals in the Activated Sludge Process,
W82-01547 5D

ADENOSINE TRIPHOSPHATE
A Survey of ATP Concentrations in Lake Ontario, 1975-1976,
W82-01144 2H

ADSORBENTS
Modeling of Activated Carbon and Coal Gasification Char Adsorbents in Single-Solute and Bisolute Systems,
W82-01447 1B

ADSORPTION
Factors Affecting the Fate of Heavy Metals in the Activated Sludge Process,
W82-01547 5D

ADVANCED WASTEWATER TREATMENT
Advanced Wastewater Plant is Energy Saver,
W82-01177 5D

AERATION
Pharmaceutical Company's Aeration System Saves Energy,
W82-01180 5D

AERIAL PHOTOGRAPHY
Application of Aerial Photographs and Surficial Geologic Maps to the Determination of Suitability of Land for Septic Tank Systems,
W82-01569 7B

AEROSOLS
Nutrient Loading of Southern Lake Michigan by Dry Deposition of Atmospheric Aerosol,
W82-01152 5B

Potential Health Hazards from Microbial Aerosols in Densely Populated Urban Regions,
W82-01232 5C

AFRICA
The Inference of Gate Convective Rainfall from SMS-1 Imagery,
W82-01519 7B

AGARS
An Estuarine Agar Medium for Enumeration of Aerobic Heterotrophic Bacteria Associated with Water, Sediment, and Shellfish,
W82-01565 5A

AGGRADATION
River Bed Aggradation Due to Overloading,
W82-01486 2J

AGRICULTURAL CHEMICALS
A Comparison of Chemical and Cultural Control of Weeds in Irrigation Ditchbanks,
W82-01120 4A

AGRICULTURAL HYDROLOGY
A Parametric Crop Water Use Model,
W82-01310 2I

AGRICULTURAL RESERVOIRS
A Verification Study on a Reservoir Sediment Deposition Model,
W82-01176 2J

AGRICULTURAL RUNOFF
Nitrate Reduction in an Organic Soil-Water System,
W82-01129 5B

Nonpoint N Runoff from Agricultural Watersheds into the Great Lakes,
W82-01148 5B

Analysis of National Water Pollution Control Policies 2. Agricultural Sediment Control,
W82-01293 6A

The Depth of Rainfall-Runoff-Soil Interaction as Determined by P32,
W82-01318 5B

Predicting Stream Salinity Changes in South-Western Australia,
W82-01350 6A

CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems.
W82-01401 5B

Residue and Tillage Effects on SCS Runoff Curve Numbers,
W82-01404 4D

Modeling Erosion and Sediment Yield from Flatland Watersheds,
W82-01406 2J

Sediment Transport Capacity of Overland Flow,
W82-01408 2J

Concentrated Flow Relationships,
W82-01409 2J

Estimating Soluble (PO4-P) and Labile Phosphorus in Runoff from Croplands,
W82-01412 5B

Soluble N and P Concentrations in Surface Runoff Water,
W82-01413 5B

Pesticide Concentrations in Agricultural Runoff: Available Data and an Approximation Formula,
W82-01414 5B

Relationship Between Increased Crop Acreage and Nonpoint-Source Pollution: A Georgia Case Study,
W82-01550 5B

Stream Nutrient Levels and Proximity of Agricultural and Forest Land to Streams: Some Relationships,
W82-01554 5B

AGRICULTURAL WATERSHEDS
Nonpoint N Runoff from Agricultural Watersheds into the Great Lakes,
W82-01148 5B

AGRICULTURE
Some Effects of Agricultural Land Use on Stream Insect Communities,
W82-01159 5C

AIR POLLUTION
A Classification and Description of Some Northeastern Ontario Lakes Influenced by Acid Precipitation,
W82-01145 5B

Nutrient Loading of Southern Lake Michigan by Dry Deposition of Atmospheric Aerosol,
W82-01152 5B

AIR POLLUTION EFFECTS
The Role of Atmospheric Deposition in an Eastern U.S. Deciduous Forest,
W82-01491 5B

AJWA RESERVOIR
Hydrobiological Studies on the Ajwa Reservoir, the Source of Raw Water Supply to the Baroda Water Works,
W82-01364 2H

ALBEDO
Effect of Grain Size and Snowpack Water Equivalence on Visible and Near-Infrared Satellite Observations of Snow,
W82-01311 7B

ALBERTA
Water and Salt Movement in a Saline-Sodic Soil in Southern Alberta,
W82-01119 2G

ALGAE
Phosphorus Uptake Dynamics as Related to Mathematical Modeling of Cladophora at a Site on Lake Huron,
W82-01149 5C

Collapsing Aphanizomenon Flos-Aquae Blooms: Possible Contributions of Photo-Oxidation, O2 Toxicity, and Cyanophages,
W82-01595 2H

Strategies of Response to Copper, Cadmium, and Lead by a Blue-Green and a Green Alga,
W82-01598 5C

ALKALINE SOILS
Infrared Spectroscopic Study of the Water-Soluble Fraction of Sewage Sludge-Soil Mixtures During Incubation,
W82-01130 5E

ALKALINITY
Fixed Endpoint Alkalinity Determination,
W82-01187 7B

ALLOTMENTS
Preferences for Allocating River Recreation Use,
W82-01181 6D

ALTERNATIVE PLANNING
Generating Alternative Solutions for Dynamic Programming Models of Water Resources Problems,
W82-01450 6A

ALUM
Demonstration Testing of Alum Recovery by Liquid Ion Exchange,
W82-01167 5D

ALUMINUM
Aluminum in Precipitation, Streams, and Shallow Groundwater in the New Jersey Pine Barrens,
W82-01297 5B

AMERICAN RIVER
Water Resources Appraisals for Hydroelectric Licensing; American River Basin, California.
W82-01441 6D

AMMONIUM
The Effects of Organophosphorus Pesticides on Estuarine Ammonium Oxidizers,
W82-01567 5C

ANAEROBIC DIGESTION
Anaerobic Processes,
W82-01245 5D

New Approaches to Anaerobic Sludge Digestion,
W82-01398 5D

Anaerobic Carbon Filter for Degradation of Phenols,
W82-01454 5D

Purification of Municipal Wastewater by Subsequent Reverse Osmosis and Anaerobic Digestion,
W82-01468 5D

ANIMAL WASTES
Chemical and Bacteriological Quality of Pasture Runoff,
W82-01555 5B

ANION EXCHANGE
Regeneration of Anion Exchange Resins by Calcium Carbonate and Carbon Dioxide,
W82-01484 5F

ANISOTROPY
Parameterization of Contaminant Transport Through an Anisotropic Unconfined Aquifer,
W82-01570 5B

ANTARCTIC
Evaluation of Ultraviolet Spectrophotometric Determination of Nitrate-Nitrogen in Glacial Snow, Firn and Ice,
W82-01572 5A

AQUACULTURE
Application of Nutrient-Saturated Growth Model to Phytoplankton Management in Freshwater Prawn (Macrobrachium Rosenbergii) Ponds in Hawaii,
W82-01483 2H

AQUATIC ANIMALS
Toxicity and Bioaccumulation of Endrin and Methoxychlor in Aquatic Invertebrates and Fish,
W82-01160 5C

AQUATIC HABITATS
Ecology of Larval Fishes in Lake Oahe, South Dakota,
W82-01444 6G

AQUATIC LIFE
Entrainment and Impingement in Power Plant Cooling Systems,
W82-01276 6G

A Hydrobiological Survey of a Polluted Canal,
W82-01356 5C

Data on the Stagnant Ponds of the Savannah of Lamto (Ivory Coast) (Donnees sur les Milieux Limniques Stagnants des Savanes de Lamto (Cote d'Ivoire)),
W82-01357 2H

Hydrobiological Studies on the Ajwa Reservoir, the Source of Raw Water Supply to the Baroda Water Works,
W82-01364 2H

AQUATIC SOILS
Aquatic Sediments,
W82-01279 5B

AQUIFER CHARACTERISTICS
Groundwater Investigations in the Vale of Stathmore,
W82-01400 2F

AQUIFER MANAGEMENT
A One-Dimensional, Finite Element Salt Water Intrusion Model,
W82-01452 7A

Thermal Energy Storage in a Confined Aquifer: Second Cycle,
W82-01473 4B

AQUIFERS
Mass Transport of Solutes in Dual-Porosity Media,
W82-01104 5B

A Comparison of the Incomplete Cholesky-Conjugate Gradient Method with the Strongly Implicit Method as Applied to the Solution of Two-Dimensional Groundwater Flow Equations,
W82-01315 2F

A Mathematical Model of Water Table Fluctuation in a Semi-Infinite Aquifer Induced by Localized Transient Recharge,
W82-01319 2F

Uranium Isotopes as a Natural Tracer in the Waters of the Bet Shean-Harod Valleys, Israel,
W82-01328 2F

Geohydrologic Models of the Houston District, Texas,
W82-01335 2F

Hydrochemical Facies in a Tertiary Basin in the Milligan Canyon Area, Southwest Montana,
W82-01481 2F

Parameterization of Contaminant Transport Through an Anisotropic Unconfined Aquifer,
W82-01570 5B

AQUITARDS
Carbon 14 Dating of Groundwater in Confined Aquifers: Implications of Aquitard Diffusion,
W82-01464 2F

ARAL SEA
Balance of Biogenic Elements in the Aral Sea Upon a Drop of Its Level,
W82-01370 2H

ARCTIC
Modeling Hydrologic Time Series from the Arctic,
W82-01198 2A

ARID-ZONE HYDROLOGY
Discussion-Engineering Geology of Arid Areas,
W82-01568 4B

ARIZONA
Results of Acidizing Water Wells in Arizona,
W82-01199 4B

Estimating Evapotranspiration from the Sonoita Creek Watershed near Patagonia, Arizona,
W82-01306 2D

Channel Instability in a Braided, Sand Bed River,
W82-01316 2J

An Index of Arizona Summer Rainfall Developed Through Eigenvector Analysis,
W82-01528 2B

ARTIFICIAL RECHARGE
Artificial Groundwater Recharge,
W82-01110 4B

ASBESTOS
Chrysotile Asbestos Fibers in Drinking Water from Asbestos-Cement Pipe,
W82-01592 5B

ATLANTIC OCEAN
The Inference of Gate Convective Rainfall from SMS-1 Imagery,
W82-01519 7B

ATMOSPHERE
Oxidation of SO2 in Aqueous Droplets: Mass Transport Limitation in Laboratory Studies and the Ambient Atmosphere,
W82-01470 2K

ATMOSPHERIC ICE
Lidar Determinations of Atmospheric Ice Crystal Layers at South Pole During Clear-Sky Precipitation,
W82-01529 2C

ATMOSPHERIC WATER
Determination of Moisture from NOAA Polar Orbiting Satellite Sounding Radiances,
W82-01535 2B

AUSTRALIA
Deuterium/Hydrogen Ratios in Australian Rainfall,
W82-01325 2B

Predicting Stream Salinity Changes in South-Western Australia,
W82-01350 6A

Mining Pollution and the Diet of the Purple-Striped Gudgeon Mogurnda Mogurnda Richardson (Eleotridae) in the Finniss River, Northern Territory, Australia,
W82-01366 5C

Land and Stream Salinity in Western Australia,
W82-01374 5B

AUTOMATION
Automatic Class-A Pan-Filling System,
W82-01326 7B

BACKFILL
Soil-Bentonite Supply Trench Cutoffs,
W82-01599 8D

BACTERIA
Persistence of Pseudomonas Aeruginosa in Chlorinated Swimming Pools,
W82-01124 5A

Bacteria: Man's Allies in Water Pollution Control,
W82-01158 5D

Potential Health Hazards from Microbial Aerosols in Densely Populated Urban Regions,
W82-01232 5C

Sediment Distribution of Methanogenic Bacteria in Lake Erie and Cleveland Harbor,
W82-01233 2H

Microbiology: Detection of Bacterial Pathogens and Their Occurrence,
W82-01288 5B

The Escherichia Coli Content of Mytilus Edulis from Analysis of Whole Tissue or Digestive Tract,
W82-01508 5A

BACTERIAL ANALYSIS
Comparison of Selective Media for the Enumeration and Identification of Fecal Streptococci from Natural Sources,
W82-01564 5A

An Estuarine Agar Medium for Enumeration of Aerobic Heterotrophic Bacteria Associated with Water, Sediment, and Shellfish,
W82-01565 5A

BACTERIOPHAGE
A Note on the Use of Membrane Faecal Coliform Medium for Enhancing Resolution and Accuracy When Enumerating a Small Plaquing Coliphage,
W82-01507 5A

BAFFIN BAY
018 Modelling of Freshwater Inputs in Baffin Bay and Canadian Arctic Coastal Waters,
W82-01590 2C

BARRIERS
Holland's Eastern Scheldt Estuary Barrier Scheme: Some Ecological Considerations,
W82-01375 2L

BAY OF BENGAL
Observations on the Hydrography and Inshore Plankton of the Bay of Bengal off Balasore,
W82-01362 2A

BELGIUM
Faecal Pollution of Belgian Coastal Water,
W82-01373 5A

BENTONITE
Soil-Bentonite Supply Trench Cutoffs,
W82-01599 8D

BETWA BASIN
The Water Balance of the Betwa Basin, India,
W82-01354 2A

BIBLIOGRAPHICS
Onsite Alternatives for Treatment and Disposal,
W82-01248 5D

BIBLIOGRAPHIES
Anaerobic Processes,
W82-01245 5D

Dentrification,
W82-01246 5D

Sludge Treatment, Utilization, and Disposal,
W82-01247 5E

Wastewater Collection,
W82-01251 5D

Land Application of Municipal Wastewater,
W82-01253 5D

Microbiology of Potable Water,
W82-01287 5F

BICARBONATES
Regeneration of Anion Exchange Resins by Calcium Carbonate and Carbon Dioxide,
W82-01484 5F

BIG CREEK MARSH
Biogeochemical Investigation of Big Creek Marsh, Lake Erie, Ontario,
W82-01163 2H

BIOACCUMULATION
Toxicity and Bioaccumulation of Endrin and Methoxychlor in Aquatic Invertebrates and Fish,
W82-01160 5C

Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements,
W82-01278 5C

Laboratory Procedure for Estimating Residue Dynamics of Xenobiotic Contaminants in a Freshwater Food Chain,
W82-01443 5B

BIOASSAY
Bioassays - Procedures and Results,
W82-01277 5A

BIOCHEMICAL OXYGEN DEMAND
Alterations in the BOD Procedure for the 15th Edition of 'Standard Methods for the Examination of Water and Wastewater',
W82-01186 5A

BIODEGRADATION
Bacteria: Man's Allies in Water Pollution Control,
W82-01158 5D

Phenanthrene Biodegradation in Freshwater Environments,
W82-01234 5B

Tenax-GC Extraction Technique for Residual Polychlorinated Biphenyl and Polyaromatic Hydrocarbon Analysis in Biodegradation Assays,
W82-01235 5A

Laboratory Procedure for Estimating Residue Dynamics of Xenobiotic Contaminants in a Freshwater Food Chain,
W82-01443 5B

BIOINDICATORS
Use of Excised Root Cultures as Bioindicators of Water Pollution (Utilisation Des Cultures de Racines Isolees Comme Test Biologique de Pollution des Eaux),
W82-01133 5A

Periphyton Analysis for the Evaluation of Water Quality in Running Waters of Greece,
W82-01358 5A

Environmental Recovery in a Marine Ecosystem Impacted by a Sulfite Process Pulp Mill,
W82-01548 5B

BIOLOGICAL FILTERS
Biological Filters,
W82-01242 5D

BIOLOGICAL TREATMENT
Denitrification of Blackwater with Greywater,
W82-01225 5D

Design and Cost Comparison of Biological Nitrogen Removal Processes,
W82-01544 5D

Operational Problems with Rotating Biological Contactors,
W82-01549 5D

BIOLOGICAL WASTEWATER TREATMENT
Advanced Wastewater Plant is Energy Saver,
W82-01177 5D

BIOMASS
A Survey of ATP Concentrations in Lake Ontario, 1975-1976,
W82-01144 2H

BLEACHING WASTES
O2 Bleaching Shows Potential for Reducing Costs and Effluent Problems,
W82-01578 5D

BLUEGILLS
Abate: Effects of the Organophosphate Insecticide on Bluegills and Invertebrates in Ponds,
W82-01445 5C

BOUNDARY PROCESS
Evaluation of Effective Boundary Roughness for Gravel-Bed Rivers,
W82-01161 8B

BOW LAKE
The Effect of Changing Sediment Supply on Sedimentation in a Glacier-Fed Lake,
W82-01510 2H

BRAIDED RIVERS
Channel Instability in a Braided, Sand Bed River,
W82-01316 2J

BRAZIL
Physical and Chemical Studies of Lago Tupe; A Central Amazonian Black Water 'Ria Lake',
W82-01381 2H

BRAZOS RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing; Brazos River Basin, Texas-New Mexico.
W82-01439 6D

BRITISH COLUMBIA
Variations of pH with Annual Cumulative Precipitation in Acid Forest Soils,
W82-01118 2G

Environmental Recovery in a Marine Ecosystem Impacted by a Sulfite Process Pulp Mill,
W82-01548 5B

BROMIDES
Methyl Bromide and Bromide-Ion in Drainage Water After Leaching of Glasshouse Soils,
W82-01492 5B

CADMIUM
Atomic Absorption Spectrophotometric Studies of Cadmium and Zinc in Commercial Fertilisers, Soils and River Waters,
W82-01388 5B

The Physicochemical Speciation of Cd, Pb, Cu, Fe, and Mn in the Final Effluent of a Sewage Treatment Works and Its Impact on Speciation in the Receiving River,
W82-01498 5B

CALIFORNIA
Water Resources Data for California, Water Year 1980--Volume 1. Colorado River Basin, Southern Great Basin from Mexican Border to Mono Lake Basin, and Pacific Slope Basins from Tijuana River to Santa Maria River.
W82-01204 7C

Water Resources Data for California, Water Year 1980--Volume 2. Pacific Slope Basins from Arroyo Grande to Oregon State Line Except Central Valley.
W82-01205 7C

Water Resources Data for California, Water Year 1980--Volume 3. Southern Central Valley Basins and the Great Basin from Walker River to Truckee River.
W82-01206 7C

Water Resources Data for California, Water Year 1980--Volume 4. Northern Central Valley Basins and the Great Basin from Honey Lake Basin to Oregon State Line.
W82-01207 7C

Storm Flow Response to Road Building and Partial Cutting in Small Streams of Northern California,
W82-01295 4C

The Stringfellow Industrial Waste Disposal Site: A Technical Assessment of Environmental Impact,
W82-01415 5B

Use of the Contingency Fund at Stringfellow Hazardous Waste Disposal Site,
W82-01416 5G

Interdisciplinary Environmental Analysis for Timber Sale Planning,
W82-01539 6A

CALLAHAN RESERVOIR
Sediment and Nutrient Trap Efficiency of a Small Flood-Detention Reservoir,
W82-01471 4A

CANADA
Studies for Abatement of Pollution from Combined Sewer Overflows in Canada,
W82-01200 5G

The Effect of Changing Sediment Supply on Sedimentation in a Glacier-Fed Lake,
W82-01510 2H

The Behavior of a Polar Ice-Dammed Lake, Ellesmere Island, N.W.T., Canada,
W82-01511 2C

CANOPY
Canopy Temperature as a Crop Water Stress Indicator,
W82-01106 2I

CARBON
Some Factors Affecting the Determination of Particulate Carbon and Nitrogen in River Water,
W82-01532 5A

CARBON RADIOISOTOPES
Carbon 14 Dating of Groundwater in Confined Aquifers: Implications of Aquitard Diffusion,
W82-01464 2F

CARCINOGENS
Radon-222, In Potable Water Supplies of New England,
W82-01221 5B

CARP
Zooplankton Abundance and Diversity in Central Florida Grass Carp Ponds,
W82-01520 2H

CASE STUDIES
Economic Impacts of Erosion and Sedimentation Control Plans: Case Studies of Pennsylvania Dairy Farms,
W82-01134 4D

CASPER CREEK
Storm Flow Response to Road Building and Partial Cutting in Small Streams of Northern California,
W82-01295 4C

CATCHMENT AREAS
Land and Stream Salinity in Western Australia,
W82-01374 5B

CATCHMENT BASINS
A Catchment Approach to Flood Estimation,
W82-01397 2E

CAYUGA LAKE
Nearshore Spatial Distribution of Fishes in Gill Net Samples, Cayuga Lake, New York,
W82-01195 7A

CHANNEL FLOW
Concentrated Flow Relationships,
W82-01409 2J

CHANNEL MORPHOLOGY
Channel Instability in a Braided, Sand Bed River,
W82-01316 2J

CHANNELING
Sediment Oxygen Demand and Its Effect on Dissolved Oxygen in a Cutoff Meander of the Kaskaskia River,
W82-01448 4A

CHELATION
Soluble Element Concentrations and Complexation in Southeastern Lake Michigan,
W82-01147 2H

The Physicochemical Speciation of Cd, Pb, Cu, Fe, and Mn in the Final Effluent of a Sewage Treatment Works and Its Impact on Speciation in the Receiving River,
W82-01498 5B

CHEMICAL ANALYSIS
Application of Capillary Gas Chromatography Mass Spectrometry/Computer Techniques to Synoptic Survey of Organic Material in Bed Sediment,
W82-01573 5A

CHEMICAL ANAYSIS
Rapid Methods of Chemical Analysis Used in Emergency Response Mobile Laboratory Activities,
W82-01431 5A

CHEMICAL COMPOSITION
The Crustacean Zooplankton of Mali (West Africa),
W82-01379 2H

Hydrochemical Facies in a Tertiary Basin in the Milligan Canyon Area, Southwest Montana,
W82-01481 2F

CHEMICAL PRECIPITATION
Data Base Development for the Design of a Radium-226 Removal Process,
W82-01188 5D

Trace Metal Mineral Equilibria in Lake Erie Sediments,
W82-01191 2H

CHEMICAL REACTIONS
Factors Affecting the Chemistry of Precipitation and River Water in an Upland Catchment,
W82-01322 2K

CHEMICAL WASTES
Bacteria: Man's Allies in Water Pollution Control,
W82-01158 5D

Organochlorine Insecticides and PCB in Surficial Sediments of Lake Michigan (1975),
W82-01190 5A

CHEMICAL WASTEWATER
Chemicals and Allied Products,
W82-01267 5D

CHEMISTRY OF PRECIPITATION
Factors Affecting the Chemistry of Precipitation and River Water in an Upland Catchment,
W82-01322 2K

CHESAPEAKE BAY
Effect of Kepone on Estuarine Microbial Activity,
W82-01231 5C

CHICAGO
Yield Verification of a Dolomite Aquifer in Northeast Illinois,
W82-01334 2F

CHINA
Bacteria: Man's Allies in Water Pollution Control,
W82-01158 5D

Hydropower--An Old Technology for a New Era,
W82-01593 4A

CHLORINATED HYDROCARBONS
The Influence of Chemical Conditioning and Dewatering on the Distribution of Polychlorinated Biphenyls and Organochlorine Insecticides in Sewage Sludges,
W82-01387 5E

Love Canal: Chemical Contamination and Migration,
W82-01436 5B

CHLORINATION
Persistence of Pseudomonas Aeruginosa in Chlorinated Swimming Pools,
W82-01124 5A

Disinfection,
W82-01250 5D

Environmental Impact and Health Effects of Wastewater Chlorination,
W82-01451 5D

CHROMIUM
Identification and Reclamation of Chromium Sludge Disposal Sites,
W82-01437 5E

CITRUS FRUITS
Hydraulic Conductivity of Four Commercial Citrus Rootstocks,
W82-01546 2I

CLADOPHORA
Phosphorus Uptake Dynamics as Related to Mathematical Modeling of Cladophora at a Site on Lake Huron,
W82-01149 5C

CLAYS
Plume Development Using Lagrangian Marker Method,
W82-01182 5B

Origin, Age and Movement of Pore Water in Agrillaceous Quaternary Deposits at Four Sites in Southwestern Ontario,
W82-01321 2F

CLIMATIC DATA
A Dendroclimatic Reconstruction of Annual Precipitation Amounts in Iowa Since 1680,
W82-01314 2B

CLOUD SEEDING
Ice Nucleus Concentrations Measured During the 1975 Florida Area Cumulus Experiment (FACE),
W82-01522 7B

CLOUDS
A Balloonborne Instrument for the Measurement of Vertical Profiles of Supercooled Liquid Water Concentration,
W82-01524 7B

Experimental Verification of the Linear Relationship Between IR Extinction and Liquid Water Content of Clouds,
W82-01525 7B

COAGULATION
Interpreting Laboratory Results for the Design of Rapid Mixing and Flocculation Systems,
W82-01166 5F

COAL GASIFICATION
Acute Toxicity of Leachates from Coal Gasification and Liquefaction Solid Wastes to the Fathead Minnow, Pimephales Promelas,
W82-01108 5C

Synthetic Fuel Effluents,
W82-01263 5B

Modeling of Activated Carbon and Coal Gasification Char Adsorbents in Single-Solute and Bisolute Systems,
W82-01447 1B

COAL MINES
The Effect of Pollutants from the Coal Industry on the Fish Fauna of a Small River in the South Wales Coalfield,
W82-01389 5C

COAL MINING
Coal and Coal Mine Drainage,
W82-01261 5G

COASTAL AQUIFERS
A Numerical Solution for the Movement of an Interface in a Layered Coastal Aquifer,
W82-01327 2F

A One-Dimensional, Finite Element Salt Water Intrusion Model,
W82-01452 7A

COASTAL WATERS
Faecal Pollution of Belgian Coastal Water,
W82-01373 5A

COLIFORMS
Potential Health Hazards from Microbial Aerosols in Densely Populated Urban Regions,
W82-01232 5C

Faecal Pollution of Belgian Coastal Water,
W82-01373 5A

COLORADO
Design and Merit of a River-Aquifer Model for Optimal Use of Agricultural Water,
W82-01193 6A

Water Resources Data for Colorado, Water Year 1980--Volume 2. Colorado River Basin Above Dolores River.
W82-01217 7C

COLORADO RIVER
Irrigation Management of Colorado River Water with Increase in Salinity,
W82-01226 3C

Geomorphology of the Colorado River in the Grand Canyon,
W82-01338 2J

COLUMBIA RIVER
Hydropower Losses from Navigation in the Snake-Columbia Rivers: 1978-79,
W82-01139 6D

COMBINED SEWER OVERFLOWS
Studies for Abatement of Pollution from Combined Sewer Overflows in Canada,
W82-01200 5G

Urban Runoff and Combined Sewer Overflow,
W82-01254 5B

COMBINED SEWERS
Studies for Abatement of Pollution from Combined Sewer Overflows in Canada,
W82-01200 5G

COMBINED TREATMENT
Purification of Municipal Wastewater by Subsequent Reverse Osmosis and Anaerobic Digestion,
W82-01468 5D

COMMON LAW
Federal Common Law of Nuisance Expands,
W82-01337 6E

COMPARISON STUDIES
Zooplankton Abundance and Diversity in Central Florida Grass Carp Ponds,
W82-01520 2H

COMPUTER MODELS
Computer Modeling of Los Angeles Water Resources,
W82-01168 6A

Potential Use of a Stream-Aquifer Model for Management of a River Basin: Case of the South Platte River in Colorado,
W82-01301 6A

CONCRETE CONSTRUCTION
An Investigation Into the Effects of Thermal Movement in the Walls of Service Reservoirs,
W82-01396 8F

CONDUCTIVITY
Determination of Solution Electrical Conductivity from Bulk Soil Electrical Conductivity Measurements by the Four-Electrode Method,
W82-01458 2G

CONFINED AQUIFERS
Gaseous Nitrogen as Evidence for Denitrification in Groundwater,
W82-01485 2K

CONNECTICUT
Preliminary Risk Evaluation for Suspected Hazardous Waste Disposal Sites in Connecticut,
W82-01417 5G

CONSERVATION
Extraction Timing and Economic Incentives for Geothermal Reservoir Management,
W82-01504 4B

CONSERVATION TILLAGE
Residue and Tillage Effects on SCS Runoff Curve Numbers,
W82-01404 4D

CONSTRUCTION
The River Ouse Water Supply Scheme,
W82-01371 5F

CONSTRUCTION METHODS
Redesign Controls Manhole Leakage,
W82-01237 8G

CONTAMINATION
The Effect of Flyash Disposal on a Shallow Ground-Water System,
W82-01220 5B

CONTROL SYSTEMS
Automatic Class-A Pan-Filling System,
W82-01326 7B

COOLING TOWERS
Optimum Recycle and Reuse Cooling System Designs Using the BCT Process,
W82-01503 3E

Anomalous Snowfall Caused by Natural-Draft Cooling Towers,
W82-01512 2B

Weather Modification from Cooling Towers. A Test Based on the Distributional Properties of Rainfall,
W82-01527 2B

Treatment of Sewage Plant Effluent for Use as Makeup Water,
W82-01585 3C

COOLING WATER
Power Industry Wastes,
W82-01265 5B

Entrainment and Impingement in Power Plant Cooling Systems,
W82-01276 6G

Cooling Water Intake Screening Devices Used to Reduce Entrainment and Impingement,
W82-01442 8I

Chemical Control of Mussel Settlement in a Cooling Water System Using Acrolein,
W82-01501 5F

COON CREEK
Changes in Sediment Storage in the Coon Creek Basin, Driftless Area, Wisconsin, 1853 to 1975,
W82-01563 2J

COPEPODS
Interactive Effects of Metals in Mixtures on Biomass Production Kinetics of Freshwater Copepods,
W82-01125 5C

COPPER
Effect of Copper on Nitrification in Activated Sludge,
W82-01497 5C

CORN
Climatic Factors Contributing to Year-To-Year Variation in Grain Yield of Corn on Brookston Clay,
W82-01115 2I

CORROSION
Treatment of Sewage Plant Effluent for Use as Makeup Water,
W82-01585 3C

COST ANALYSIS
Expansion of Effluent Constrained Treatment Plants,
W82-01355 5D

Extraction Timing and Economic Incentives for Geothermal Reservoir Management,
W82-01504 4B

COST-BENEFIT ANALYSIS
Effect of Investments in Water Supply and Sanitation on Health Status: A Threshold-Saturation Theory,
W82-01331 6B

COSTS
Cost Effective Ground Water Monitoring,
W82-01113 4B

Energy Requirement for Small Wastewater Treatment Systems,
W82-01185 5D

Economics,
W82-01304 5G

CRACKS
An Investigation Into the Effects of Thermal Movement in the Walls of Service Reservoirs,
W82-01396 8F

CROP PRODUCTION
Combination Surface-Subsurface Drainage Systems for Humid Regions,
W82-01228 4A

CROP YIELD
Effect of Water, Nitrogen and Row Spacing on the Yield and Oil Content of Safflower,
W82-01112 2I

Climatic Factors Contributing to Year-To-Year Variation in Grain Yield of Corn on Brookston Clay,
W82-01115 2I

Estimating Evapotranspiration from Irrigated Crops in Southwestern Ontario,
W82-01116 2D

The Effect of Snow Trapping and Cropping Sequence on Moisture Conservation and Utilization in West-Central Saskatchewan,
W82-01117 3F

Yield and Phenotypic Traits of Semidwarf and Normal-Statured Barley (Hordeum Vulgare L.) Genotypes Grown Under Differing Levels of Moisture Stress,
W82-01121 2I

Drought Susceptibility of Two Tomato (Lycopersicum Esculentum) Varieties,
W82-01369 2I

Irrigation Needs and Yield of Rice on a Sandy-Loam Soil as Affected by Continuous and Intermittent Submergence,
W82-01382 3F

CROP YIELDS
Vegetation Selection and Management for Overland Flow Systems,
W82-01500 5E

CROPLAND
Relationship Between Increased Crop Acreage and Nonpoint-Source Pollution: A Georgia Case Study,
W82-01550 5B

CROPS
Comparison of Tests Characterizing Varieties of Barley and Wheat for Moisture Stress Resistance,
W82-01114 2I

CRYSTAL GROWTH
Lidar Determinations of Atmospheric Ice Crystal Layers at South Pole During Clear-Sky Precipitation,
W82-01529 2C

CULTURE MEDIA
A Note on the Use of Membrane Faecal Coliform Medium for Enhancing Resolution and Accuracy When Enumerating a Small Plaquing Coliphage,
W82-01507 5A

Comparison of Selective Media for the Enumeration and Identification of Fecal Streptococci from Natural Sources,
W82-01564 5A

CUTOFFS
Soil-Bentonite Supply Trench Cutoffs,
W82-01599 8D

CYANIDE
Electroplating and Cyanide Wastes,
W82-01266 5D

CYCLING NUTRIENTS
Dynamic Nutrient Cycle Model for Waste Stabilization Ponds,
W82-01541 5D

DAIRY INDUSTRY
Economic Impacts of Erosion and Sedimentation Control Plans: Case Studies of Pennsylvania Dairy Farms,
W82-01134 4D

Dairy Wastes,
W82-01258 5D

Effects of Dairy Manure on Phosphorus Concentrations and Losses in Tile Effluent,
W82-01479 5B

DAM CONSTRUCTION
Yangtze Gorges Scheme Could Yield 110 TWh/Year.
W82-01394 8A

Northfield Mountain Pumped Storage Project: Performance,
W82-01517 8A

Rosario Dominicana's Cyanide Tailings Dam Construction and Operation.
W82-01589 5D

DAM DESIGN
Siting and Design of Tailings Impoundments,
W82-01588 8A

DAMS
Hydropower--An Old Technology for a New Era,
W82-01593 4A

DATA COLLECTIONS
Data Base Development for the Design of a Radium-226 Removal Process,
W82-01188 5D

DATING
Carbon 14 Dating of Groundwater in Confined Aquifers: Implications of Aquitard Diffusion,
W82-01464 2F

DDT
Influence of PCBs in Water on Uptake and Elimination of DDT and DDE by Lake Trout,
W82-01342 5C

DEBRIS CONE
Debris Flows in Small Mountain Stream Channels of Colorado and Their Hydrologic Implications,
W82-01597 2E

DECIDUOUS FORESTS
The Role of Atmospheric Deposition in an Eastern U.S. Deciduous Forest,
W82-01491 5B

DECOMPOSITION
Effect of Different Levels of Water Salinity on the Decomposition of Organic Manures in a Brackish Water Fish Pond Soil,
W82-01363 3C

DEDHAM
Organic Contamination of Ground Water: Tell it All,
W82-01474 5C

DELMARVA PENINSULA
Using Computed Stream Flow in Watershed Analysis,
W82-01538 2A

DENDROCHRONOLOGY
A Dendroclimatic Reconstruction of Annual Precipitation Amounts in Iowa Since 1680,
W82-01314 2B

DENITRIFICATION
Nitrate Reduction in an Organic Soil-Water System,
W82-01129 5B

Denitrification of Blackwater with Greywater,
W82-01225 5D

Gaseous Nitrogen as Evidence for Denitrification in Groundwater,
W82-01485 2K

Design and Cost Comparison of Biological Nitrogen Removal Processes,
W82-01544 5D

DENTRIFICATION
Dentrification,
W82-01246 5D

DENUDATION
Drainage Density as an Index of Climatic Geomorphology,
W82-01324 2A

DEPOSITION
The Role of Atmospheric Deposition in an Eastern U.S. Deciduous Forest,
W82-01491 5B

DESALINATION
Periodic Operation for Desalination with Thermally Regenerable Ion-Exchange Resin. Dynamic Studies,
W82-01341 3A

DESIGN CRITERIA
Design and Merit of a River-Aquifer Model for Optimal Use of Agricultural Water,
W82-01193 6A

Risk Models for Flood Levee Design,
W82-01307 8A

Optimal Risk-Based Design of Flood Levee Systems,
W82-01313 8B

Design and Construction of Shieldhall Sewage-Treatment Works, Glasgow,
W82-01385 5D

Preliminary Design and Cost Estimates for Remedial Actions at Hazardous Waste Disposal Sites,
W82-01435 5G

Optimum Recycle and Reuse Cooling System Designs Using the BCT Process,
W82-01503 3E

Northfield Mountain Pumped Storage Project: Performance,
W82-01517 8A

Survey of Treatment Plant Design and Operation Deficiencies,
W82-01543 5D

DESIGN STORMS
Erosivity 'R' for Individual Design Storms,
W82-01403 2J

DETENTION RESERVOIRS
Sediment and Nutrient Trap Efficiency of a Small Flood-Detention Reservoir,
W82-01471 4A

DETROIT
Detroit - Fresh Clean Water,
W82-01506 5D

DEUTERIUM
Deuterium/Hydrogen Ratios in Australian Rainfall,
W82-01325 2B

DEVELOPING COUNTRIES
Rural Water Supply and Related Services in Developing Countries-Comparative Analysis of Several Approaches,
W82-01330 6A

Rural Sanitation in Developing Countries,
W82-01392 5D

The Water Decade (1981-1990).
W82-01534 6E

Hydropower--An Old Technology for a New Era,
W82-01593 4A

DEWATERING
Electro-Osmosis Chemistry and Water Quality,
W82-01518 5E

DIATOMS
The Effects of a New Reservoir on the Attached Diatom Communities in Huntington Creek, Utah, U.S.A.,
W82-01521 2H

DIETS
Mining Pollution and the Diet of the Purple-Striped Gudgeon Mogurnda Mogurnda Richardson (Eleotridae) in the Finniss River, Northern Territory, Australia,
W82-01366 5C

DIFFUSION COEFFICIENT
Carbon 14 Dating of Groundwater in Confined Aquifers: Implications of Aquitard Diffusion,
W82-01464 2F

DIOXIN
Love Canal: Chemical Contamination and Migration,
W82-01436 5B

DISEASES
Disease Outbreaks Caused by Drinking Water,
W82-01289 5C

DISINFECTION
Disinfection,
W82-01250 5D

DISSOLVED OXYGEN
Dissolved Oxygen in Streams and Reservoirs,
W82-01272 5G

Sediment Oxygen Demand and Its Effect on Dissolved Oxygen in a Cutoff Meander of the Kaskaskia River,
W82-01448 4A

The Interaction of Treated Bleached Kraft Mill Effluent and Dissolved Oxygen Concentration on the Survival of the Developmental Stages of the Sheepshead Minnow (Cyprinodon Variegatus),
W82-01494 5C

DISTRIBUTION PATTERNS
An Analysis of Acidic Precipitation in South-Central Ontario Using Air Parcel Trajectories,
W82-01513 5B

Characterizing Sprinkler Distribution Patterns with a Clustering Algorithm,
W82-01575 3F

DIURNAL DISTRIBUTION
Diurnal, Depth-Wise, and Seasonal Changes of Physico-Chemical Factors in Sathiar Reservoir,
W82-01372 2H

DOMESTIC WASTES
Denitrification of Blackwater with Greywater,
W82-01225 5D

DOMINICAN REPUBLIC
Rosario Dominicana's Cyanide Tailings Dam Construction and Operation.
W82-01589 5D

DOUGLAS POINT NUCLEAR PLANT
An Empirical Methodology for Estimating Entrainment Losses at Power Plants Sited on Estuaries,
W82-01173 6G

DRAINAGE
Water and Salt Movement in a Saline-Sodic Soil in Southern Alberta,
W82-01119 2G

DRAINAGE DENSITY
Drainage Density as an Index of Climatic Geomorphology,
W82-01324 2A

DRAINAGE PATTERNS
Drainage Network Structure and the Diameter-Magnitude Relation,
W82-01308 2A

DRAINAGE SYSTEMS
Combination Surface-Subsurface Drainage Systems for Humid Regions,
W82-01228 4A

DRINKING WATER
The Problems of Non-Return and the Use of Valves in Drinking Water Protection Against Waste Water Return, Applying the Regulations in Force,
W82-01142 5F

Disease Outbreaks Caused by Drinking Water,
W82-01289 5C

The Application of Mutagenicity Testing to Drinking Water,
W82-01487 5A

Relationship of the Raw Water Quality to Mutagens Detectable by the Ames Salmonella/Microsome Assay in a Drinking-Water Supply,
W82-01493 5A

Organics in Water - An Engineering Challenge,
W82-01540 5F

Chrysotile Asbestos Fibers in Drinking Water from Asbestos-Cement Pipe,
W82-01592 5B

DROUGHT
Potential Use of a Stream-Aquifer Model for Management of a River Basin: Case of the South Platte River in Colorado,
W82-01301 6A

A Dendroclimatic Reconstruction of Annual Precipitation Amounts in Iowa Since 1680,
W82-01314 2B

DULUTH
Transports in the Duluth-Superior Harbor,
W82-01136 5B

DYE INDUSTRY WASTES
Textile Wastes,
W82-01259 5D

DYSTROPHIC LAKES
Physical and Chemical Studies of Lago Tupe; A Central Amazonian Black Water 'Ria Lake',
W82-01381 2H

EARTHQUAKE PREDICTIONS
Some Recent Studies on Groundwater Radon Content as an Earthquake Precursor,
W82-01127 2F

EARTHQUAKES
Some Recent Studies on Groundwater Radon Content as an Earthquake Precursor,
W82-01127 2F

Liquefaction Analysis for Multidirectional Shaking,
W82-01169 8D

ECOLOGICAL EFFECTS
Entrainment and Impingement in Power Plant Cooling Systems,
W82-01276 6G

Bioassays - Procedures and Results,
W82-01277 5A

Phytoplankton of Four Rivers, the Tyne, Wear, Tees and Swale,
W82-01376 2E

The Effects of a New Reservoir on the Attached Diatom Communities in Huntington Creek, Utah, U.S.A.,
W82-01521 2H

Environmental Recovery in a Marine Ecosystem Impacted by a Sulfite Process Pulp Mill,
W82-01548 5B

ECONOMIC ASPECTS
Economics,
W82-01304 5G

Relationship Between Increased Crop Acreage and Nonpoint-Source Pollution: A Georgia Case Study,
W82-01550 5B

Soil Erosion Control in Idaho's Cow Creek Watershed: An Economic Analysis,
W82-01556 4D

ECUADOR
Hydraulic Model Study of Daule-Peripa Spillway and Outlet Works,
W82-01446 8A

EDISTO RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing; Savannah and Edisto River Basins Area; Georgia-South Carolina-North Carolina.
W82-01440 6D

ELCTRICAL CONDUCTIVITY
Prediction of Diffusion Coefficients from the Electrical Conductance of Soil,
W82-01224 2G

ELECTRIC POWER
Hydropower Losses from Navigation in the Snake-Columbia Rivers: 1978-79,
W82-01139 6D

ELECTRIC POWER INDUSTRY
Power Industry Wastes,
W82-01265 5B

ELECTRICAL PROPERTIES
Determination of Solution Electrical Conductivity from Bulk Soil Electrical Conductivity Measurements by the Four-Electrode Method,
W82-01458 2G

ELECTRO-OSMOSIS
Electro-Osmosis Chemistry and Water Quality,
W82-01518 5E

ELECTROPLATING
Electroplating and Cyanide Wastes,
W82-01266 5D

ELLESMERE ISLAND
The Behavior of a Polar Ice-Dammed Lake, Ellesmere Island, N.W.T., Canada,
W82-01511 2C

ENDRIN
Toxicity and Bioaccumulation of Endrin and Methoxychlor in Aquatic Invertebrates and Fish,
W82-01160 5C

ENERGY
Energy Requirement for Small Wastewater Treatment Systems,
W82-01185 5D

ENERGY LOSS
Hydropower Losses from Navigation in the Snake-Columbia Rivers: 1978-79,
W82-01139 6D

ENERGY STORAGE
Thermal Energy Storage in a Confined Aquifer: Second Cycle,
W82-01473 4B

ENGLAND
The River Ouse Water Supply Scheme,
W82-01371 5F

Phytoplankton of Four Rivers, the Tyne, Wear, Tees and Swale,
W82-01376 2E

The Distribution of Mercury in the Sediments of the Plym Estuary,
W82-01390 5B

An Investigation Into the Effects of Thermal Movement in the Walls of Service Reservoirs,
W82-01396 8F

ENGLISH CHANNEL
Year-to-Year Changes in the Salinity of the Eastern English Channel, 1948-1973: A Budget,
W82-01399 2A

ENTERIC BACTERIA
Chemical and Bacteriological Quality of Pasture Runoff,
W82-01555 5B

ENTRAINMENT
An Empirical Methodology for Estimating Entrainment Losses at Power Plants Sited on Estuaries,
W82-01173 6G

Cooling Water Intake Screening Devices Used to Reduce Entrainment and Impingement,
W82-01442 8I

ENVIRONMENTAL EFFECTS
Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements,
W82-01278 5C

Water Characteristics,
W82-01305 5B

Holland's Eastern Scheldt Estuary Barrier Scheme: Some Ecological Considerations,
W82-01375 2L

Environmental Impact and Health Effects of Wastewater Chlorination,
W82-01451 5D

Management Concerns for Swimming, Tubing, and Wading in the Great Smoky Mountains National Park,
W82-01475 6A

EPHEMERAL LAKES
Data on the Stagnant Ponds of the Savannah of Lamto (Ivory Coast) (Donnees sur les Milieux Limniques Stagnants des Savanes de Lamto (Cote d'Ivoire)),
W82-01357 2H

EQUILIBRIUM
Chemical Equilibria in Split-Treatment Softening of Water,
W82-01165 5F

The Use of the Equilibrium Temperature to Establish the Heat Balance of a Water Surface (Sur l'Utilization de la Temperature d'Equilibre pour l'Etablissement du Bilan Thermique d'Un Plan d'Eau),
W82-01353 2H

EROSION
CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems.
W82-01401 5B

Changes in Sediment Storage in the Coon Creek Basin, Driftless Area, Wisconsin, 1853 to 1975,
W82-01563 2J

EROSION CONTROL
Economic Impacts of Erosion and Sedimentation Control Plans: Case Studies of Pennsylvania Dairy Farms,
W82-01134 4D

Residue and Tillage Effects on SCS Runoff Curve Numbers,
W82-01404 4D

Soil Conservation Problems and Practices: A Farmer View.
W82-01551 4D

Erosion and Sedimentation Control in Regional and Site Planning,
W82-01552 4D

Soil Erosion Control in Idaho's Cow Creek Watershed: An Economic Analysis,
W82-01556 4D

Managing Land to Meet Water Quality Goals,
W82-01557 4D

EROSION RATES
Modeling Erosion and Sediment Yield from Flatland Watersheds,
W82-01406 2J

ERROR ANALYSIS
Comparison of First-Order Error Analysis and Monte Carlo Simulation in Time-Dependent Lake Eutrophication Models,
W82-01460 2H

ESCHERICHIA COLI
The Escherichia Coli Content of Mytilus Edulis from Analysis of Whole Tissue or Digestive Tract,
W82-01508 5A

ESTIMATING EQUATIONS
Linearized Solution to Inlet Equation with Inertia,
W82-01183 2L

ESTUARIES
An Empirical Methodology for Estimating Entrainment Losses at Power Plants Sited on Estuaries,
W82-01173 6G

Limnetic Larval Fish of the Maumee and Sandusky River Estuaries,
W82-01197 7A

Holland's Eastern Scheldt Estuary Barrier Scheme: Some Ecological Considerations,
W82-01375 2L

The Distribution of Mercury in the Sediments of the Plym Estuary,
W82-01390 5B

ESTUARINE ENVIRONMENT
Effect of Kepone on Estuarine Microbial Activity,
W82-01231 5C

Marine and Estuarine Pollution,
W82-01274 5C

Thoughts on the Need to Control Discharges to Estuarial and Coastal Waters,
W82-01384 6E

An Estuarine Agar Medium for Enumeration of Aerobic Heterotrophic Bacteria Associated with Water, Sediment, and Shellfish,
W82-01565 5A

The Effects of Organophosphorus Pesticides on Estuarine Ammonium Oxidizers,
W82-01567 5C

EUTROPHICATION
Regionalization of the Upper Great Lakes with Respect to Surveillance Eutrophication Data,
W82-01150 7A

Phytoplankton Productivity and Standing Crop in the Vicinity of the Lake Huron-Saginaw Bay Front,
W82-01164 2H

Eutrophication,
W82-01271 2H

Physico-Chemistry, Destratification and Nutrient Budget of a Lowland Eutrophicated Malaysian Reservoir and Its Limnological Implications,
W82-01360 2H

Comparative Limnology of Nine Lakes of Jammu and Kashmir Himalayas,
W82-01361 2H

The Effect of Fertilization with Phosphorus and Nitrogen Versus Phosphorus Alone on Eutrophication of Experimental Lakes,
W82-01457 5C

Comparison of First-Order Error Analysis and Monte Carlo Simulation in Time-Dependent Lake Eutrophication Models,
W82-01460 2H

Historical Changes and Relationship to Internal Loading of Sediment Phosphorus Forms in Hypertrophic Prairie Lakes,
W82-01516 2H

Collapsing Aphanizomenon Flos-Aquae Blooms: Possible Contributions of Photo-Oxidation, O2 Toxicity, and Cyanophages,
W82-01595 2H

EVALUATION
Comparative Evaluation of Processes for the Treatment of Concentrated Wastewaters at Uncontrolled Hazardous Waste Sites,
W82-01430 5D

EVAPORATION PANS
Automatic Class-A Pan-Filling System,
W82-01326 7B

EVAPOTRANSPIRATION
Estimating Evapotranspiration from Irrigated Crops in Southwestern Ontario,
W82-01116 2D

Estimating Evapotranspiration from the Sonoita Creek Watershed near Patagonia, Arizona,
W82-01306 2D

FARM MANAGEMENT
Soil Erosion Control in Idaho's Cow Creek Watershed: An Economic Analysis,
W82-01556 4D

FARM WASTES
The Movement of Salts from Soils Following Heavy Application of Feedlot Wastes,
W82-01132 5B

FARMING
Economic Impacts of Erosion and Sedimentation Control Plans: Case Studies of Pennsylvania Dairy Farms,
W82-01134 4D

Soil Conservation Problems and Practices: A Farmer View.
W82-01551 4D

FARMS
Land and Stream Salinity in Western Australia,
W82-01374 5B

FATE OF POLLUTANTS
The Movement of Salts from Soils Following Heavy Application of Feedlot Wastes,
W82-01132 5B

Microbiology: Detection, Occurrence, and Removal of Viruses,
W82-01290 5A

Chemical and Bacteriological Quality of Pasture Runoff,
W82-01555 5B

FATHEAD MINNOWS
Acute Toxicity of Leachates from Coal Gasification and Liquefaction Solid Wastes to the Fathead Minnow, Pimephales Promelas,
W82-01108 5C

FATTY ACIDS
Fatty Acid and Hydrocarbon Content of Settling Sediments in Lake Michigan,
W82-01154 2H

FECES
Faecal Pollution of Belgian Coastal Water,
W82-01373 5A

FEEDLOT RUNOFF
Chemical and Bacteriological Quality of Pasture Runoff,
W82-01555 5B

FERMENTATION
Fermentation Industry,
W82-01257 5D

FERTILIZERS
The Movement of Salts from Soils Following Heavy Application of Feedlot Wastes,
W82-01132 5B

Atomic Absorption Spectrophotometric Studies of Cadmium and Zinc in Commercial Fertilisers, Soils and River Waters,
W82-01388 5B

Nitrate Production, Uptake, and Leaching,
W82-01411 5B

Nitrogen Leaching as Influenced by Nitrogen Management and Supplement Irrigation Level,
W82-01472 5B

FILTRATION
Reclamation of Wastewater with a Soil-Turf Filter: I: Removal of Nitrogen,
W82-01101 5D

Reclamation of Wastewater with a Soil-Turf Filter: II: Removal of Phosphorus, Boron, Sodium and Chlorine,
W82-01102 5D

A Successful Low Technology Wastewater Process,
W82-01178 5D

Investigation of Volatile Organics Removal,
W82-01490 5F

FINNISS RIVER
Mining Pollution and the Diet of the Purple-Striped Gudgeon Mogurnda Mogurnda Richardson (Eleotridae) in the Finniss River, Northern Territory, Australia,
W82-01366 5C

FIRN
Evaluation of Ultraviolet Spectrophotometric Determination of Nitrate-Nitrogen in Glacial Snow, Firn and Ice,
W82-01572 5A

FISH
The Effects of Pollution on Freshwater Fish,
W82-01282 5C

Mining Pollution and the Diet of the Purple-Striped Gudgeon Mogurnda Mogurnda Richardson (Eleotridae) in the Finniss River, Northern Territory, Australia,
W82-01366 5C

Ecology of Larval Fishes in Lake Oahe, South Dakota,
W82-01444 6G

Polychlorinated Biphenyls and Other Organic Chemical Residues in Fish from Major United States Watersheds Near the Great Lakes, 1978,
W82-01583 5A

Cadmium, Lead, Mercury, Arsenic, and Selenium Concentrations in Freshwater Fish, 1976-77-National Pesticide Monitoring Program,
W82-01584 5B

FISH ESTABLISHMENT
Evidence of Natural Reproduction by Planted Lake Trout in Lake Michigan,
W82-01194 8I

FISH HANDLING FACILITIES
Meat-, Fish-, and Poultry-Processing Wastes,
W82-01256 5D

FISH PONDS
Effect of Different Levels of Water Salinity on the Decomposition of Organic Manures in a Brackish Water Fish Pond Soil,
W82-01363 3C

FISH POPULATIONS
Postspawning Mortality of Rainbow Smelt in Western Lake Superior,
W82-01189 5C

Evidence of Natural Reproduction by Planted Lake Trout in Lake Michigan,
W82-01194 8I

Nearshore Spatial Distribution of Fishes in Gill Net Samples, Cayuga Lake, New York,
W82-01195 7A

Limnetic Larval Fish of the Maumee and Sandusky River Estuaries,
W82-01197 7A

Mercury and Lead Concentrations in Some Species of Fish From the Tuscan Coasts (Italy),
W82-01368 5B

The Effect of Pollutants from the Coal Industry on the Fish Fauna of a Small River in the South Wales Coalfield,
W82-01389 5C

Preliminary Report of Stream Sampling for Acidification Studies 1980,
W82-01453 5A

FISH TOXINS
Preliminary Report of Stream Sampling for Acidification Studies 1980,
W82-01453 5A

The Interaction of Treated Bleached Kraft Mill Effluent and Dissolved Oxygen Concentration on the Survival of the Developmental Stages of the Sheepshead Minnow (Cyprinodon Variegatus),
W82-01494 5C

FLOCCULATION
Interpreting Laboratory Results for the Design of Rapid Mixing and Flocculation Systems,
W82-01166 5F

FLOOD FLOW
Debris Flows in Small Mountain Stream Channels of Colorado and Their Hydrologic Implications,
W82-01597 2E

FLOOD FORECASTING
Regional Flood Frequency Estimation and Network Design,
W82-01294 2E

A Catchment Approach to Flood Estimation,
W82-01397 2E

Monitoring Glacier Outburst Floods,
W82-01558 2C

FLOOD FREQUENCY
Regional Flood Frequency Estimation and Network Design,
W82-01294 2E

Determination of the Confidence Intervals of the Wakeby Distribution Using Order Statistics,
W82-01317 2E

FLOOD PROTECTION
Risk Models for Flood Levee Design,
W82-01307 8A

Optimal Risk-Based Design of Flood Levee Systems,
W82-01313 8B

Holland's Eastern Scheldt Estuary Barrier Scheme: Some Ecological Considerations,
W82-01375 2L

FLOODNG
The Stringfellow Industrial Waste Disposal Site: A Technical Assessment of Environmental Impact,
W82-01415 5B

FLOODS
Monitoring Glacier Outburst Floods,
W82-01558 2C

FLOODWATER
Nitrate Reduction in an Organic Soil-Water System,
W82-01129 5B

FLORIDA
Water Resources Data for Florida, Water Year 1980--Volume 3A: Southwest Florida Surface Water.
W82-01215 7C

Water Resources Data for Florida, Water Year 1980--Volume 3B: Southwest Florida Ground Water.
W82-01216 7C

FLOTATION
High-Solubility Gas Flotation,
W82-01184 5D

Developments in Sedimentation and Flotation,
W82-01391 5F

FLOW CHARACTERISTICS
Vertical Velocity Profiles in Stratified Flows,
W82-01171 8B

Hydrodynamic Dispersion During Constant Rate Absorption of Water by Soil,
W82-01174 2G

A Model for Simulation of Flow in Singular and Interconnected Channels,
W82-01210 2E

Phosphorus Concentration-Water Flow Interactions in Tile Effluent from Manured Land,
W82-01340 5B

FLOW VELOCITY
Evaluation of Effective Boundary Roughness for Gravel-Bed Rivers,
W82-01161 8B

An Approach to Determining Pathways and Residence Time of Groundwaters: Dual Radiotracer Dating,
W82-01348 2F

FLUORESCENCE SPECTROSCOPY
Rapid Methods of Chemical Analysis Used in Emergency Response Mobile Laboratory Activities,
W82-01431 5A

FLUSHING
Significant Features of Emitter Flushing Mode Characteristics,
W82-01576 3F

FLY ASH
Monitoring Ground-Water Contamination at a Fly Ash Disposal Site Using Surface Electrical Resistivity Methods,
W82-01218 5B

The Effect of Flyash Disposal on a Shallow Ground-Water System,
W82-01220 5B

FOOD CHAINS
Laboratory Procedure for Estimating Residue Dynamics of Xenobiotic Contaminants in a Freshwater Food Chain,
W82-01443 5B

FOOD PROCESSING INDUSTRY
Meat-, Fish-, and Poultry-Processing Wastes,
W82-01256 5D

FOREST MANAGEMENT
Changes in Soil Water Quality Resulting from Three Timber Cutting Methods and Three Levels of Fiber Utilization,
W82-01135 2G

FOREST WATERSHEDS
Water Quality from Two Small Forested Watersheds in Southern Illinois,
W82-01140 4C

Predicting Stream Salinity Changes in South-Western Australia,
W82-01350 6A

FORESTRY
Interdisciplinary Environmental Analysis for Timber Sale Planning,
W82-01539 6A

FORESTS
Variations of pH with Annual Cumulative Precipitation in Acid Forest Soils,
W82-01118 2G

Stream Nutrient Levels and Proximity of Agricultural and Forest Land to Streams: Some Relationships,
W82-01554 5B

Acid Precipitation: Basic Principles and Ecological Consequences,
W82-01586 5C

FOULING
Chemical Control of Mussel Settlement in a Cooling Water System Using Acrolein,
W82-01501 5F

FRACTURE PERMEABILITY
An Analytical Solution for Solute Transport Through Fractured Media with Matrix Diffusion,
W82-01179 2F

FRANCE
Use of Excised Root Cultures as Bioindicators of Water Pollution (Utilisation Des Cultures de Racines Isolees Comme Test Biologique de Pollution des Eaux),
W82-01133 5A

Sanitation Service Management in France (La Gestion des Services d'Assainissement en France),
W82-01351 6F

The Use of the Equilibrium Temperature to Establish the Heat Balance of a Water Surface (Sur l'Utilization de la Temperature d'Equilibre pour l'Etablissement du Bilan Thermique d'Un Plan d'Eau),
W82-01353 2H

FRANKLIN COUNTY
Remedial Technique of Controlling and Treating Low Volume Leachate Discharge,
W82-01428 5G

FRICTION LOSS
Pipeline Friction Losses for Wastewater Sludges,
W82-01545 5D

FROST
Water Frost and Ice: The Near-Infrared Spectral Reflectance 0.65-2.5 Microns,
W82-01346 2C

GAGING
Compatibility of Canadian Snowfall and Snow Cover Data,
W82-01466 2C

GAGING STATIONS
A Catchment Approach to Flood Estimation,
W82-01397 2E

GAS CHROMATOGRAPHY
Rapid Methods of Chemical Analysis Used in Emergency Response Mobile Laboratory Activities,
W82-01431 5A

GEOCHEMISTRY
Ferromanganese Nodules from Lake Ontario (Bay of Quinte): Minor Element Geochemistry,
W82-01143 2H

GEOHYDROLOGY
Geohydrologic Models of the Houston District, Texas,
W82-01335 2F

GEOLOGIC FRACTURES
Groundwater Investigations in the Vale of Stathmore,
W82-01400 2F

GEOMORPHOLOGY
Drainage Density as an Index of Climatic Geomorphology,
W82-01324 2A

Geomorphology of the Colorado River in the Grand Canyon,
W82-01338 2J

GEOTHERMAL POWER
Identification of the Wairakei Geothermal System,
W82-01312 2F

GEOTHERMAL RESOURCES
On Identification and Validation of Some Geothermal Models,
W82-01467 6A

Extraction Timing and Economic Incentives for Geothermal Reservoir Management,
W82-01504 4B

GEOTHERMAL STUDIES
On Identification and Validation of Some Geothermal Models,
W82-01467 6A

Thermal Energy Storage in a Confined Aquifer: Second Cycle,
W82-01473 4B

GILA RIVER
Channel Instability in a Braided, Sand Bed River,
W82-01316 2J

GLACIAL LAKES
Monitoring Glacier Outburst Floods,
W82-01558 2C

GLACIAL SEDIMENTS
The Effect of Changing Sediment Supply on Sedimentation in a Glacier-Fed Lake,
W82-01510 2H

GLACIOHYDROLOGY
Monitoring Glacier Outburst Floods,
W82-01558 2C

GLASGOW DRAINAGE AREA
Design and Construction of Shieldhall Sewage-Treatment Works, Glasgow,
W82-01385 5D

GLOBAL ENVIRONMENTAL MONITORING SYSTEM
Water-Quality Monitoring: A Global Approach,
W82-01339 7A

GRAND CANYON
Geomorphology of the Colorado River in the Grand Canyon,
W82-01338 2J

GRANITES
Geologic and Hydrologic Factors Controlling Radon-222 in Ground Water in Maine,
W82-01222 2F

GRAVEL
Evaluation of Effective Boundary Roughness for Gravel-Bed Rivers,
W82-01161 8B

GREAT BRITAIN
Artificial Groundwater Recharge,
W82-01110 4B

Developments in Sedimentation and Flotation,
W82-01391 5F

Development of Upton Intake Works, River Severn Supply Scheme, With the Aid of a Model,
W82-01395 8B

A Catchment Approach to Flood Estimation,
W82-01397 2E

GREAT LAKES
Public Concerns and PLUARG: Selected findings and Discussion,
W82-01137 5G

Modelling Effects of Remedial Programs to Aid Great Lakes Environmental Management,
W82-01146 5G

Nonpoint N Runoff from Agricultural Watersheds into the Great Lakes,
W82-01148 5B

Regionalization of the Upper Great Lakes with Respect to Surveillance Eutrophication Data,
W82-01150 7A

GREAT SMOKY MOUNTAIN NATIONAL PARK
Management Concerns for Swimming, Tubing, and Wading in the Great Smoky Mountains National Park,
W82-01475 6A

GREECE
Periphyton Analysis for the Evaluation of Water Quality in Running Waters of Greece,
W82-01358 5A

GREENHOUSES
Methyl Bromide and Bromide-Ion in Drainage Water After Leaching of Glasshouse Soils,
W82-01492 5B

GROUNDWATER
Some Recent Studies on Groundwater Radon Content as an Earthquake Precursor,
W82-01127 2F

Water Resources Data for California, Water Year 1980--Volume 1. Colorado River Basin, Southern Great Basin from Mexican Border to Mono Lake Basin, and Pacific Slope Basins from Tijuana River to Santa Maria River.
W82-01204 7C

Water Resources Data for California, Water Year 1980--Volume 2. Pacific Slope Basins from Arroyo Grande to Oregon State Line Except Central Valley.
W82-01205 7C

Water Resources Data for California, Water Year 1980--Volume 3. Southern Central Valley Basins and the Great Basin from Walker River to Truckee River.
W82-01206 7C

Water Resources Data for California, Water Year 1980--Volume 4. Northern Central Valley Basins and the Great Basin from Honey Lake Basin to Oregon State Line.
W82-01207 7C

Water Resources Data for Hawaii and Other Pacific Areas, Water Year 1980 - Volume 2. Trust Territory of the Pacific Islands, Guam, American Samoa, and Northern Mariana Islands.
W82-01209 7C

Water Resources Data for South Carolina, Water Year 1980.
W82-01211 7C

Water Resources Data for Pennsylvania, Water Year 1980--Volume 2. Susquehanna and Potomac River Basins.
W82-01212 7C

Water Resources Data for Montana, Water Year 1980--Volume 1. Hudson Bay Basin, Missouri River Basin.
W82-01213 7C

Water Resources Data for Montana, Water Year 1980--Volume 2. Upper Columbia River Basin.
W82-01214 7C

Water Resources Data for Florida, Water Year 1980--Volume 3B: Southwest Florida Ground Water.
W82-01216 7C

Water Resources Data for Colorado, Water Year 1980--Volume 2. Colorado River Basin Above Dolores River.
W82-01217 7C

The Effect of Flyash Disposal on a Shallow Ground-Water System.
W82-01220 5B

Ground Water,
W82-01273 2F

Microbiology of Ground Water,
W82-01286 5B

Discussion-Engineering Geology of Arid Areas,
W82-01568 4B

GROUNDWATER AVAILABILITY
Groundwater Investigations in the Vale of Stathmore,
W82-01400 2F

GROUNDWATER BUDGET
Yield Verification of a Dolomite Aquifer in Northeast Illinois,
W82-01334 2F

GROUNDWATER CONTAMINATION
Site Assessment: Improving Confidence Levels with Surface Remote Sensing,
W82-01422 5G

GROUNDWATER DATING
Origin, Age and Movement of Pore Water in Agrillaceous Quaternary Deposits at Four Sites in Southwestern Ontario,
W82-01321 2F

GROUNDWATER DIVIDE
Seasonal Reversals of Groundwater Flow Around Lakes and the Relevance to Stagnation Points and Lake Budgets,
W82-01103 2F

GROUNDWATER MANAGEMENT
Cost Effective Ground Water Monitoring,
W82-01113 4B

Results of Acidizing Water Wells in Arizona,
W82-01199 4B

Nebraska Ground Water Law and Administration,
W82-01236 6E

Evaluation of Remedial Treatment, Detoxification and Stabilization Alternatives,
W82-01434 5D

GROUNDWATER MOVEMENT
Seasonal Reversals of Groundwater Flow Around Lakes and the Relevance to Stagnation Points and Lake Budgets,
W82-01103 2F

An Analytical Solution for Solute Transport Through Fractured Media with Matrix Diffusion,
W82-01179 2F

A Comparison of the Incomplete Cholesky-Conjugate Gradient Method with the Strongly Implicit Method as Applied to the Solution of Two-Dimensional Groundwater Flow Equations.
W82-01315 2F

Uranium Isotopes as a Natural Tracer in the Waters of the Bet Shean-Harod Valleys, Israel.
W82-01328 2F

Computer Modeling and Ground-Water Protection.
W82-01336 2F

A Study of Regional Temperature and Thermohydrologic Effects of an Underground Repository for Nuclear Wastes in Hard Rock.
W82-01347 5E

An Approach to Determining Pathways and Residence Time of Groundwaters: Dual Radiotracer Dating.
W82-01348 2F

Case Studies on the Migration of Pollutants in Ground Water.
W82-01424 5B

Parameterization of Contaminant Transport Through an Anisotropic Unconfined Aquifer,
W82-01570 5B

GROUNDWATER POLLUTION
Monitoring Ground-Water Contamination at a Fly Ash Disposal Site Using Surface Electrical Resistivity Methods,
W82-01218 5B

Groundwater Contamination by Sanitary Landfill Leachate and Domestic Wastewater in Carbonate Terrain: Principal Source Diagnosis, Chemical Transport Characteristics and Design Implications,
W82-01223 5B

The National Assessment of the Ground-Water Contamination Potential of Wastewater Impoundments,
W82-01419 5G

Evaluation of Hydrogeologic Conditions,
W82-01420 5G

Practical Aspects of Ground Water Monitoring at Existing Disposal Sites,
W82-01421 5G

Case Studies on the Migration of Pollutants in Ground Water,
W82-01424 5B

Geological Studies of Industrially-Related Contamination: Soil and Ground Water Investigations,
W82-01425 5B

Remedial Options for Ground Water Protection at Abandoned Solid Waste Disposal Facilities,
W82-01426 5G

Top-Sealing to Minimize Leachate Generation, Case Study of the Windham, Connecticut, Landfill,
W82-01427 5G

Bench Scale Assessment of Technologies for Contaminated Ground Water Treatment.
W82-01433 5G

Evaluation of Remedial Treatment, Detoxification and Stabilization Alternatives,
W82-01434 5D

Preliminary Design and Cost Estimates for Remedial Actions at Hazardous Waste Disposal Sites,
W82-01435 5G

Love Canal: Chemical Contamination and Migration,
W82-01436 5B

Identification and Reclamation of Chromium Sludge Disposal Sites,
W82-01437 5E

Organic Contamination of Ground Water: Tell it All,
W82-01474 5C

Investigation of Volatile Organics Removal,
W82-01490 5F

GROUNDWATER RECHARGE
Artificial Groundwater Recharge,
W82-01110 4B

The Water Balance of the Betwa Basin, India,
W82-01354 2A

GULLY EROSION
Gully Erosion,
W82-01407 2J

GYPSUM
A Combined Salt Transport-Chemical Equilibrium Model for Calcareous and Cypsiferous Soils,
W82-01230 5B

HARBORS
Transports in the Duluth-Superior Harbor,
W82-01136 5B

Sediment Distribution of Methanogenic Bacteria in Lake Erie and Cleveland Harbor,
W82-01233 2H

HAWAII
Water Resources Data for Hawaii and Other Pacific Areas, Water Year 1980 - Volume 1. Hawaii.
W82-01208 7C

Water Resources Data for Hawaii and Other Pacific Areas, Water Year 1980 - Volume 2. Trust Territory of the Pacific Islands, Guam, American Samoa, and Northern Mariana Islands.
W82-01209 7C

Application of Nutrient-Saturated Growth Model to Phytoplankton Management in Freshwater Prawn (Macrobrachium Rosenbergii) Ponds in Hawaii,
W82-01483 2H

Suspended Sediment Production from Forested Watersheds on Oahu, Hawaii,
W82-01531 2J

HAZARDOUS MATERIAL
Evaluation of Remedial Treatment, Detoxification and Stabilization Alternatives,
W82-01434 5D

HAZARDOUS MATERIALS
Preliminary Risk Evaluation for Suspected Hazardous Waste Disposal Sites in Connecticut,
W82-01417 5G

Rating the Hazard Potential of Waste Disposal Facilities.
W82-01418 5G

Evaluation of Hydrogeologic Conditions,
W82-01420 5G

Site Assessment: Improving Confidence Levels with Surface Remote Sensing,
W82-01422 5G

Mapping Contaminated Soil Plumes by Kriging.
W82-01423 5G

Surface Water Management at Hazardous Waste Sites.
W82-01429 5G

Comparative Evaluation of Processes for the Treatment of Concentrated Wastewaters at Uncontrolled Hazardous Waste Sites.
W82-01430 5D

Rapid Methods of Chemical Analysis Used in Emergency Response Mobile Laboratory Activities.
W82-01431 5A

Stabilization/Solidification of Waste from Uncontrolled Disposal Sites.
W82-01432 5E

Preliminary Design and Cost Estimates for Remedial Actions at Hazardous Waste Disposal Sites.
W82-01435 5G

HEAD LOSS
Pipeline Friction Losses for Wastewater Sludges.
W82-01545 5D

HEAT BALANCE
The Use of the Equilibrium Temperature to Establish the Heat Balance of a Water Surface (Sur l'Utilization de la Temperature d'Equilibre pour l'Etablissement du Bilan Thermique d'Un Plan d'Eau),
W82-01353 2H

HEAT TRANSFER
Wave Formation and Heat Transfer at an Ice-Water Interface in the Presence of a Turbulent Flow,
W82-01128 2C

HEAVY METALS
Determination of Labilities of Soluble Trace Metal Species in Aqueous Environmental Samples by Anodic Stripping Voltammetry and Chelex Column and Batch Methods,
W82-01229 5A

Electroplating and Cyanide Wastes,
W82-01266 5D

Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements,
W82-01278 5C

Metal Ion Concentrations Associated with Late Summer Sediments of the Ohio River,
W82-01300 5A

The Role of Atmospheric Deposition in an Eastern U.S. Deciduous Forest,
W82-01491 5B

The Physicochemical Speciation of Cd, Pb, Cu, Fe, and Mn in the Final Effluent of a Sewage Treatment Works and Its Impact on Speciation in the Receiving River,
W82-01498 5B

Factors Affecting the Fate of Heavy Metals in the Activated Sludge Process,
W82-01547 5D

Cadmium, Lead, Mercury, Arsenic, and Selenium Concentrations in Freshwater Fish, 1976-77-National Pesticide Monitoring Program,
W82-01584 5B

Strategies of Response to Copper, Cadmium, and Lead by a Blue-Green and a Green Alga,
W82-01598 5C

HETEROGENEITY
Immediate Detection of Heterogeneities in Continuous Multivariate, Oceanographic Recordings. Application to Time Series Analysis of Changes in the Bay of Villefranche sur Mer.
W82-01393 7A

HOUSTON
Geohydrologic Models of the Houston District, Texas,
W82-01335 2F

HUMID AREAS
Combination Surface-Subsurface Drainage Systems for Humid Regions,
W82-01228 4A

HYDRAULIC CONDUCTING
Hydraulic Conductivity of Four Commercial Citrus Rootstocks.
W82-01546 2I

HYDRAULIC CONDUCTIVITY
Measuring the Hydraulic Conductivity of Soil Adjacent to Tile Drains in a Heavy Clay Soil in the Netherlands.
W82-01323 2G

HYDRAULIC MODELS
Hydraulic Model Study of Daule-Peripa Spillway and Outlet Works.
W82-01446 8A

HYDRAULIC ROUGHNESS
Evaluation of Effective Boundary Roughness for Gravel-Bed Rivers,
W82-01161 8B

HYDRAULIC VALVES
The Problems of Non-Return and the Use of Valves in Drinking Water Protection Against Waste Water Return, Applying the Regulations in Force,
W82-01142 5F

HYDRAULICS
Development of Upton Intake Works, River Severn Supply Scheme, With the Aid of a Model,
W82-01395 8B

HYDROBIOLOGY
Hydrobiological Studies on the Ajwa Reservoir, the Source of Raw Water Supply to the Baroda Water Works,
W82-01364 2H

HYDROCARBONS
Fatty Acid and Hydrocarbon Content of Settling Sediments in Lake Michigan,
W82-01154 2H

Phenanthrene Biodegradation in Freshwater Environments,
W82-01234 5B

Tenax-GC Extraction Technique for Residual Polychlorinated Biphenyl and Polyaromatic Hydrocarbon Analysis in Biodegradation Assays,
W82-01235 5A

Volatile C1-C7 Organic Compounds in Surface Sediments from Walvis Bay,
W82-01367 5B

HYDROELECTRIC PLANTS
Yangtze Gorges Scheme Could Yield 110 TWh/Year.
W82-01394 8A

Water Resources Appraisals for Hydroelectric Licensing; Savannah and Edisto River Basins Area; Georgia-South Carolina-North Carolina.
W82-01440 6D

Water Resources Appraisals for Hydroelectric Licensing; American River Basin, California.
W82-01441 6D

HYDROELECTRIC POWER
Yangtze Gorges Scheme Could Yield 110 TWh/Year.
W82-01394 8A

Water Resources Appraisals for Hydroelectric Licensing; Brazos River Basin, Texas-New Mexico.
W82-01439 6D

Hydropower--An Old Technology for a New Era.
W82-01593 4A

HYDROGEN ION CONCENTRATION
Fixed Endpoint Alkalinity Determination.
W82-01187 7B

Background Document for Modification of pH Effluent Limitations Guidelines and Standards for Point Sources Required by NPDES Permit to Monitor Continuously Effluent pH.
W82-01438 5D

Preliminary Report of Stream Sampling for Acidification Studies 1980.
W82-01453 5A

HYDROLOGIC BUDGET
The Water Balance of the Betwa Basin, India.
W82-01354 2A

Balance of Biogenic Elements in the Aral Sea Upon a Drop of Its Level,
W82-01370 2H

The Behavior of a Polar Ice-Dammed Lake, Ellesmere Island, N.W.T., Canada,
W82-01511 2C

Using Computed Stream Flow in Watershed Analysis,
W82-01538 2A

HYDROLOGIC DATA
Modeling Hydrologic Time Series from the Arctic,
W82-01198 2A

Water Resources Data for Texas, Water Year 1980--Volume 1. Arkansas River Basin, Red River Basin, Sabine River Basin, Neches River Basin, Trinity River Basin and Intervening Coastal Basins.
W82-01201 7C

Water Resources Data for Texas, Water Year 1980--Volume 2. San Jacinto River Basin, Brazos River Basin, San Bernard River Basin and Intervening Coastal Basins.
W82-01202 7C

Water Resources Data for Texas, Water Year 1980--Volume 3. Colorado River Basin, Lavaca River Basin, Guadalupe River Basin, Nueces River Basin, Rio Grande Basin and Intervening Coastal Basins.
W82-01203 7C

Water Resources Data for California, Water Year 1980--Volume 1. Colorado River Basin, Southern Great Basin from Mexican Border to Mono Lake Basin, and Pacific Slope Basins from Tijuana River to Santa Maria River.
W82-01204 7C

Water Resources Data for California, Water Year 1980--Volume 2. Pacific Slope Basins from Arroyo Grande to Oregon State Line Except Central Valley.
W82-01205 7C

Water Resources Data for California, Water Year 1980--Volume 3. Southern Central Valley Basins and the Great Basin from Walker River to Truckee River.
W82-01206 7C

Water Resources Data for California, Water Year 1980--Volume 4. Northern Central Valley Basins and the Great Basin from Honey Lake Basin to Oregon State Line.
W82-01207 7C

Water Resources Data for Hawaii and Other Pacific Areas, Water Year 1980 - Volume 1. Hawaii.
W82-01208 7C

Water Resources Data for Hawaii and Other Pacific Areas, Water Year 1980 - Volume 2. Trust Territory of the Pacific Islands, Guam, American Samoa, and Northern Mariana Islands.
W82-01209 7C

Water Resources Data for South Carolina, Water Year 1980.
W82-01211 7C

Water Resources Data for Pennsylvania, Water Year 1980--Volume 2. Susquehanna and Potomac River Basins.
W82-01212 7C

Water Resources Data for Montana, Water Year 1980--Volume 1. Hudson Bay Basin, Missouri River Basin.
W82-01213 7C

Water Resources Data for Montana, Water Year 1980--Volume 2. Upper Columbia River Basin.
W82-01214 7C

Water Resources Data for Florida, Water Year 1980--Volume 3A: Southwest Florida Surface Water.
W82-01215 7C

Water Resources Data for Florida, Water Year 1980--Volume 3B: Southwest Florida Ground Water.
W82-01216 7C

Water Resources Data for Colorado, Water Year 1980--Volume 2. Colorado River Basin Above Dolores River.
W82-01217 7C

Evaluation of Hydrogeologic Conditions,
W82-01420 5G

HYDROLOGIC MODELS
Computer Modeling and Ground-Water Protection,
W82-01336 2F

HYDROMETEOROLOGY
An Improved Method for Obtaining the Water Content Values of Ice Hydrometeors from Aircraft and Radar Data,
W82-01523 7B

HYPOLIMNION
Hypolimnion Flow Between the Central and Eastern Basins of Lake Erie During 1977 (Interbasin Hypolimnion Flows)
W82-01153 2H

ICE
Water Frost and Ice: The Near-Infrared Spectral Reflectance 0.65-2.5 Microns,
W82-01346 2C

Ice Nucleus Concentrations Measured During the 1975 Florida Area Cumulus Experiment (FACE),
W82-01522 7B

An Improved Method for Obtaining the Water Content Values of Ice Hydrometeors from Aircraft and Radar Data,
W82-01523 7B

Lidar Determinations of Atmospheric Ice Crystal Layers at South Pole During Clear-Sky Precipitation,
W82-01529 2C

ICE-WATER INTERFACES
Wave Formation and Heat Transfer at an Ice-Water Interface in the Presence of a Turbulent Flow.
W82-01128 2C

Ice Blocks Melting Into a Salinity Gradient.
W82-01530 2C

ICED LAKES
The Behavior of a Polar Ice-Dammed Lake, Ellesmere Island, N.W.T., Canada.
W82-01511 2C

IDAHO
Preferences for Allocating River Recreation Use.
W82-01181 6D

ILLINOIS
Water Quality from Two Small Forested Watersheds in Southern Illinois.
W82-01140 4C

Federal Common Law of Nuisance Expands.
W82-01337 6E

IMPERVIOUS SURFACES
Estimation of Impervious-Area Washoff Parameters,
W82-01465 4C

INDIA
Study of a Complex Water Resources System with Screening and Simulation Models,
W82-01309 6A

The Water Balance of the Betwa Basin, India,
W82-01354 2A

Comparative Limnology of Nine Lakes of Jammu and Kashmir Himalayas,
W82-01361 2H

Hydrobiological Studies on the Ajwa Reservoir, the Source of Raw Water Supply to the Baroda Water Works,
W82-01364 2H

Diurnal, Depth-Wise, and Seasonal Changes of Physico-Chemical Factors in Sathiar Reservoir,
W82-01372 2H

Note on Probability Approach to Study the Occurrence of Rainfall at Hyderabad,
W82-01380 2B

Irrigation Needs and Yield of Rice on a Sandy-Loam Soil as Affected by Continuous and Intermittent Submergence,
W82-01382 3F

INDUSTRIAL WASTES
Abundance of Organic Compounds in Water,
W82-01162 5A

Pharmaceutical Company's Aeration System Saves Energy,
W82-01180 5D

The Stringfellow Industrial Waste Disposal Site: A Technical Assessment of Environmental Impact,
W82-01415 5B

The National Assessment of the Ground-Water Contamination Potential of Wastewater Impoundments.
W82-01419 5G

Case Studies on the Migration of Pollutants in Ground Water,
W82-01424 5B

INDUSTRIAL WASTEWATER
Activated Sludge,
W82-01243 5D

Fermentation Industry,
W82-01257 5D

Background Document for Modification of pH Effluent Limitations Guidelines and Standards for Point Sources Required by NPDES Permit to Monitor Continuously Effluent pH.
W82-01438 5D

INDUSTRIAL WATER
Optimum Recycle and Reuse Cooling System Designs Using the BCT Process.
W82-01503 3E

INFILTRATION
Scaling of Infiltration Behavior in Dissimilar Porous Materials.
W82-01105 2G

Statistical Analysis of the Brooks-Corey and the Green-Ampt Parameters Across Soil Textures.
W82-01107 2G

Studies on Unsaturated Zone Hydrology and Radionuclide Migration at a Shallow-Land Burial Site.
W82-01172 5B

Apportionment of Net Recharge in Landfill Covering Layer into Separate Components of Vertical Leakage and Horizontal Seepage,
W82-01298 2G

Super Slurper Effects on Crust Strength, Water Retention, and Water Infiltration of Soils,
W82-01562 2G

INFILTRATION RATE
Spatial Variability of Steady-State Infiltration Rates as a Stochastic Process,
W82-01560 2G

INFLOW
Nonpoint N Runoff from Agricultural Watersheds into the Great Lakes,
W82-01148 5B

INFRARED SPECTROSCOPY
Rapid Methods of Chemical Analysis Used in Emergency Response Mobile Laboratory Activities,
W82-01431 5A

INJECTION WELLS
Thermal Energy Storage in a Confined Aquifer: Second Cycle,
W82-01473 4B

INLETS
Linearized Solution to Inlet Equation with Inertia,
W82-01183 2L

INPUT-OUTPUT ANALYSIS
Water Multipliers--Regional Impact Analysis,
W82-01138 6A

INSECTICIDES
Toxicity and Bioaccumulation of Endrin and Methoxychlor in Aquatic Invertebrates and Fish,
W82-01160 5C

Organochlorine Insecticides and PCB in Surficial Sediments of Lake Michigan (1975),
W82-01190 5A

Effect of Kepone on Estuarine Microbial Activity,
W82-01231 5C

The Influence of Chemical Conditioning and Dewatering on the Distribution of Polychlorinated Biphenyls and Organochlorine Insecticides in Sewage Sludges,
W82-01387 5E

Abate: Effects of the Organophosphate Insecticide on Bluegills and Invertebrates in Ponds,
W82-01445 5C

INSECTS
Some Effects of Agricultural Land Use on Stream Insect Communities,
W82-01159 5C

INTAKES
Development of Upton Intake Works, River Severn Supply Scheme, With the Aid of a Model,
W82-01395 8B

Cooling Water Intake Screening Devices Used to Reduce Entrainment and Impingement,
W82-01442 8I

INTERBASIN TRANSFERS
Supply-Demand Coordination in Water Resources Management,
W82-01299 6C

INTERDISCIPLINARY STUDIES
Interdisciplinary Environmental Analysis for Timber Sale Planning,
W82-01539 6A

INTERFACES
Phytoplankton Productivity and Standing Crop in the Vicinity of the Lake Huron-Saginaw Bay Front,
W82-01164 2H

INTERNATIONAL JOINT COMMISSION
Public Concerns and PLUARG: Selected findings and Discussion,
W82-01137 5G

INTERVENTION ANALYSIS
Modeling Hydrologic Time Series from the Arctic,
W82-01198 2A

INVERTEBRATES
Effects of Pollution on Freshwater Invertebrates,
W82-01280 5C

Abate: Effects of the Organophosphate Insecticide on Bluegills and Invertebrates in Ponds,
W82-01445 5C

Release of Phosphorus by Certain Benthic Invertebrates,
W82-01502 2H

ION EXCHANGE
Demonstration Testing of Alum Recovery by Liquid Ion Exchange,
W82-01167 5D

ION EXCHANGE RESINS
Periodic Operation for Desalination with Thermally Regenerable Ion-Exchange Resin. Dynamic Studies,
W82-01341 3A

ION TRANSPORT
A Combined Salt Transport-Chemical Equilibrium Model for Calcareous and Cypsiferous Soils,
W82-01230 5B

IOWA
A Dendroclimatic Reconstruction of Annual Precipitation Amounts in Iowa Since 1680,
W82-01314 2B

Mandatory or Voluntary Water Conservation: A Case Study of Iowa Communities During Drought,
W82-01553 3D

IRAQ
A Hydrobiological Survey of a Polluted Canal,
W82-01356 5C

IRON
A Bioassay Study of Effects of Zooplankton, Iron and NTA on the Phytoplankton Productivity of a Marl Lake,
W82-01157 2H

IRRIGATION
Nitrogen Balances for an Effluent Irrigation Area,
W82-01478 3C

IRRIGATION CANALS
A Comparison of Chemical and Cultural Control of Weeds in Irrigation Ditchbanks,
W82-01120 4A

IRRIGATION DESIGN
A Survey of Mathematical Optimization Models and Algorithms for Designing and Extending Irrigation and Wastewater Networks,
W82-01296 6A

Input and Output Constraints Affecting Irrigation Development,
W82-01476 6B

Trickle Irrigation Lateral Design on Sloping Fields,
W82-01537 8C

IRRIGATION EFFECTS
Irrigation Management of Colorado River Water with Increase in Salinity,
W82-01226 3C

Nitrogen Leaching as Influenced by Nitrogen Management and Supplement Irrigation Level,
W82-01472 5B

Effects of Water and Nitrogen Management on Nitrate Leaching Loss from Sands,
W82-01581 5B

IRRIGATION EFFICIENCY
Irrigation Needs and Yield of Rice on a Sandy-Loam Soil as Affected by Continuous and Intermittent Submergence,
W82-01382 3F

Characterizing Sprinkler Distribution Patterns with a Clustering Algorithm,
W82-01575 3F

IRRIGATION ENGINEERING
Significant Features of Emitter Flushing Mode Characteristics,
W82-01576 3F

IRRIGATION PROGRAMS
Design and Merit of a River-Aquifer Model for Optimal Use of Agricultural Water,
W82-01193 6A

IRRIGATION WATER
Potential Use of a Stream-Aquifer Model for Management of a River Basin: Case of the South Platte River in Colorado,
W82-01301 6A

ISOTOPE STUDIES
Deuterium/Hydrogen Ratios in Australian Rainfall,
W82-01325 2B

ISOTOPE TRACERS
Uranium Isotopes as a Natural Tracer in the Waters of the Bet Shean-Harod Valleys, Israel,
W82-01328 2F

ISOTOPIC STUDIES
018 Modelling of Freshwater Inputs in Baffin Bay and Canadian Arctic Coastal Waters,
W82-01590 2C

ISRAEL
Uranium Isotopes as a Natural Tracer in the Waters of the Bet Shean-Harod Valleys, Israel,
W82-01328 2F

IVORY COAST
Data on the Stagnant Ponds of the Savannah of Lamto (Ivory Coast) (Donnees sur les Milieux Limniques Stagnants des Savanes de Lamto (Cote d'Ivoire)),
W82-01357 2H

JUDICIAL DECISIONS
Federal Common Law of Nuisance Expands,
W82-01337 6E

Middlesex County Sewerage Authority V. National Sea Clammers Association: Implied Private Rights of Action for Damages under the Federal Water Pollution Control Act Amendments of 1972,
W82-01455 6E

Avoyelles Sportsmen's League V. Alexander,
W82-01456 6E

Compelled Self-Incrimination and the Federal Water Pollution Control Act,
W82-01600 6E

KALAHARI DESERT
Gaseous Nitrogen as Evidence for Denitrification in Groundwater,
W82-01485 2K

LIBRARY U. S. L. CHINA-BRAZIL

KASKASKIA RIVER
Sediment Oxygen Demand and Its Effect on Dissolved Oxygen in a Cutoff Meander of the Kaskaskia River,
W82-01448 4A

KENTUCKY
Studies on Unsaturated Zone Hydrology and Radionuclide Migration at a Shallow-Land Burial Site,
W82-01172 5B

KEPONE
Effect of Kepone on Estuarine Microbial Activity,
W82-01231 5C

KOHL SPRING
Groundwater Contamination by Sanitary Landfill Leachate and Domestic Wastewater in Carbonate Terrain: Principal Source Diagnosis, Chemical Transport Characteristics and Design Implications,
W82-01223 5B

KRAFT MILLS
New Opportunities for In-Plant Reduction of Pollutants Through Process Changes,
W82-01559 5G

LADBROKE SERVICE RESERVOIR
An Investigation Into the Effects of Thermal Movement in the Walls of Service Reservoirs,
W82-01396 8F

LAGOONS
Lagoons and Oxidation Ponds,
W82-01244 5D

LAKE BASINS
Hypolimnion Flow Between the Central and Eastern Basins of Lake Erie During 1977 (Interbasin Hypolimnion Flows)
W82-01153 2H

LAKE CLASSIFICATION
A Classification and Description of Some Northeastern Ontario Lakes Influenced by Acid Precipitation,
W82-01145 5B

LAKE ERIE
Hypolimnion Flow Between the Central and Eastern Basins of Lake Erie During 1977 (Interbasin Hypolimnion Flows)
W82-01153 2H

Biogeochemical Investigation of Big Creek Marsh, Lake Erie, Ontario,
W82-01163 2H

Trace Metal Mineral Equilibria in Lake Erie Sediments,
W82-01191 2H

Sediment Distribution of Methanogenic Bacteria in Lake Erie and Cleveland Harbor,
W82-01233 2H

LAKE HURON
Petroleum Hydrocarbons in Sediments of Saginaw Bay, Lake Huron,
W82-01141 5A

Phosphorus Uptake Dynamics as Related to Mathematical Modeling of Cladophora at a Site on Lake Huron,
W82-01149 5C

LAKE MICHIGAN
Soluble Element Concentrations and Complexation in Southeastern Lake Michigan,
W82-01147 2H

Nutrient Loading of Southern Lake Michigan by Dry Deposition of Atmospheric Aerosol,
W82-01152 5B

Fatty Acid and Hydrocarbon Content of Settling Sediments in Lake Michigan,
W82-01154 2H

Organochlorine Insecticides and PCB in Surficial Sediments of Lake Michigan (1975),
W82-01190 5A

Seasonal Features of Zooplankton Assemblages in the Nearshore Area of Southeastern Lake Michigan,
W82-01192 2H

Evidence of Natural Reproduction by Planted Lake Trout in Lake Michigan,
W82-01194 8I

Effects of Atmospheric Precipitation Additions on Phytoplankton Photosynthesis in Lake Michigan Water Samples,
W82-01196 2H

Influence of PCBs in Water on Uptake and Elimination of DDT and DDE by Lake Trout,
W82-01342 5C

Nepheloid and Suspended Particulate Matter in South-Eastern Lake Michigan,
W82-01499 2H

Release of Phosphorus by Certain Benthic Invertebrates,
W82-01502 2H

LAKE ONTARIO
A Quantitative Study of Shoreline Marsh Communities Along Lake Huron in Ontario,
W82-01122 2H

Changes in Lake Ontario Total Phosphorus Concentrations, 1976-1978,
W82-01126 2H

Ferromanganese Nodules from Lake Ontario (Bay of Quinte): Minor Element Geochemistry,
W82-01143 2H

A Survey of ATP Concentrations in Lake Ontario, 1975-1976,
W82-01144 2H

PCB Residues in Bottom Sediments Collected From the Bay of Quinte, Lake Ontario 1972-1973,
W82-01155 5B

LAKE SEDIMENTS
Petroleum Hydrocarbons in Sediments of Saginaw Bay, Lake Huron,
W82-01141 5A

Mercury and Zinc in the Sediments of Seneca Lake, Seneca River, and Keuka Outlet, New York,
W82-01151 5B

Fatty Acid and Hydrocarbon Content of Settling Sediments in Lake Michigan,
W82-01154 2H

PCB Residues in Bottom Sediments Collected From the Bay of Quinte, Lake Ontario 1972-1973,
W82-01155 5B

Trace Metal Mineral Equilibria in Lake Erie Sediments,
W82-01191 2H

The Effect of Changing Sediment Supply on Sedimentation in a Glacier-Fed Lake,
W82-01510 2H

Historical Changes and Relationship to Internal Loading of Sediment Phosphorus Forms in Hypertrophic Prairie Lakes,
W82-01516 2H

LAKE SUPERIOR
Transports in the Duluth-Superior Harbor,
W82-01136 5B

Plume Development Using Lagrangian Marker Method,
W82-01182 5B

Postspawning Mortality of Rainbow Smelt in Western Lake Superior,
W82-01189 5C

LAKES
Seasonal Reversals of Groundwater Flow Around Lakes and the Relevance to Stagnation Points and Lake Budgets,
W82-01103 2F

An Example of the Application of Statistical Techniques to Predict Lake Level Elevations,
W82-01111 6A

A Bioassay Study of Effects of Zooplankton, Iron and NTA on the Phytoplankton Productivity of a Marl Lake,
W82-01157 2H

Phytoplankton Productivity and Standing Crop in the Vicinity of the Lake Huron-Saginaw Bay Front,
W82-01164 2H

Effects of Atmospheric Precipitation Additions on Phytoplankton Photosynthesis in Lake Michigan Water Samples,
W82-01196 2H

The Use of the Equilibrium Temperature to Establish the Heat Balance of a Water Surface (Sur l'Utilization de la Temperature d'Equilibre pour l'Etablissement du Bilan Thermique d'Un Plan d'Eau),
W82-01353 2H

Physico-Chemistry, Destratification and Nutrient Budget of a Lowland Eutrophicated Malaysian Reservoir and Its Limnological Implications,
W82-01360 2H

Comparative Limnology of Nine Lakes of Jammu and Kashmir Himalayas,
W82-01361 2H

Investigations into the Occurrence of Midge Plagues in the Vicinity of Harderwijk (Netherlands),
W82-01378 2H

The Crustacean Zooplankton of Mali (West Africa),
W82-01379 2H

The Effect of Fertilization with Phosphorus and Nitrogen Versus Phosphorus Alone on Eutrophication of Experimental Lakes,
W82-01457 5C

Mercury in the Muscle Tissue of Fish from Three Northern Maine lakes,
W82-01459 5B

Comparison of First-Order Error Analysis and Monte Carlo Simulation in Time-Dependent Lake Eutrophication Models,
W82-01460 2H

LAND CLEARING
Avoyelles Sportsmen's League V. Alexander,
W82-01456 6E

LAND DISPOSAL
Factors Affecting Radionuclide Availability to Vegetables Grown at Los Alamos,
W82-01109 5B

Artificial Groundwater Recharge,
W82-01110 4B

Land Application of Municipal Wastewater,
W82-01253 5D

Formation of N-Nitrosodimethylamine During Treatment of Municipal Waste Water by Simulated Land Application,
W82-01343 5D

The Stringfellow Industrial Waste Disposal Site: A Technical Assessment of Environmental Impact,
W82-01415 5B

Use of the Contingency Fund at Stringfellow Hazardous Waste Disposal Site,
W82-01416 5G

Preliminary Risk Evaluation for Suspected Hazardous Waste Disposal Sites in Connecticut,
W82-01417 5G

Rating the Hazard Potential of Waste Disposal Facilities,
W82-01418 5G

The National Assessment of the Ground-Water Contamination Potential of Wastewater Impoundments,
W82-01419 5G

Evaluation of Hydrogeologic Conditions,
W82-01420 5G

Practical Aspects of Ground Water Monitoring at Existing Disposal Sites,
W82-01421 5G

Site Assessment: Improving Confidence Levels with Surface Remote Sensing,
W82-01422 5G

Case Studies on the Migration of Pollutants in Ground Water,
W82-01424 5B

Geological Studies of Industrially-Related Contamination: Soil and Ground Water Investigations,
W82-01425 5B

Remedial Options for Ground Water Protection at Abandoned Solid Waste Disposal Facilities,
W82-01426 5G

Surface Water Management at Hazardous Waste Sites,
W82-01429 5G

Stabilization/Solidification of Waste from Uncontrolled Disposal Sites,
W82-01432 5E

Identification and Reclamation of Chromium Sludge Disposal Sites,
W82-01437 5E

Nitrogen Balances for an Effluent Irrigation Area,
W82-01478 3C

Vegetation Selection and Management for Overland Flow Systems,
W82-01500 5E

Utilization Efficiency of Nitrogen from Sewage Effluent and Fertilizer Applied to Corn Plants Growing in a Clay Soil,
W82-01515 3C

Land Treatment Site Evaluation in Southeastern Mountainous Areas,
W82-01596 5D

LAND SUBSIDENCE
Geohydrologic Models of the Houston District, Texas,
W82-01335 2F

LAND USE
Public Concerns and PLUARG: Selected findings and Discussion,
W82-01137 5G

Some Effects of Agricultural Land Use on Stream Insect Communities,
W82-01159 5C

LANDFILLS
Monitoring Ground-Water Contamination at a Fly Ash Disposal Site Using Surface Electrical Resistivity Methods,
W82-01218 5B

The Effect of Flyash Disposal on a Shallow Ground-Water System,
W82-01220 5B

Apportionment of Net Recharge in Landfill Covering Layer into Separate Components of Vertical Leakage and Horizontal Seepage,
W82-01298 2G

Top-Sealing to Minimize Leachate Generation, Case Study of the Windham, Connecticut, Landfill,
W82-01427 5G

Remedial Technique of Controlling and Treating Low Volume Leachate Discharge,
W82-01428 5G

Remedial Action Controls Groundwater Contamination at a Paper Mill Sludge Disposal Site,
W82-01582 5G

LANDIFLLS
Groundwater Contamination by Sanitary Landfill Leachate and Domestic Wastewater in Carbonate Terrain: Principal Source Diagnosis, Chemical Transport Characteristics and Design Implications,
W82-01223 5B

LARVAE
An Empirical Methodology for Estimating Entrainment Losses at Power Plants Sited on Estuaries,
W82-01173 6G

LARVAL GROWTH STAGE
Ecology of Larval Fishes in Lake Oahe, South Dakota,
W82-01444 6G

LASERS
Experimental Verification of the Linear Relationship Between IR Extinction and Liquid Water Content of Clouds,
W82-01525 7B

LEACHAGES
Effects of Sanitary Landfill Leachage on Some Soil Chemical Properties,
W82-01480 5E

LEACHATES
Acute Toxicity of Leachates from Coal Gasification and Liquefaction Solid Wastes to the Fathead Minnow, Pimephales Promelas,
W82-01108 5C

Monitoring Leachate in Ground Water by Corrected Resistivity Methods,
W82-01219 5A

Apportionment of Net Recharge in Landfill Covering Layer into Separate Components of Vertical Leakage and Horizontal Seepage,
W82-01298 2G

Formation of N-Nitrosodimethylamine During Treatment of Municipal Waste Water by Simulated Land Application,
W82-01343 5D

Top-Sealing to Minimize Leachate Generation, Case Study of the Windham, Connecticut, Landfill,
W82-01427 5G

Remedial Technique of Controlling and Treating Low Volume Leachate Discharge,
W82-01428 5G

Remedial Action Controls Groundwater Contamination at a Paper Mill Sludge Disposal Site,
W82-01582 5G

LEACHING
Nitrate Production, Uptake, and Leaching,
W82-01411 5B

Nitrogen Leaching as Influenced by Nitrogen Management and Supplement Irrigation Level,
W82-01472 5B

Effects of Water and Nitrogen Management on Nitrate Leaching Loss from Sands,
W82-01581 5B

LEAD
Mercury and Lead Concentrations in Some Species of Fish From the Tuscan Coasts (Italy),
W82-01368 5B

LEGAL ASPECTS
Law,
W82-01302 6E

The Workings of the Control of Pollution Act in Tidal Waters: A View of the Ministry of Agriculture, Fisheries and Food,
W82-01383 6E

LEVEES
Risk Models for Flood Levee Design,
W82-01307 8A

Optimal Risk-Based Design of Flood Levee Systems,
W82-01313 8B

LIGHT PENETRATION
Mineral Impact of Lakes as Background for Their Biogenic Dynamics,
W82-01359 2H

LIMNOLOGY
Comparative Limnology of Nine Lakes of Jammu and Kashmir Himalayas,
W82-01361 2H

Physical and Chemical Studies of Lago Tupe; A Central Amazonian Black Water 'Ria Lake',
W82-01381 2H

LINEAR PROGRAMMING
Study of a Complex Water Resources System with Screening and Simulation Models,
W82-01309 6A

LIQUEFACTION
Liquefaction Analysis for Multidirectional Shaking,
W82-01169 8D

Cyclic Strengths Compared for Two Sampling Techniques,
W82-01170 8D

LITERATURE REVIEW
Lagoons and Oxidation Ponds,
W82-01244 5D

Anaerobic Processes,
W82-01245 5D

Dentrification,
W82-01246 5D

Sludge Treatment, Utilization, and Disposal,
W82-01247 5E

Onsite Alternatives for Treatment and Disposal,
W82-01248 5D

O & M Wastewater Collection and Treatment Facilities,
W82-01249 5D

Disinfection,
W82-01250 5D

Wastewater Collection,
W82-01251 5D

Water Reclamation and Reuse,
W82-01252 3C

Land Application of Municipal Wastewater,
W82-01253 5D

Urban Runoff and Combined Sewer Overflow,
W82-01254 5B

Eutrophication,
W82-01271 2H

Dissolved Oxygen in Streams and Reservoirs,
W82-01272 5G

Ground Water,
W82-01273 2F

Marine and Estuarine Pollution,
W82-01274 5C

Thermal Effects,
W82-01275 5C

Aquatic Sediments,
W82-01279 5B

Effects of Pollution on Freshwater Invertebrates,
W82-01280 5C

Freshwater Macroinvertebrates,
W82-01281 5C

The Effects of Pollution on Freshwater Fish,
W82-01282 5C

Substrate Associated Microfauna,
W82-01283 5C

Microbiology of Water,
W82-01284 5B

Microbiology: Methodology and Quality Assurance,
W82-01285 5A

Microbiology of Ground Water,
W82-01286 5B

Microbiology of Potable Water,
W82-01287 5F

Microbiology: Detection of Bacterial Pathogens and Their Occurrence,
W82-01288 5B

Law,
W82-01302 6E

Systems Analysis,
W82-01303 6A

Pipeline Friction Losses for Wastewater Sludges,
W82-01545 5D

LITERATURE REVIEWS
Non-Point Sources,
W82-01270 5B

LOAM
Hydraulic Properties of Fullerton Cherty Silt Loam,
W82-01561 2G

LOCKS
Hydropower Losses from Navigation in the Snake-Columbia Rivers: 1978-79,
W82-01139 6D

LOGGING
Changes in Soil Water Quality Resulting from Three Timber Cutting Methods and Three Levels of Fiber Utilization,
W82-01135 2G

Effects of Logging on Macroinvertebrates in Streams with and Without Buffer Strips,
W82-01227 5C

Storm Flow Response to Road Building and Partial Cutting in Small Streams of Northern California,
W82-01295 4C

LOS ANGELES
Computer Modeling of Los Angeles Water Resources,
W82-01168 6A

LOTIC ENVIRONMENT
Sediment Oxygen Demand and Its Effect on Dissolved Oxygen in a Cutoff Meander of the Kaskaskia River,
W82-01448 4A

LOUISIANA
Avoyelles Sportsmen's League V. Alexander,
W82-01456 6E

LOVE CANAL
Love Canal: Chemical Contamination and Migration,
W82-01436 5B

MACROINVERTEBRATES
Effects of Logging on Macroinvertebrates in Streams with and Without Buffer Strips,
W82-01227 5C

Freshwater Macroinvertebrates,
W82-01281 5C

MAINE
Radon-222, In Potable Water Supplies of New England,
W82-01221 5B

Geologic and Hydrologic Factors Controlling Radon-222 in Ground Water in Maine,
W82-01222 2F

Mercury in the Muscle Tissue of Fish from Three Northern Maine lakes,
W82-01459 5B

MAINTENANCE
Sanitation Service Management in France (La Gestion des Services d'Assainissement en France),
W82-01351 6F

MALAWI
Malawi: A Community Approach,
W82-01365 5F

MALAYSIA
Physico-Chemistry, Destratification and Nutrient Budget of a Lowland Eutrophicated Malaysian Reservoir and Its Limnological Implications,
W82-01360 2H

MALI
The Crustacean Zooplankton of Mali (West Africa),
W82-01379 2H

MANAGEMENT PLANNING
Managing Land to Meet Water Quality Goals,
W82-01557 4D

MANURE
The Movement of Salts from Soils Following Heavy Application of Feedlot Wastes,
W82-01132 5B

Phosphorus Concentration-Water Flow Interactions in Tile Effluent from Manured Land,
W82-01340 5B

Effect of Different Levels of Water Salinity on the Decomposition of Organic Manures in a Brackish Water Fish Pond Soil,
W82-01363 3C

Effects of Dairy Manure on Phosphorus Concentrations and Losses in Tile Effluent,
W82-01479 5B

MARINE ENVIRONMENT
Marine and Estuarine Pollution,
W82-01274 5C

Immediate Detection of Heterogeneities in Continuous Multivariate, Oceanographic Recordings. Application to Time Series Analysis of Changes in the Bay of Villefranche sur Mer,
W82-01393 7A

MARINE SEDIMENTS
Volatile C1-C7 Organic Compounds in Surface Sediments from Walvis Bay,
W82-01367 5B

MARSHES
A Quantitative Study of Shoreline Marsh Communities Along Lake Huron in Ontario,
W82-01122 2H

Biogeochemical Investigation of Big Creek Marsh, Lake Erie, Ontario,
W82-01163 2H

MASSACHUSETTS
Northfield Mountain Pumped Storage Project: Performance,
W82-01517 8A

MATHEMATICAL MODELS
An Example of the Application of Statistical Techniques to Predict Lake Level Elevations,
W82-01111 6A

Plume Development Using Lagrangian Marker Method,
W82-01182 5B

Prediction of Diffusion Coefficients from the Electrical Conductance of Soil,
W82-01224 2G

Modeling of Activated Carbon and Coal Gasification Char Adsorbents in Single-Solute and Bisolute Systems,
W82-01447 1B

Impact of Management Practices on the Tallgrass Prairie,
W82-01580 4A

MATHEMATICAL STUDIES
Selecting a Formula to Estimate Sediment Transport Capacity in Nonvegetated Channels,
W82-01405 2J

An Index of Arizona Summer Rainfall Developed Through Eigenvector Analysis,
W82-01528 2B

Characterizing Sprinkler Distribution Patterns with a Clustering Algorithm,
W82-01575 3F

MAUMEE RIVER
Limnetic Larval Fish of the Maumee and Sandusky River Estuaries,
W82-01197 7A

MEAT PROCESSING INDUSTRY
Meat-, Fish-, and Poultry-Processing Wastes,
W82-01256 5D

MELTING
Ice Blocks Melting Into a Salinity Gradient,
W82-01530 2C

MEMBRANE FILTERS
Comparison of Selective Media for the Enumeration and Identification of Fecal Streptococci from Natural Sources,
W82-01564 5A

High Temperature Ultrafiltration with Kynar Poly(Vinylidene Fluoride) Membranes,
W82-01566 5D

MERCURY
Mercury and Zinc in the Sediments of Seneca Lake, Seneca River, and Keuka Outlet, New York,
W82-01151 5B

Mercury and Lead Concentrations in Some Species of Fish From the Tuscan Coasts (Italy),
W82-01368 5B

The Distribution of Mercury in the Sediments of the Plym Estuary,
W82-01390 5B

Mercury in the Muscle Tissue of Fish from Three Northern Maine lakes,
W82-01459 5B

Determination of Nanogram Quantities of Mercury in Water with a Gold-Plated Piezoelectric Crystal Detector,
W82-01509 5A

METAL FINISHING WASTES
Steel Industry Wastes,
W82-01264 5D

Electroplating and Cyanide Wastes,
W82-01266 5D

METALS
Interactive Effects of Metals in Mixtures on Biomass Production Kinetics of Freshwater Copepods,
W82-01125 5C

The Effect of Flyash Disposal on a Shallow Ground-Water System,
W82-01220 5B

Metal Ion Concentrations Associated with Late Summer Sediments of the Ohio River,
W82-01300 5A

METEOROLOGICAL DATA COLLECTION
An Improved Method for Obtaining the Water Content Values of Ice Hydrometeors from Aircraft and Radar Data.
W82-01523 7B

METHYL BROMIDE
Methyl Bromide and Bromide-Ion in Drainage Water After Leaching of Glasshouse Soils,
W82-01492 5B

MEXICO
Supply-Demand Coordination in Water Resources Management.
W82-01299 6C

Hydroelectrical Model for Optimal Operation of a Single Multipurpose Reservoir.
W82-01329 6A

Input and Output Constraints Affecting Irrigation Development.
W82-01476 6B

MICHIGAN
A Bioassay Study of Effects of Zooplankton, Iron and NTA on the Phytoplankton Productivity of a Marl Lake.
W82-01157 2H

The Wayne County, Michigan, Wastewater Collection and Treatment System.
W82-01505 5D

MICROBIAL DEGRADATION
Phenanthrene Biodegradation in Freshwater Environments,
W82-01234 5B

MICROBIOLOGICAL STUDIES
Effect of Kepone on Estuarine Microbial Activity,
W82-01231 5C

Microbiology of Water,
W82-01284 5B

Microbiology: Methodology and Quality Assurance,
W82-01285 5A

Microbiology of Ground Water,
W82-01286 5B

Microbiology of Potable Water,
W82-01287 5F

Microbiology of Wastewater Treatment,
W82-01291 5D

MICROORGANISMS
Substrate Associated Microfauna,
W82-01283 5C

MICROWAVES
Remote Sensing of Soil Moisture Content Over Bare Field at 1.4 GHz Frequency,
W82-01345 7B

MIDGES
Investigations into the Occurrence of Midge Plagues in the Vicinity of Harderwijk (Netherlands),
W82-01378 2H

MILLIGAN CANYON
Hydrochemical Facies in a Tertiary Basin in the Milligan Canyon Area, Southwest Montana,
W82-01481 2F

MINE DRAINAGE
Mining Pollution and the Diet of the Purple-Striped Gudgeon Mogurnda Mogurnda Richardson (Eleotridae) in the Finniss River, Northern Territory, Australia,
W82-01366 5C

MINE WASTES
Coal and Coal Mine Drainage,
W82-01261 5G

The Effect of Pollutants from the Coal Industry on the Fish Fauna of a Small River in the South Wales Coalfield.
W82-01389 5C

Rosario Dominicana's Cyanide Tailings Dam Construction and Operation.
W82-01589 5D

MINERAL INDUSTRY
A Water Rights Strategy for Mining Operations in the Western US.
W82-01587 6E

MINERALIZATION
Nitrate Production, Uptake, and Leaching.
W82-01411 5B

MISSOURI RIVER
River Bed Aggradation Due to Overloading.
W82-01486 2J

MIXING
Interpreting Laboratory Results for the Design of Rapid Mixing and Flocculation Systems.
W82-01166 5F

MODEL STUDIES
An Empirical Methodology for Estimating Entrainment Losses at Power Plants Sited on Estuaries.
W82-01173 6G

Studies for Abatement of Pollution from Combined Sewer Overflows in Canada,
W82-01200 5G

A Model for Simulation of Flow in Singular and Interconnected Channels,
W82-01210 2E

A Combined Salt Transport-Chemical Equilibrium Model for Calcareous and Cypsiferous Soils,
W82-01230 5B

A Survey of Mathematical Optimization Models and Algorithms for Designing and Extending Irrigation and Wastewater Networks,
W82-01296 6A

Identification of the Wairakei Geothermal System,
W82-01312 2F

A Comparison of the Incomplete Cholesky-Conjugate Gradient Method with the Strongly Implicit Method as Applied to the Solution of Two-Dimensional Groundwater Flow Equations,
W82-01315 2F

A Mathematical Model of Water Table Fluctuation in a Semi-Infinite Aquifer Induced by Localized Transient Recharge,
W82-01319 2F

Hydroelectrical Model for Optimal Operation of a Single Multipurpose Reservoir,
W82-01329 6A

Computer Modeling and Ground-Water Protection,
W82-01336 2F

CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems.
W82-01401 5B

Modeling Erosion and Sediment Yield from Flatland Watersheds,
W82-01406 2J

Concentrated Flow Relationships,
W82-01409 2J

Laboratory Procedure for Estimating Residue Dynamics of Xenobiotic Contaminants in a Freshwater Food Chain,
W82-01443 5B

Hydraulic Model Study of Daule-Peripa Spillway and Outlet Works,
W82-01446 8A

Methods for Generating Alternative Solutions to Water Resources Planning Problems.
W82-01449 6A

Generating Alternative Solutions for Dynamic Programming Models of Water Resources Problems.
W82-01450 6A

A One-Dimensional, Finite Element Salt Water Intrusion Model.
W82-01452 7A

Comparison of First-Order Error Analysis and Monte Carlo Simulation in Time-Dependent Lake Eutrophication Models.
W82-01460 2H

Performance Evaluation of a Stochastic Optimization Model for Reservoir Design and Management with Explicit Reliability Criteria.
W82-01462 8A

On Identification and Validation of Some Geothermal Models.
W82-01467 6A

LIBRARY U. S. INTERNATIONAL TRADE COMMISSION

River Basin Hydrosalinity Modeling,
W82-01469 2K

Application of Nutrient-Saturated Growth Model to Phytoplankton Management in Freshwater Prawn (Macrobrachium Rosenbergii) Ponds in Hawaii,
W82-01483 2H

Water Management Model Evaluation for North Central Ohio,
W82-01536 4A

Snowmelt Prediction in a Subarctic Drainage Area,
W82-01571 2C

MODEL TESTING
Development of Upton Intake Works, River Severn Supply Scheme, With the Aid of a Model,
W82-01395 8B

MOISTURE AVAILABILITY
Effect of Water, Nitrogen and Row Spacing on the Yield and Oil Content of Safflower,
W82-01112 2I

MOISTURE CONTENT
Determination of Moisture from NOAA Polar Orbiting Satellite Sounding Radiances,
W82-01535 2B

MOISTURE EQUIVALENT
Compatibility of Canadian Snowfall and Snow Cover Data,
W82-01466 2C

MOISTURE STRESS
Comparison of Tests Characterizing Varieties of Barley and Wheat for Moisture Stress Resistance,
W82-01114 2I

Yield and Phenotypic Traits of Semidwarf and Normal-Statured Barley (Hordeum Vulgare L.) Genotypes Grown Under Differing Levels of Moisture Stress,
W82-01121 2I

Drought Susceptibility of Two Tomato (Lycopersicum Esculentum) Varieties,
W82-01369 2I

MONITORING
Cost Effective Ground Water Monitoring,
W82-01113 4B

Regionalization of the Upper Great Lakes with Respect to Surveillance Eutrophication Data,
W82-01150 7A

Monitoring Leachate in Ground Water by Corrected Resistivity Methods,
W82-01219 5A

Continuous Monitoring, Automated Analysis, and Sampling Procedures,
W82-01240 5A

Water-Quality Monitoring: A Global Approach,
W82-01339 7A

Evaluation of the Polluted River Savinja with the Help of Macrophytes,
W82-01377 5C

Practical Aspects of Ground Water Monitoring at Existing Disposal Sites,
W82-01421 5G

Background Document for Modification of pH Effluent Limitations Guidelines and Standards for Point Sources Required by NPDES Permit to Monitor Continuously Effluent pH,
W82-01438 5D

Environmental Recovery in a Marine Ecosystem Impacted by a Sulfite Process Pulp Mill,
W82-01548 5B

Monitoring Glacier Outburst Floods,
W82-01558 2C

MONSOONS
Observations on the Hydrography and Inshore Plankton of the Bay of Bengal off Balasore,
W82-01362 2A

MONTANA
Water Resources Data for Montana, Water Year 1980--Volume 1. Hudson Bay Basin, Missouri River Basin,
W82-01213 7C

Water Resources Data for Montana, Water Year 1980--Volume 2. Upper Columbia River Basin,
W82-01214 7C

Hydrochemical Facies in a Tertiary Basin in the Milligan Canyon Area, Southwest Montana,
W82-01481 2F

MONTE CARLO METHOD
Comparison of First-Order Error Analysis and Monte Carlo Simulation in Time-Dependent Lake Eutrophication Models,
W82-01460 2H

MULTIOBJECTIVE PLANNING
Generating Alternative Solutions for Dynamic Programming Models of Water Resources Problems,
W82-01450 6A

MULTIPURPOSE RESERVOIRS
Water Resources Appraisals for Hydroelectric Licensing; Brazos River Basin, Texas-New Mexico,
W82-01439 6D

Water Resources Appraisals for Hydroelectric Licensing; Savannah and Edisto River Basins Area; Georgia-South Carolina-North Carolina,
W82-01440 6D

Water Resources Appraisals for Hydroelectric Licensing; American River Basin, California,
W82-01441 6D

MULTIVARIATE ANALYSIS
Immediate Detection of Heterogeneities in Continuous Multivariate, Oceanographic Recordings. Application to Time Series Analysis of Changes in the Bay of Villefranche sur Mer,
W82-01393 7A

MUNICIPAL WASTEWATER
Land Application of Municipal Wastewater,
W82-01253 5D

Land Treatment Site Evaluation in Southeastern Mountainous Areas,
W82-01596 5D

MUSSELS
Chemical Control of Mussel Settlement in a Cooling Water System Using Acrolein,
W82-01501 5F

The Escherichia Coli Content of Mytilus Edulis from Analysis of Whole Tissue or Digestive Tract,
W82-01508 5A

MUTAGENS
The Application of Mutagenicity Testing to Drinking Water,
W82-01487 5A

Relationship of the Raw Water Quality to Mutagens Detectable by the Ames Salmonella/Microsome Assay in a Drinking-Water Supply,
W82-01493 5A

MYTILUS
The Escherichia Coli Content of Mytilus Edulis from Analysis of Whole Tissue or Digestive Tract,
W82-01508 5A

NARMADA RIVER
Study of a Complex Water Resources System with Screening and Simulation Models,
W82-01309 6A

NAVIGATION
Hydropower Losses from Navigation in the Snake-Columbia Rivers: 1978-79,
W82-01139 6D

NEBRASKA
Nebraska Ground Water Law and Administration,
W82-01236 6E

Chemical and Bacteriological Quality of Pasture Runoff,
W82-01555 5B

NEPHELOID LAYER
Nepheloid and Suspended Particulate Matter in South-Eastern Lake Michigan,
W82-01499 2H

NETHERLANDS
Measuring the Hydraulic Conductivity of Soil Adjacent to Tile Drains in a Heavy Clay Soil in the Netherlands,
W82-01323 2G

Holland's Eastern Scheldt Estuary Barrier Scheme: Some Ecological Considerations,
W82-01375 2L

Investigations into the Occurrence of Midge Plagues in the Vicinity of Harderwijk (Netherlands),
W82-01378 2H

NETWORK DESIGN
Regional Flood Frequency Estimation and Network Design,
W82-01294 2E

NETWORKS
A Model for Simulation of Flow in Singular and Interconnected Channels,
W82-01210 2E

NEVADA
Water Multipliers--Regional Impact Analysis,
W82-01138 6A

NEW ENGLAND
The Significance of Snowmelt on Water Supplies in the Northeast,
W82-01488 2A

NEW JERSEY
Aluminum in Precipitation, Streams, and Shallow Groundwater in the New Jersey Pine Barrens,
W82-01297 5B

NEW YORK
Mercury and Zinc in the Sediments of Seneca Lake, Seneca River, and Keuka Outlet, New York,
W82-01151 5B

Nearshore Spatial Distribution of Fishes in Gill Net Samples, Cayuga Lake, New York,
W82-01195 7A

Preliminary Report of Stream Sampling for Acidification Studies 1980,
W82-01453 5A

NEW ZEALAND
Identification of the Wairakei Geothermal System,
W82-01312 2F

On Identification and Validation of Some Geothermal Models,
W82-01467 6A

NITRATES
Nitrate Reduction in an Organic Soil-Water System,
W82-01129 5B

Nitrate Production, Uptake, and Leaching,
W82-01411 5B

Evaluation of Ultraviolet Spectrophotometric Determination of Nitrate-Nitrogen in Glacial Snow, Firn and Ice,
W82-01572 5A

Effects of Water and Nitrogen Management on Nitrate Leaching Loss from Sands,
W82-01581 5B

NITRIFICATION
Activated Sludge,
W82-01243 5D

Effect of Copper on Nitrification in Activated Sludge,
W82-01497 5C

Operational Problems with Rotating Biological Contactors,
W82-01549 5D

NITRILOTRIACETIC ACID
A Bioassay Study of Effects of Zooplankton, Iron and NTA on the Phytoplankton Productivity of a Marl Lake,
W82-01157 2H

NITROGEN
Soluble N and P Concentrations in Surface Runoff Water,
W82-01413 5B

Nitrogen Leaching as Influenced by Nitrogen Management and Supplement Irrigation Level,
W82-01472 5B

Nitrogen Balances for an Effluent Irrigation Area,
W82-01478 3C

Gaseous Nitrogen as Evidence for Denitrification in Groundwater,
W82-01485 2K

Utilization Efficiency of Nitrogen from Sewage Effluent and Fertilizer Applied to Corn Plants Growing in a Clay Soil,
W82-01515 3C

NITROGEN COMPOUNDS
Nonpoint N Runoff from Agricultural Watersheds into the Great Lakes,
W82-01148 5B

Formation of N-Nitrosodimethylamine During Treatment of Municipal Waste Water by Simulated Land Application,
W82-01343 5D

Some Factors Affecting the Determination of Particulate Carbon and Nitrogen in River Water,
W82-01532 5A

NITROGEN REMOVAL
Design and Cost Comparison of Biological Nitrogen Removal Processes,
W82-01544 5D

NODULES
Ferromanganese Nodules from Lake Ontario (Bay of Quinte): Minor Element Geochemistry,
W82-01143 2H

NONPOINT POLLUTION SOURCES
Non-Point Sources,
W82-01270 5B

CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems,
W82-01401 5B

Erosivity 'R' for Individual Design Storms,
W82-01403 2J

Nitrate Production, Uptake, and Leaching,
W82-01411 5B

Estimating Soluble (PO4-P) and Labile Phosphorus in Runoff from Croplands,
W82-01412 5B

Pesticide Concentrations in Agricultural Runoff: Available Data and an Approximation Formula,
W82-01414 5B

Relationship Between Increased Crop Acreage and Nonpoint-Source Pollution: A Georgia Case Study,
W82-01550 5B

NORTH AMERICA
Recent Acidification of Precipitation in North America,
W82-01514 5B

NORTHUMBRIAN WATER AUTHORITY
A Catchment Approach to Flood Estimation,
W82-01397 2E

NOTTAWASAGA BAY
Wave Climate and Potential Longshore Sediment Transport Patterns, Nottawasaga Bay, Ontario,
W82-01156 2J

NUCLEAR POWERPLANTS
A Quantitative Study of Shoreline Marsh Communities Along Lake Huron in Ontario,
W82-01122 2H

NUTRIENT RELEASE
Release of Phosphorus by Certain Benthic Invertebrates,
W82-01502 2H

NUTRIENT REMOVAL
Water Quality from Two Small Forested Watersheds in Southern Illinois,
W82-01140 4C

NUTRIENTS
Changes in Soil Water Quality Resulting from Three Timber Cutting Methods and Three Levels of Fiber Utilization,
W82-01135 2G

Nutrient Loading of Southern Lake Michigan by Dry Deposition of Atmospheric Aerosol,
W82-01152 5B

Physico-Chemistry, Destratification and Nutrient Budget of a Lowland Eutrophicated Malaysian Reservoir and Its Limnological Implications,
W82-01360 2H

Enrichment Ratios for Water Quality Modeling,
W82-01410 2J

Estimating Soluble (PO4-P) and Labile Phosphorus in Runoff from Croplands,
W82-01412 5B

Soluble N and P Concentrations in Surface Runoff Water,
W82-01413 5B

The Effect of Fertilization with Phosphorus and Nitrogen Versus Phosphorus Alone on Eutrophication of Experimental Lakes,
W82-01457 5C

Sediment and Nutrient Trap Efficiency of a Small Flood-Detention Reservoir,
W82-01471 4A

Application of Nutrient-Saturated Growth Model to Phytoplankton Management in Freshwater Prawn (Macrobrachium Rosenbergii) Ponds in Hawaii,
W82-01483 2H

Stream Nutrient Levels and Proximity of Agricultural and Forest Land to Streams: Some Relationships,
W82-01554 5B

OHIO
Limnetic Larval Fish of the Maumee and Sandusky River Estuaries,
W82-01197 7A

Water Management Model Evaluation for North Central Ohio,
W82-01536 4A

OHIO RIVER
Metal Ion Concentrations Associated with Late Summer Sediments of the Ohio River,
W82-01300 5A

OIL POLLUTION
Petroleum Hydrocarbons in Sediments of Saginaw Bay, Lake Huron,
W82-01141 5A

OIL RECOVERY
Petroleum Processing Wastes,
W82-01262 5D

OIL SHALE
Synthetic Fuel Effluents,
W82-01263 5B

OIL SPILLS
Compelled Self-Incrimination and the Federal Water Pollution Control Act,
W82-01600 6E

ONTARIO
Climatic Factors Contributing to Year-To-Year Variation in Grain Yield of Corn on Brookston Clay,
W82-01115 2I

Estimating Evapotranspiration from Irrigated Crops in Southwestern Ontario,
W82-01116 2D

A Quantitative Study of Shoreline Marsh Communities Along Lake Huron in Ontario,
W82-01122 2H

A Classification and Description of Some Northeastern Ontario Lakes Influenced by Acid Precipitation,
W82-01145 5B

Some Effects of Agricultural Land Use on Stream Insect Communities,
W82-01159 5C

Origin, Age and Movement of Pore Water in Agrillaceous Quaternary Deposits at Four Sites in Southwestern Ontario,
W82-01321 2F

Compatibility of Canadian Snowfall and Snow Cover Data,
W82-01466 2C

An Analysis of Acidic Precipitation in South-Central Ontario Using Air Parcel Trajectories,
W82-01513 5B

OPTIMIZATION
Daily Optimization of Power Generation in Cascade Hydrosystems (A Stochastic Approach),
W82-01320 6A

Methods for Generating Alternative Solutions to Water Resources Planning Problems,
W82-01449 6A

ORGANIC COMPOUNDS
Abundance of Organic Compounds in Water,
W82-01162 5A

Organics,
W82-01239 5A

Chemicals and Allied Products,
W82-01267 5D

Volatile C1-C7 Organic Compounds in Surface Sediments from Walvis Bay,
W82-01367 5B

Bench Scale Assessment of Technologies for Contaminated Ground Water Treatment,
W82-01433 5G

Modeling of Activated Carbon and Coal Gasification Char Adsorbents in Single-Solute and Bisolute Systems,
W82-01447 1B

Investigation of Volatile Organics Removal,
W82-01490 5F

Relationship of the Raw Water Quality to Mutagens Detectable by the Ames Salmonella/Microsome Assay in a Drinking-Water Supply,
W82-01493 5A

Groundwater Contamination by Trace Level Organics from a Rapid Infiltration Site,
W82-01496 5B

Application of Capillary Gas Chromatography Mass Spectrometry/Computer Techniques to Synoptic Survey of Organic Material in Bed Sediment,
W82-01573 5A

Concentrating Organics in Water for Biological Testing,
W82-01591 5A

ORGANIC MATTER
Organics in Water - An Engineering Challenge,
W82-01540 5F

ORGANIC MATTER *ULTRAVIOLET RADIATION
U.V.-DOC Characterization of Pulp and Paper Bleach Effluents,
W82-01495 5A

ORGANIC SOILS
Nitrate Reduction in an Organic Soil-Water System,
W82-01129 5B

ORGANIC SOLVENTS
A Study of a Method for Displacing Soil Solution by Centrifuging with an Immiscible Liquid,
W82-01131 5B

ORGANOPHOSPHORUS PESTICIDES
Abate: Effects of the Organophosphate Insecticide on Bluegills and Invertebrates in Ponds,
W82-01445 5C

The Effects of Organophosphorus Pesticides on Estuarine Ammonium Oxidizers,
W82-01567 5C

OSWEGO COUNTY
Case Studies on the Migration of Pollutants in Ground Water,
W82-01424 5B

OUTLETS
Hydraulic Model Study of Daule-Peripa Spillway and Outlet Works,
W82-01446 8A

OVERLAND FLOW
Sediment Transport Capacity of Overland Flow,
W82-01408 2J

Vegetation Selection and Management for Overland Flow Systems,
W82-01500 5E

OXIDATION
Oxidation of SO2 in Aqueous Droplets: Mass Transport Limitation in Laboratory Studies and the Ambient Atmosphere,
W82-01470 2K

Collapsing Aphanizomenon Flos-Aquae Blooms: Possible Contributions of Photo-Oxidation, O2 Toxicity, and Cyanophages,
W82-01595 2H

OXIDATION LAGOONS
Lagoons and Oxidation Ponds,
W82-01244 5D

OXIDATION PONDS
Lagoons and Oxidation Ponds,
W82-01244 5D

OXYGEN
O2 Bleaching Shows Potential for Reducing Costs and Effluent Problems,
W82-01578 5D

OXYGEN DEMAND
Sediment Oxygen Demand and Its Effect on Dissolved Oxygen in a Cutoff Meander of the Kaskaskia River,
W82-01448 4A

OXYGEN ISOTOPES
018 Modelling of Freshwater Inputs in Baffin Bay and Canadian Arctic Coastal Waters,
W82-01590 2C

OXYGEN TRANSFER
Hypolimnion Flow Between the Central and Eastern Basins of Lake Erie During 1977 (Interbasin Hypolimnion Flows)
W82-01153 2H

OXYGENATION
Treatment of Pulp and Papermill Wastewaters and the Use of the Oxygen Activated Sludge System,
W82-01594 5D

OZONATION
Disinfection,
W82-01250 5D

OZONE
Mechanism of Enteroviral Inactivation by Ozone,
W82-01482 5D

PAINT INDUSTRY
Geological Studies of Industrially-Related Contamination: Soil and Ground Water Investigations,
W82-01425 5B

PARAMETRIC HYDROLOGY
A Parametric Crop Water Use Model,
W82-01310 2I

PASTURES
Chemical and Bacteriological Quality of Pasture Runoff,
W82-01555 5B

PATH OF POLLUTANTS
A Study of a Method for Displacing Soil Solution by Centrifuging with an Immiscible Liquid,
W82-01131 5B

Transports in the Duluth-Superior Harbor,
W82-01136 5B

An Analytical Solution for Solute Transport Through Fractured Media with Matrix Diffusion,
W82-01179 2F

Monitoring Leachate in Ground Water by Corrected Resistivity Methods,
W82-01219 5A

Synthetic Fuel Effluents,
W82-01263 5B

Radioactive Wastes,
W82-01268 5D

Solid Wastes and Water Quality,
W82-01269 5B

Aquatic Sediments,
W82-01279 5B

Analysis of National Water Pollution Control Policies 1. A National Network Model,
W82-01292 6A

Analysis of National Water Pollution Control Policies 2. Agricultural Sediment Control,
W82-01293 6A

Love Canal: Chemical Contamination and Migration,
W82-01436 5B

PATHOGENS
Microbiology: Detection of Bacterial Pathogens and Their Occurrence,
W82-01288 5B

Disease Outbreaks Caused by Drinking Water,
W82-01289 5C

PENNSYLVANIA
Water Resources Data for Pennsylvania, Water Year 1980--Volume 2. Susquehanna and Potomac River Basins,
W82-01212 7C

PENTICTON
Design and Cost Comparison of Biological Nitrogen Removal Processes,
W82-01544 5D

PEOPLE'S REPUBLIC OF CHINA
Yangtze Gorges Scheme Could Yield 110 TWh/Year,
W82-01394 8A

PERFORMANCE EVALUATION
Survey of Treatment Plant Design and Operation Deficiencies,
W82-01543 5D

Operational Problems with Rotating Biological Contactors,
W82-01549 5D

High Temperature Ultrafiltration with Kynar Poly(Vinylidene Fluoride) Membranes,
W82-01566 5D

PERIPHYTON
Periphyton Analysis for the Evaluation of Water Quality in Running Waters of Greece,
W82-01358 5A

PERMEABILITY
Origin, Age and Movement of Pore Water in Agrillaceous Quaternary Deposits at Four Sites in Southwestern Ontario,
W82-01321 2F

PERMEABILITY COEFFICIENT
Hydraulic Conductivity of Four Commercial Citrus Rootstocks,
W82-01546 2I

Hydraulic Properties of Fullerton Cherty Silt Loam,
W82-01561 2G

PESTICIDE KINETICS
Pesticide Concentrations in Agricultural Runoff: Available Data and an Approximation Formula,
W82-01414 5B

PESTICIDES
Pesticide Concentrations in Agricultural Runoff: Available Data and an Approximation Formula,
W82-01414 5B

The Effects of Organophosphorus Pesticides on Estuarine Ammonium Oxidizers,
W82-01567 5C

Polychlorinated Biphenyls and Other Organic Chemical Residues in Fish from Major United States Watersheds Near the Great Lakes, 1978,
W82-01583 5A

PHARMACEUTICAL INDUSTRY
Pharmaceutical Company's Aeration System Saves Energy,
W82-01180 5D

PHENOLS
Anaerobic Carbon Filter for Degradation of Phenols,
W82-01454 5D

PHOSPHORUS
Changes in Lake Ontario Total Phosphorus Concentrations, 1976-1978,
W82-01126 2H

Modelling Effects of Remedial Programs to Aid Great Lakes Environmental Management,
W82-01146 5G

Phosphorus Uptake Dynamics as Related to Mathematical Modeling of Cladophora at a Site on Lake Huron,
W82-01149 5C

The Depth of Rainfall-Runoff-Soil Interaction as Determined by P32,
W82-01318 5B

Phosphorus Concentration-Water Flow Interactions in Tile Effluent from Manured Land,
W82-01340 5B

Estimating Soluble (PO4-P) and Labile Phosphorus in Runoff from Croplands,
W82-01412 5B

Soluble N and P Concentrations in Surface Runoff Water,
W82-01413 5B

The Release of Soil Phosphorous to Runoff in Relation to the Kinetics of Desorption,
W82-01477 5B

Effects of Dairy Manure on Phosphorus Concentrations and Losses in Tile Effluent,
W82-01479 5B

Release of Phosphorus by Certain Benthic Invertebrates,
W82-01502 2H

Historical Changes and Relationship to Internal Loading of Sediment Phosphorus Forms in Hypertrophic Prairie Lakes,
W82-01516 2H

PHOSPHORUS REMOVAL
Removal of Phosphorus from Waste Water by Soil Under Aerobic and Anaerobic Conditions,
W82-01344 5D

PHYSICOCHEMICAL PROPERTIES
Diurnal, Depth-Wise, and Seasonal Changes of Physico-Chemical Factors in Sathiar Reservoir,
W82-01372 2H

Physical and Chemical Studies of Lago Tupe: A Central Amazonian Black Water 'Ria Lake',
W82-01381 2H

PHYSICOCHEMICAL TREATMENT
Physical and Chemical Methods,
W82-01241 5D

PHYTOPLANKTON
A Bioassay Study of Effects of Zooplankton, Iron and NTA on the Phytoplankton Productivity of a Marl Lake,
W82-01157 2H

Phytoplankton Productivity and Standing Crop in the Vicinity of the Lake Huron-Saginaw Bay Front,
W82-01164 2H

Effects of Atmospheric Precipitation Additions on Phytoplankton Photosynthesis in Lake Michigan Water Samples,
W82-01196 2H

Phytoplankton of Four Rivers, the Tyne, Wear, Tees and Swale,
W82-01376 2E

The Effect of Fertilization with Phosphorus and Nitrogen Versus Phosphorus Alone on Eutrophication of Experimental Lakes,
W82-01457 5C

PIPELINES
Pipeline Friction Losses for Wastewater Sludges,
W82-01545 5D

PLANKTON
Observations on the Hydrography and Inshore Plankton of the Bay of Bengal off Balasore,
W82-01362 2A

PLANNING
Systems Analysis,
W82-01303 6A

Rural Water Supply and Related Services in Developing Countries-Comparative Analysis of Several Approaches,
W82-01330 6A

Input and Output Constraints Affecting Irrigation Development,
W82-01476 6B

Interdisciplinary Environmental Analysis for Timber Sale Planning,
W82-01539 6A

PLANT TISSUES
Use of Excised Root Cultures as Bioindicators of Water Pollution (Utilisation Des Cultures de Racines Isolees Comme Test Biologique de Pollution des Eaux),
W82-01133 5A

PLUMES
Plume Development Using Lagrangian Marker Method,
W82-01182 5B

Mapping Contaminated Soil Plumes by Kriging,
W82-01423 5G

PLUTONIUM RADIOISOTOPES
Factors Affecting Radionuclide Availability to Vegetables Grown at Los Alamos,
W82-01109 5B

POLAR REGIONS
The Behavior of a Polar Ice-Dammed Lake, Ellesmere Island, N.W.T., Canada,
W82-01511 2C

POLICY MAKING
On Water Tariff Equalization Policies,
W82-01175 6C

POLLUTANT IDENTIFICATION
Use of Excised Root Cultures as Bioindicators of Water Pollution (Utilisation Des Cultures de Racines Isolees Comme Test Biologique de Pollution des Eaux),
W82-01133 5A

Monitoring Leachate in Ground Water by Corrected Resistivity Methods,
W82-01219 5A

Inorganics,
W82-01238 5A

Microbiology: Detection, Occurrence, and Removal of Viruses,
W82-01290 5A

Faecal Pollution of Belgian Coastal Water,
W82-01373 5A

A Note on the Use of Membrane Faecal Coliform Medium for Enhancing Resolution and Accuracy When Enumerating a Small Plaquing Coliphage,
W82-01507 5A

The Escherichia Coli Content of Mytilus Edulis from Analysis of Whole Tissue or Digestive Tract,
W82-01508 5A

Determination of Nanogram Quantities of Mercury in Water with a Gold-Plated Piezoelectric Crystal Detector,
W82-01509 5A

Comparison of Selective Media for the Enumeration and Identification of Fecal Streptococci from Natural Sources,
W82-01564 5A

Preconcentration for Trace Element Determination in Aqueous Samples,
W82-01574 5A

Chrysotile Asbestos Fibers in Drinking Water from Asbestos-Cement Pipe,
W82-01592 5B

POLLUTANTS
Rapid Methods of Chemical Analysis Used in Emergency Response Mobile Laboratory Activities,
W82-01431 5A

Bench Scale Assessment of Technologies for Contaminated Ground Water Treatment,
W82-01433 5G

Laboratory Procedure for Estimating Residue Dynamics of Xenobiotic Contaminants in a Freshwater Food Chain,
W82-01443 5B

POLLUTION CONTROL
The Workings of the Control of Pollution Act in Tidal Waters: A View of the Ministry of Agriculture, Fisheries and Food,
W82-01383 6E

Thoughts on the Need to Control Discharges to Estuarial and Coastal Waters,
W82-01384 6E

POLLUTION LOAD
Evaluation of the Polluted River Savinja with the Help of Macrophytes,
W82-01377 5C

New Opportunities for In-Plant Reduction of Pollutants Through Process Changes,
W82-01559 5G

POLYCHLORINATED BIPHENYLS
PCB Residues in Bottom Sediments Collected From the Bay of Quinte, Lake Ontario 1972-1973,
W82-01155 5B

Influence of PCBs in Water on Uptake and Elimination of DDT and DDE by Lake Trout,
W82-01342 5C

The Influence of Chemical Conditioning and Dewatering on the Distribution of Polychlori-

LIBRARY U. S. U. ENVIRONMENTAL RESEARCH LABORATORY

nated Biphenyls and Organochlorine Insecticides in Sewage Sludges,
W82-01387 5E

Polychlorinated Biphenyls and Other Organic Chemical Residues in Fish from Major United States Watersheds Near the Great Lakes, 1978,
W82-01583 5A

POLYMERS
Open-Pore Polyurethane as a Medium for Coal Conversion Process Aqueous Effluent Cleanup,
W82-01577 5D

PONDS
Zooplankton Abundance and Diversity in Central Florida Grass Carp Ponds,
W82-01520 2H

POPULATION DYNAMICS
The Effects of a New Reservoir on the Attached Diatom Communities in Huntington Creek, Utah, U.S.A.,
W82-01521 2H

PORE WATER
Origin, Age and Movement of Pore Water in Agrillaceous Quaternary Deposits at Four Sites in Southwestern Ontario,
W82-01321 2F

POROUS MEDIA
Mass Transport of Solutes in Dual-Porosity Media,
W82-01104 5B

Scaling of Infiltration Behavior in Dissimilar Porous Materials,
W82-01105 2G

A Stochastic Approach for Describing Convective-Dispersive Solute Transport in Saturated Porous Media,
W82-01461 5B

POTABLE WATER
Radon-222, In Potable Water Supplies of New England,
W82-01221 5B

Microbiology of Potable Water,
W82-01287 5F

Chrysotile Asbestos Fibers in Drinking Water from Asbestos-Cement Pipe,
W82-01592 5B

POULTRY
Meat-, Fish-, and Poultry-Processing Wastes,
W82-01256 5D

POWERPLANTS
An Empirical Methodology for Estimating Entrainment Losses at Power Plants Sited on Estuaries,
W82-01173 6G

Entrainment and Impingement in Power Plant Cooling Systems,
W82-01276 6G

Daily Optimization of Power Generation in Cascade Hydrosystems (A Stochastic Approach),
W82-01320 6A

Northfield Mountain Pumped Storage Project: Performance,
W82-01517 8A

The Effects of a New Reservoir on the Attached Diatom Communities in Huntington Creek, Utah, U.S.A.,
W82-01521 2H

PRAIRIES
Impact of Management Practices on the Tallgrass Prairie,
W82-01580 4A

PRECIPITATION
Effects of Atmospheric Precipitation Additions on Phytoplankton Photosynthesis in Lake Michigan Water Samples,
W82-01196 2H

A Dendroclimatic Reconstruction of Annual Precipitation Amounts in Iowa Since 1680,
W82-01314 2B

Factors Affecting the Chemistry of Precipitation and River Water in an Upland Catchment,
W82-01322 2K

PREDICTIONS
An Example of the Application of Statistical Techniques to Predict Lake Level Elevations,
W82-01111 6A

PRIMARY PRODUCTION
Mineral Impact of Lakes as Background for Their Biogenic Dynamics,
W82-01359 2H

PRIVATE RIGHTS
Middlesex County Sewerage Authority V. National Sea Clammers Association: Implied Private Rights of Action for Damages under the Federal Water Pollution Control Act Amendments of 1972,
W82-01455 6E

PROBABILISTIC PROCESS
Channel Instability in a Braided, Sand Bed River,
W82-01316 2J

PROBABILITY DISTRIBUTION
Note on Probability Approach to Study the Occurrence of Rainfall at Hyderabad,
W82-01380 2B

Simulation of Daily Weather Data Using Theoretical Probability Distributions,
W82-01526 2B

PROCESS CONTROL
Survey of Treatment Plant Design and Operation Deficiencies,
W82-01543 5D

PUBLIC HEALTH
Health Effects Associated with Wastewater Treatment and Disposal,
W82-01255 5C

Effect of Investments in Water Supply and Sanitation on Health Status: A Threshold-Saturation Theory,
W82-01331 6B

Environmental Impact and Health Effects of Wastewater Chlorination,
W82-01451 5D

The Water Decade (1981-1990),
W82-01534 6E

PUBLIC PARTICIPATION
Public Concerns and PLUARG: Selected findings and Discussion,
W82-01137 5G

Malawi: A Community Approach,
W82-01365 5F

PUBLIC RELATIONS
Organic Contamination of Ground Water: Tell it All,
W82-01474 5C

PUERTO RICO
Multifrequency Radiometer Detection of Submarine Freshwater Sources Along the Puerto Rican Coastline,
W82-01349 3B

PULP AND PAPER INDUSTRY
Pulp and Paper Industry Effluent Management,
W82-01260 5D

Environmental Recovery in a Marine Ecosystem Impacted by a Sulfite Process Pulp Mill,
W82-01548 5B

New Opportunities for In-Plant Reduction of Pollutants Through Process Changes,
W82-01559 5G

O2 Bleaching Shows Potential for Reducing Costs and Effluent Problems,
W82-01578 5D

Closeup of Whitewater System Helps Menasha Meet Effluent Standards,
W82-01579 5D

Remedial Action Controls Groundwater Contamination at a Paper Mill Sludge Disposal Site,
W82-01582 5G

Acid Precipitation: Basic Principles and Ecological Consequences,
W82-01586 5C

Treatment of Pulp and Papermill Wastewaters and the Use of the Oxygen Activated Sludge System,
W82-01594 5D

PULP WASTES
The Interaction of Treated Bleached Kraft Mill Effluent and Dissolved Oxygen Concentration on the Survival of the Developmental Stages of the Sheepshead Minnow (Cyprinodon Variegatus),
W82-01494 5C

U.V.-DOC Characterization of Pulp and Paper Bleach Effluents,
W82-01495 5A

PUMPAGE
Yield Verification of a Dolomite Aquifer in Northeast Illinois,
W82-01334 2F

PUMPS
An All-Teflon Bailer and an Air-Driven Pump for Evacuating Small-Diameter Ground-Water Wells,
W82-01333 7B

QANAT AL-JAISH CANAL
A Hydrobiological Survey of a Polluted Canal,
W82-01356 5C

QUALITY CONTROL
Microbiology: Methodology and Quality Assurance,
W82-01285 5A

RADIOACTIVE TRACERS
An Approach to Determining Pathways and Residence Time of Groundwaters: Dual Radiotracer Dating,
W82-01348 2F

RADIOACTIVE WASTE DISPOSAL
Factors Affecting Radionuclide Availability to Vegetables Grown at Los Alamos,
W82-01109 5B

Studies on Unsaturated Zone Hydrology and Radionuclide Migration at a Shallow-Land Burial Site,
W82-01172 5B

RADIOACTIVE WASTES
Radioactive Wastes,
W82-01268 5D

A Study of Regional Temperature and Thermohydrologic Effects of an Underground Repository for Nuclear Wastes in Hard Rock,
W82-01347 5E

RADIOISOTOPES
Geologic and Hydrologic Factors Controlling Radon-222 in Ground Water in Maine,
W82-01222 2F

RADIOMETERY
Remote Sensing of Soil Moisture Content Over Bare Field at 1.4 GHz Frequency,
W82-01345 7B

RADIOMETRY
Multifrequency Radiometer Detection of Submarine Freshwater Sources Along the Puerto Rican Coastline,
W82-01349 3B

RADIUM-226
Data Base Development for the Design of a Radium-226 Removal Process,
W82-01188 5D

RADON
Some Recent Studies on Groundwater Radon Content as an Earthquake Precursor,
W82-01127 2F

Radon-222, In Potable Water Supplies of New England,
W82-01221 5B

Geologic and Hydrologic Factors Controlling Radon-222 in Ground Water in Maine,
W82-01222 2F

RAINFALL
Note on Probability Approach to Study the Occurrence of Rainfall at Hyderabad,
W82-01380 2B

Time Distribution of Clock Hour Rainfall,
W82-01402 2A

An Index of Arizona Summer Rainfall Developed Through Eigenvector Analysis,
W82-01528 2B

A Comparison of Two Satellite Rainfall Estimates for GATE,
W82-01533 7B

RAINFALL DISTRIBUTION
The Inference of Gate Convective Rainfall from SMS-1 Imagery,
W82-01519 7B

RAINFALL INTENSITY
Deuterium/Hydrogen Ratios in Australian Rainfall,
W82-01325 2B

Erosivity 'R' for Individual Design Storms,
W82-01403 2J

RAINFALL-RUNOFF RELATIONSHIPS
The Depth of Rainfall-Runoff-Soil Interaction as Determined by P32,
W82-01318 5B

RANGE MANAGEMENT
Impact of Management Practices on the Tallgrass Prairie,
W82-01580 4A

RAPID INFILTRATION
Groundwater Contamination by Trace Level Organics from a Rapid Infiltration Site,
W82-01496 5B

RECHARGE
A Mathematical Model of Water Table Fluctuation in a Semi-Infinite Aquifer Induced by Localized Transient Recharge,
W82-01319 2F

RECREATION DEMAND
Preferences for Allocating River Recreation Use,
W82-01181 6D

Management Concerns for Swimming, Tubing, and Wading in the Great Smoky Mountains National Park,
W82-01475 6A

REFLECTANCE
Water Frost and Ice: The Near-Infrared Spectral Reflectance 0.65-2.5 Microns,
W82-01346 2C

REGENERATION
Regeneration of Anion Exchange Resins by Calcium Carbonate and Carbon Dioxide,
W82-01484 5F

REGIONAL ANALYSIS
Regionalization of the Upper Great Lakes with Respect to Surveillance Eutrophication Data,
W82-01150 7A

Regional Flood Frequency Estimation and Network Design,
W82-01294 2E

REGIONAL DEVELOPMENT
Erosion and Sedimentation Control in Regional and Site Planning,
W82-01552 4D

REGIONAL PLANNING
Water Multipliers--Regional Impact Analysis,
W82-01138 6A

REGULATIONS
Surface Water Management at Hazardous Waste Sites,
W82-01429 5G

Background Document for Modification of pH Effluent Limitations Guidelines and Standards for Point Sources Required by NPDES Permit to Monitor Continuously Effluent pH.
W82-01438 5D

REMOTE SENSING
Sites of River-Derived Sedimentation in the Ocean,
W82-01332 7B

Remote Sensing of Soil Moisture Content Over Bare Field at 1.4 GHz Frequency,
W82-01345 7B

Water Frost and Ice: The Near-Infrared Spectral Reflectance 0.65-2.5 Microns,
W82-01346 2C

Multifrequency Radiometer Detection of Submarine Freshwater Sources Along the Puerto Rican Coastline,
W82-01349 3B

Site Assessment: Improving Confidence Levels with Surface Remote Sensing,
W82-01422 5G

The Inference of Gate Convective Rainfall from SMS-1 Imagery,
W82-01519 7B

A Balloonborne Instrument for the Measurement of Vertical Profiles of Supercooled Liquid Water Concentration,
W82-01524 7B

Experimental Verification of the Linear Relationship Between IR Extinction and Liquid Water Content of Clouds,
W82-01525 7B

A Comparison of Two Satellite Rainfall Estimates for GATE,
W82-01533 7B

Determination of Moisture from NOAA Polar Orbiting Satellite Sounding Radiances,
W82-01535 2B

RESERVOIR CONSTRUCTION
An Investigation Into the Effects of Thermal Movement in the Walls of Service Reservoirs,
W82-01396 8F

RESERVOIR DESIGN
Performance Evaluation of a Stochastic Optimization Model for Reservoir Design and Management with Explicit Reliability Criteria,
W82-01462 8A

RESERVOIR OPERATION
Performance Evaluation of a Stochastic Optimization Model for Reservoir Design and Management with Explicit Reliability Criteria,
W82-01462 8A

RESERVOIRS
Dissolved Oxygen in Streams and Reservoirs,
W82-01272 5G

Hydroelectrical Model for Optimal Operation of a Single Multipurpose Reservoir,
W82-01329 6A

Hydrobiological Studies on the Ajwa Reservoir, the Source of Raw Water Supply to the Baroda Water Works,
W82-01364 2H

Water Resources Appraisals for Hydroelectric Licensing; Brazos River Basin, Texas-New Mexico,
W82-01439 6D

Ecology of Larval Fishes in Lake Oahe, South Dakota,
W82-01444 6G

The Effects of a New Reservoir on the Attached Diatom Communities in Huntington Creek, Utah, U.S.A.,
W82-01521 2H

RESIDUAL CHLORINE
Environmental Impact and Health Effects of Wastewater Chlorination,
W82-01451 5D

RESISTIVITY
Monitoring Ground-Water Contamination at a Fly Ash Disposal Site Using Surface Electrical Resistivity Methods,
W82-01218 5B

Monitoring Leachate in Ground Water by Corrected Resistivity Methods,
W82-01219 5A

RETURN FLOW
The Problems of Non-Return and the Use of Valves in Drinking Water Protection Against Waste Water Return, Applying the Regulations in Force,
W82-01142 5F

REVERSE OSMOSIS
Purification of Municipal Wastewater by Subsequent Reverse Osmosis and Anaerobic Digestion,
W82-01468 5D

REVIEWS
Inorganics,
W82-01238 5A

Biological Filters,
W82-01242 5D

Pulp and Paper Industry Effluent Management,
W82-01260 5D

Bioassays - Procedures and Results,
W82-01277 5A

Economics,
W82-01304 5G

Water Characteristics,
W82-01305 5B

Small Water Systems: Role of Technology,
W82-01542 5F

RICE
Irrigation Needs and Yield of Rice on a Sandy-Loam Soil as Affected by Continuous and Intermittent Submergence,
W82-01382 3F

RISKS
Risk Models for Flood Levee Design,
W82-01307 8A

Optimal Risk-Based Design of Flood Levee Systems,
W82-01313 8B

RIVER BASINS
Potential Use of a Stream-Aquifer Model for Management of a River Basin: Case of the South Platte River in Colorado,
W82-01301 6A

Drainage Network Structure and the Diameter-Magnitude Relation,
W82-01308 2A

River Basin Hydrosalinity Modeling,
W82-01469 2K

RIVER BEDS
Evaluation of Effective Boundary Roughness for Gravel-Bed Rivers,
W82-01161 8B

River Bed Aggradation Due to Overloading,
W82-01486 2J

RIVER RUNOFF
Year-to-Year Changes in the Salinity of the Eastern English Channel, 1948-1973: A Budget,
W82-01399 2A

RIVER RUNOFF *SALINITY
Observations on the Hydrography and Inshore Plankton of the Bay of Bengal off Balasore,
W82-01362 2A

RIVERS
Factors Affecting the Chemistry of Precipitation and River Water in an Upland Catchment,
W82-01322 2K

Sites of River-Derived Sedimentation in the Ocean,
W82-01332 7B

Phytoplankton of Four Rivers, the Tyne, Wear, Tees and Swale,
W82-01376 2E

Evaluation of the Polluted River Savinja with the Help of Macrophytes,
W82-01377 5C

ROAD CONSTRUCTION
Storm Flow Response to Road Building and Partial Cutting in Small Streams of Northern California,
W82-01295 4C

ROTATING BIOLOGICAL CONTACTORS
Biological Filters,
W82-01242 5D

Operational Problems with Rotating Biological Contactors,
W82-01549 5D

RUNOFF
The Depth of Rainfall-Runoff-Soil Interaction as Determined by P32,
W82-01318 5B

Time Distribution of Clock Hour Rainfall,
W82-01402 2A

The Release of Soil Phosphorous to Runoff in Relation to the Kinetics of Desorption,
W82-01477 5B

The Significance of Snowmelt on Water Supplies in the Northeast,
W82-01488 2A

Snowmelt Prediction in a Subarctic Drainage Area,
W82-01571 2C

RUNOFF RATES
Residue and Tillage Effects on SCS Runoff Curve Numbers,
W82-01404 4D

SAFFLOWER
Effect of Water, Nitrogen and Row Spacing on the Yield and Oil Content of Safflower,
W82-01112 2I

SAGINAW BAY
Petroleum Hydrocarbons in Sediments of Saginaw Bay, Lake Huron,
W82-01141 5A

Phytoplankton Productivity and Standing Crop in the Vicinity of the Lake Huron-Saginaw Bay Front,
W82-01164 2H

SALINE-FRESHWATER INTERFACES
Ice Blocks Melting Into a Salinity Gradient,
W82-01530 2C

018 Modelling of Freshwater Inputs in Baffin Bay and Canadian Arctic Coastal Waters,
W82-01590 2C

SALINE SOILS
Water and Salt Movement in a Saline-Sodic Soil in Southern Alberta,
W82-01119 2G

A Combined Salt Transport-Chemical Equilibrium Model for Calcareous and Cypsiferous Soils,
W82-01230 5B

SALINE WATER
Land and Stream Salinity in Western Australia,
W82-01374 5B

SALINE WATER INTRUSION
A Numerical Solution for the Movement of an Interface in a Layered Coastal Aquifer,
W82-01327 2F

Geohydrologic Models of the Houston District, Texas,
W82-01335 2F

SALINITY
Irrigation Management of Colorado River Water with Increase in Salinity,
W82-01226 3C

Predicting Stream Salinity Changes in South-Western Australia,
W82-01350 6A

Effect of Different Levels of Water Salinity on the Decomposition of Organic Manures in a Brackish Water Fish Pond Soil,
W82-01363 3C

Land and Stream Salinity in Western Australia,
W82-01374 5B

Year-to-Year Changes in the Salinity of the Eastern English Channel, 1948-1973: A Budget,
W82-01399 2A

Determination of Solution Electrical Conductivity from Bulk Soil Electrical Conductivity Measurements by the Four-Electrode Method,
W82-01458 2G

River Basin Hydrosalinity Modeling,
W82-01469 2K

SALMON RIVER
Preferences for Allocating River Recreation Use,
W82-01181 6D

SALTS
The Movement of Salts from Soils Following Heavy Application of Feedlot Wastes,
W82-01132 5B

Prediction of Diffusion Coefficients from the Electrical Conductance of Soil,
W82-01224 2G

A Combined Salt Transport-Chemical Equilibrium Model for Calcareous and Cypsiferous Soils,
W82-01230 5B

SAMPLE PREPARATION
Preconcentration for Trace Element Determination in Aqueous Samples,
W82-01574 5A

SAMPLE PRESERVATION
Some Factors Affecting the Determination of Particulate Carbon and Nitrogen in River Water,
W82-01532 5A

SAMPLING
A Simple Low Cost Apparatus for Conditioning Large Volumes of Water for Virological Analysis,
W82-01123 5A

Cyclic Strengths Compared for Two Sampling Techniques,
W82-01170 8D

Continuous Monitoring, Automated Analysis, and Sampling Procedures,
W82-01240 5A

Immediate Detection of Heterogeneities in Continuous Multivariate, Oceanographic Recordings. Application to Time Series Analysis of Changes in the Bay of Villefranche sur Mer,
W82-01393 7A

SAN FRANCISCO BAY AREA
Chrysotile Asbestos Fibers in Drinking Water from Asbestos-Cement Pipe,
W82-01592 5B

SAND FILTERS
A Successful Low Technology Wastewater Process,
W82-01178 5D

SANDUSKY RIVER
Limnetic Larval Fish of the Maumee and Sandusky River Estuaries,
W82-01197 7A

SANITARY LANDFILLS
Effects of Sanitary Landfill Leachage on Some Soil Chemical Properties,
W82-01480 5E

SANITATION
Rural Sanitation in Developing Countries,
W82-01392 5D

SASKATCHEWAN
The Effect of Snow Trapping and Cropping Sequence on Moisture Conservation and Utilization in West-Central Saskatchewan,
W82-01117 3F

SATELLITE TECHNOLOGY
Effect of Grain Size and Snowpack Water Equivalence on Visible and Near-Infrared Satellite Observations of Snow,
W82-01311 7B

The Inference of Gate Convective Rainfall from SMS-1 Imagery,
W82-01519 7B

A Comparison of Two Satellite Rainfall Estimates for GATE,
W82-01533 7B

Determination of Moisture from NOAA Polar Orbiting Satellite Sounding Radiances,
W82-01535 2B

SATHIAR RESERVOIR
Diurnal, Depth-Wise, and Seasonal Changes of Physico-Chemical Factors in Sathiar Reservoir,
W82-01372 2H

SATURATED FLOW
A Stochastic Approach for Describing Convective-Dispersive Solute Transport in Saturated Porous Media,
W82-01461 5B

SAVANNAH RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing; Savannah and Edisto River Basins Area; Georgia-South Carolina-North Carolina,
W82-01440 6D

SAVINJA RIVER
Evaluation of the Polluted River Savinja with the Help of Macrophytes,
W82-01377 5C

SCOTLAND
Factors Affecting the Chemistry of Precipitation and River Water in an Upland Catchment,
W82-01322 2K

SCREENS
Cooling Water Intake Screening Devices Used to Reduce Entrainment and Impingement,
W82-01442 8I

SEA ICE
018 Modelling of Freshwater Inputs in Baffin Bay and Canadian Arctic Coastal Waters,
W82-01590 2C

SEASONAL VARIATION
Variations of pH with Annual Cumulative Precipitation in Acid Forest Soils,
W82-01118 2G

Changes in Lake Ontario Total Phosphorus Concentrations, 1976-1978,
W82-01126 2H

A Successful Low Technology Wastewater Process,
W82-01178 5D

Seasonal Features of Zooplankton Assemblages in the Nearshore Area of Southeastern Lake Michigan,
W82-01192 2H

Diurnal, Depth-Wise, and Seasonal Changes of Physico-Chemical Factors in Sathiar Reservoir,
W82-01372 2H

Year-to-Year Changes in the Salinity of the Eastern English Channel, 1948-1973: A Budget,
W82-01399 2A

SEASONAL VARIATIONS
Climatic Factors Contributing to Year-To-Year Variation in Grain Yield of Corn on Brookston Clay,
W82-01115 2I

SEDIMENT-CARRYING CAPACITY
Selecting a Formula to Estimate Sediment Transport Capacity in Nonvegetated Channels,
W82-01405 2J

SEDIMENT CONTROL
Analysis of National Water Pollution Control Policies 2. Agricultural Sediment Control,
W82-01293 6A

Erosion and Sedimentation Control in Regional and Site Planning,
W82-01552 4D

SEDIMENT DEPOSITION
Sites of River-Derived Sedimentation in the Ocean,
W82-01332 7B

Unsteady One-Dimensional Settling of Suspended Sediment,
W82-01463 2J

SEDIMENT DEPOSITION, *RESERVOIR SILTING
A Verification Study on a Reservoir Sediment Deposition Model,
W82-01176 2J

SEDIMENT DISCHARGE
Suspended Sediment Production from Forested Watersheds on Oahu, Hawaii,
W82-01531 2J

SEDIMENT DISTRIBUTION
Sediment Distribution of Methanogenic Bacteria in Lake Erie and Cleveland Harbor,
W82-01233 2H

Nepheloid and Suspended Particulate Matter in South-Eastern Lake Michigan,
W82-01499 2H

The Effect of Changing Sediment Supply on Sedimentation in a Glacier-Fed Lake,
W82-01510 2H

SEDIMENT EROSION
Gully Erosion,
W82-01407 2J

SEDIMENT TRANSPORT
Transports in the Duluth-Superior Harbor,
W82-01136 5B

Wave Climate and Potential Longshore Sediment Transport Patterns, Nottawasaga Bay, Ontario,
W82-01156 2J

Selecting a Formula to Estimate Sediment Transport Capacity in Nonvegetated Channels,
W82-01405 2J

Sediment Transport Capacity of Overland Flow,
W82-01408 2J

Concentrated Flow Relationships,
W82-01409 2J

River Bed Aggradation Due to Overloading,
W82-01486 2J

SEDIMENT YIELD
Modeling Erosion and Sediment Yield from Flatland Watersheds,
W82-01406 2J

Changes in Sediment Storage in the Coon Creek Basin, Driftless Area, Wisconsin, 1853 to 1975,
W82-01563 2J

SEDIMENTATION
Channel Instability in a Braided, Sand Bed River,
W82-01316 2J

Geomorphology of the Colorado River in the Grand Canyon,
W82-01338 2J

Mineral Impact of Lakes as Background for Their Biogenic Dynamics,
W82-01359 2H

Developments in Sedimentation and Flotation,
W82-01391 5F

Sediment and Nutrient Trap Efficiency of a Small Flood-Detention Reservoir,
W82-01471 4A

SEDIMENTS
Biogeochemical Investigation of Big Creek Marsh, Lake Erie, Ontario,
W82-01163 2H

Sediment Distribution of Methanogenic Bacteria in Lake Erie and Cleveland Harbor,
W82-01233 2H

Aquatic Sediments,
W82-01279 5B

Metal Ion Concentrations Associated with Late Summer Sediments of the Ohio River,
W82-01300 5A

The Distribution of Mercury in the Sediments of the Plym Estuary,
W82-01390 5B

Sediment Oxygen Demand and Its Effect on Dissolved Oxygen in a Cutoff Meander of the Kaskaskia River,
W82-01448 4A

Application of Capillary Gas Chromatography Mass Spectrometry/Computer Techniques to Synoptic Survey of Organic Material in Bed Sediment,
W82-01573 5A

SEEPAGE CONTROL
Soil-Bentonite Supply Trench Cutoffs,
W82-01599 8D

SEISMIC WAVES
Liquefaction Analysis for Multidirectional Shaking,
W82-01169 8D

SENECA LAKE
Mercury and Zinc in the Sediments of Seneca Lake, Seneca River, and Keuka Outlet, New York,
W82-01151 5B

SEPARATION TECHNIQUES
A Study of a Method for Displacing Soil Solution by Centrifuging with an Immiscible Liquid,
W82-01131 5B

Preconcentration for Trace Element Determination in Aqueous Samples,
W82-01574 5A

SEPTIC TANKS
Application of Aerial Photographs and Surficial Geologic Maps to the Determination of Suitability of Land for Septic Tank Systems,
W82-01569 7B

SETTLING VELOCITY
Unsteady One-Dimensional Settling of Suspended Sediment,
W82-01463 2J

SEVERN RIVER
Development of Upton Intake Works, River Severn Supply Scheme, With the Aid of a Model,
W82-01395 8B

SEWER SYSTEMS
Wastewater Collection,
W82-01251 5D

SEWERS
Redesign Controls Manhole Leakage,
W82-01237 8G

SHEAR STRESS
Concentrated Flow Relationships.
W82-01409 2J

SHELLFISH
Middlesex County Sewerage Authority V. National Sea Clammers Association: Implied Private Rights of Action for Damages under the Federal Water Pollution Control Act Amendments of 1972.
W82-01455 6E

The Escherichia Coli Content of Mytilus Edulis from Analysis of Whole Tissue or Digestive Tract.
W82-01508 5A

SHIPS
Transports in the Duluth-Superior Harbor.
W82-01136 5B

SHORES
Wave Climate and Potential Longshore Sediment Transport Patterns, Nottawasaga Bay, Ontario.
W82-01156 2J

SIMULATION
Time Distribution of Clock Hour Rainfall.
W82-01402 2A

SIMULATION ANALYSIS
Significant Features of Emitter Flushing Mode Characteristics.
W82-01576 3F

SITE SELECTION
Land Treatment Site Evaluation in Southeastern Mountainous Areas.
W82-01596 5D

SLOPE STABILIZATION
Electro-Osmosis Chemistry and Water Quality.
W82-01518 5E

SLOPES
Modeling Erosion and Sediment Yield from Flatland Watersheds.
W82-01406 2J

Trickle Irrigation Lateral Design on Sloping Fields.
W82-01537 8C

SLUDGE CONDITIONING
Demonstration Testing of Alum Recovery by Liquid Ion Exchange.
W82-01167 5D

The Influence of Chemical Conditioning and Dewatering on the Distribution of Polychlorinated Biphenyls and Organochlorine Insecticides in Sewage Sludges.
W82-01387 5E

SLUDGE DIGESTION
Infrared Spectroscopic Study of the Water-Soluble Fraction of Sewage Sludge-Soil Mixtures During Incubation.
W82-01130 5E

New Approaches to Anaerobic Sludge Digestion.
W82-01398 5D

SLUDGE DISPOSAL
Infrared Spectroscopic Study of the Water-Soluble Fraction of Sewage Sludge-Soil Mixtures During Incubation.
W82-01130 5E

Sludge Treatment, Utilization, and Disposal.
W82-01247 5E

Health Effects Associated with Wastewater Treatment and Disposal.
W82-01255 5C

Identification and Reclamation of Chromium Sludge Disposal Sites.
W82-01437 5E

SLUDGE THICKENING
High-Solubility Gas Flotation.
W82-01184 5D

SLUDGE TREATMENT
Identification and Reclamation of Chromium Sludge Disposal Sites.
W82-01437 5E

SLURRIES
Soil-Bentonite Supply Trench Cutoffs.
W82-01599 8D

SMALL WATERSHEDS
Estimating Evapotranspiration from the Sonoita Creek Watershed near Patagonia, Arizona.
W82-01306 2D

SNAKE LAKE
Seasonal Reversals of Groundwater Flow Around Lakes and the Relevance to Stagnation Points and Lake Budgets.
W82-01103 2F

SNAKE RIVER
Hydropower Losses from Navigation in the Snake-Columbia Rivers: 1978-79.
W82-01139 6D

SNOW
Anomalous Snowfall Caused by Natural-Draft Cooling Towers.
W82-01512 2B

An Improved Method for Obtaining the Water Content Values of Ice Hydrometeors from Aircraft and Radar Data.
W82-01523 7B

Evaluation of Ultraviolet Spectrophotometric Determination of Nitrate-Nitrogen in Glacial Snow, Firn and Ice.
W82-01572 5A

SNOW COVER
Effect of Grain Size and Snowpack Water Equivalence on Visible and Near-Infrared Satellite Observations of Snow.
W82-01311 7B

Compatibility of Canadian Snowfall and Snow Cover Data.
W82-01466 2C

SNOW DEPTH
The Significance of Snowmelt on Water Supplies in the Northeast.
W82-01488 2A

SNOW SURVEYS
Compatibility of Canadian Snowfall and Snow Cover Data.
W82-01466 2C

SNOW TRAPS
The Effect of Snow Trapping and Cropping Sequence on Moisture Conservation and Utilization in West-Central Saskatchewan.
W82-01117 3F

SNOWMELT
Effect of Grain Size and Snowpack Water Equivalence on Visible and Near-Infrared Satellite Observations of Snow.
W82-01311 7B

The Significance of Snowmelt on Water Supplies in the Northeast.
W82-01488 2A

Snowmelt Prediction in a Subarctic Drainage Area.
W82-01571 2C

SOIL ADSORPTION CAPACITY
The Depth of Rainfall-Runoff-Soil Interaction as Determined by P32.
W82-01318 5B

SOIL CHEMISTRY
Changes in Soil Water Quality Resulting from Three Timber Cutting Methods and Three Levels of Fiber Utilization.
W82-01135 2G

Enrichment Ratios for Water Quality Modeling.
W82-01410 2J

Nitrate Production, Uptake, and Leaching.
W82-01411 5B

Estimating Soluble (PO4-P) and Labile Phosphorus in Runoff from Croplands.
W82-01412 5B

Effects of Sanitary Landfill Leachage on Some Soil Chemical Properties.
W82-01480 5E

SOIL COMPACTION
Measuring the Hydraulic Conductivity of Soil Adjacent to Tile Drains in a Heavy Clay Soil in the Netherlands.
W82-01323 2G

SOIL CONSERVATION
Economic Impacts of Erosion and Sedimentation Control Plans: Case Studies of Pennsylvania Dairy Farms.
W82-01134 4D

SOIL CONTAMINATION
The Stringfellow Industrial Waste Disposal Site: A Technical Assessment of Environmental Impact.
W82-01415 5B

Mapping Contaminated Soil Plumes by Kriging.
W82-01423 5G

SOIL EROSION
Erosivity 'R' for Individual Design Storms.
W82-01403 2J

Enrichment Ratios for Water Quality Modeling.
W82-01410 2J

Soil Conservation Problems and Practices: A Farmer View.
W82-01551 4D

Soil Erosion Control in Idaho's Cow Creek Watershed: An Economic Analysis.
W82-01556 4D

Changes in Sediment Storage in the Coon Creek Basin, Driftless Area, Wisconsin, 1853 to 1975.
W82-01563 2J

SOIL FILTERS
Removal of Phosphorus from Waste Water by Soil Under Aerobic and Anaerobic Conditions.
W82-01344 5D

SOIL MOISTURE
The Effect of Snow Trapping and Cropping Sequence on Moisture Conservation and Utilization in West-Central Saskatchewan.
W82-01117 3F

Remote Sensing of Soil Moisture Content Over Bare Field at 1.4 GHz Frequency.
W82-01345 7B

SOIL PHYSICS
Scaling of Infiltration Behavior in Dissimilar Porous Materials.
W82-01105 2G

SOIL PROPERTIES
Variations of pH with Annual Cumulative Precipitation in Acid Forest Soils.
W82-01118 2G

SOIL PROPERTIES

Water and Salt Movement in a Saline-Sodic Soil in Southern Alberta.
W82-01119 2G

Gully Erosion.
W82-01407 2J

The Release of Soil Phosphorous to Runoff in Relation to the Kinetics of Desorption.
W82-01477 5B

Spatial Variability of Steady-State Infiltration Rates as a Stochastic Process.
W82-01560 2G

Hydraulic Properties of Fullerton Cherty Silt Loam.
W82-01561 2G

SOIL SOLUTION
A Study of a Method for Displacing Soil Solution by Centrifuging with an Immiscible Liquid.
W82-01131 5B

SOIL TEXTURE
Statistical Analysis of the Brooks-Corey and the Green-Ampt Parameters Across Soil Textures.
W82-01107 2G

SOIL-TURF FILTER
Reclamation of Wastewater with a Soil-Turf Filter: I: Removal of Nitrogen.
W82-01101 5D

SOIL WATER
Infrared Spectroscopic Study of the Water-Soluble Fraction of Sewage Sludge-Soil Mixtures During Incubation.
W82-01130 5E

Changes in Soil Water Quality Resulting from Three Timber Cutting Methods and Three Levels of Fiber Utilization.
W82-01135 2G

Hydrodynamic Dispersion During Constant Rate Absorption of Water by Soil.
W82-01174 2G

Apportionment of Net Recharge in Landfill Covering Layer into Separate Components of Vertical Leakage and Horizontal Seepage.
W82-01298 2G

The Water Balance of the Betwa Basin, India.
W82-01354 2A

Determination of Solution Electrical Conductivity from Bulk Soil Electrical Conductivity Measurements by the Four-Electrode Method.
W82-01458 2G

Spatial Variability of Steady-State Infiltration Rates as a Stochastic Process.
W82-01560 2G

Hydraulic Properties of Fullerton Cherty Silt Loam.
W82-01561 2G

Super Slurper Effects on Crust Strength, Water Retention, and Water Infiltration of Soils.
W82-01562 2G

SOIL-WATER-PLANT RELATIONSHIPS
Drought Susceptibility of Two Tomato (Lycopersicum Esculentum) Varieties.
W82-01369 2I

Irrigation Needs and Yield of Rice on a Sandy-Loam Soil as Affected by Continuous and Intermittent Submergence.
W82-01382 3F

SOLID WASTES
Solid Wastes and Water Quality.
W82-01269 5B

SOLUBILITY
Soluble Element Concentrations and Complexation in Southeastern Lake Michigan.
W82-01147 2H

High-Solubility Gas Flotation.
W82-01184 5D

SOLUTE TRANSPORT
Mass Transport of Solutes in Dual-Porosity Media.
W82-01104 5B

An Analytical Solution for Solute Transport Through Fractured Media with Matrix Diffusion.
W82-01179 2F

A Stochastic Approach for Describing Convective-Dispersive Solute Transport in Saturated Porous Media.
W82-01461 5B

SONOITA CREEK
Estimating Evapotranspiration from the Sonoita Creek Watershed near Patagonia, Arizona.
W82-01306 2D

SOUTH AFRICA
A Look at Some Water Reclamation Plants in Southern Africa.
W82-01352 5D

Volatile C1-C7 Organic Compounds in Surface Sediments from Walvis Bay.
W82-01367 5B

SOUTH CAROLINA
Water Resources Data for South Carolina, Water Year 1980.
W82-01211 7C

SOUTH DAKOTA
Ecology of Larval Fishes in Lake Oahe, South Dakota.
W82-01444 6G

SOUTH PLATTE RIVER
Design and Merit of a River-Aquifer Model for Optimal Use of Agricultural Water.
W82-01193 6A

Potential Use of a Stream-Aquifer Model for Management of a River Basin: Case of the South Platte River in Colorado.
W82-01301 6A

SOUTH POLE
Lidar Determinations of Atmospheric Ice Crystal Layers at South Pole During Clear-Sky Precipitation.
W82-01529 2C

SPATIAL DISTRIBUTION
Nearshore Spatial Distribution of Fishes in Gill Net Samples, Cayuga Lake, New York.
W82-01195 7A

SPAWNING
Ecology of Larval Fishes in Lake Oahe, South Dakota.
W82-01444 6G

SPECIATION
The Physicochemical Speciation of Cd, Pb, Cu, Fe, and Mn in the Final Effluent of a Sewage Treatment Works and Its Impact on Speciation in the Receiving River.
W82-01498 5B

SPECTROPHOTOMETRY
Evaluation of Ultraviolet Spectrophotometric Determination of Nitrate-Nitrogen in Glacial Snow, Firn and Ice.
W82-01572 5A

SPILLWAYS
Hydraulic Model Study of Daule-Peripa Spillway and Outlet Works.
W82-01446 8A

SPLIT TREATMENT
Chemical Equilibria in Split-Treatment Softening of Water.
W82-01165 5F

SPRINKLER IRRIGATION
Irrigation Management of Colorado River Water with Increase in Salinity.
W82-01226 3C

SPRINKLERS
Characterizing Sprinkler Distribution Patterns with a Clustering Algorithm.
W82-01575 3F

STABILITY ANALYSIS
Stability of Activated Sludge Processes Based on Statistical Measures.
W82-01489 5D

STABILIZATION LAGOONS
Lagoons and Oxidation Ponds.
W82-01244 5D

STABILIZATION PONDS
Dynamic Nutrient Cycle Model for Waste Stabilization Ponds.
W82-01541 5D

STAGNANT WATER
Data on the Stagnant Ponds of the Savannah of Lamto (Ivory Coast) (Donnees sur les Milieux Limniques Stagnants des Savanes de Lamto (Cote d'Ivoire)).
W82-01357 2H

STANDARDS
Alterations in the BOD Procedure for the 15th Edition of 'Standard Methods for the Examination of Water and Wastewater',
W82-01186 5A

STATE JURISDICTION
Federal Common Law of Nuisance Expands.
W82-01337 6E

STATISTICAL ANALYSIS
Statistical Analysis of the Brooks-Corey and the Green-Ampt Parameters Across Soil Textures.
W82-01107 2G

Determination of the Confidence Intervals of the Wakeby Distribution Using Order Statistics.
W82-01317 2E

Stability of Activated Sludge Processes Based on Statistical Measures.
W82-01489 5D

Weather Modification from Cooling Towers. A Test Based on the Distributional Properties of Rainfall.
W82-01527 2B

STEEL INDUSTRY
Steel Industry Wastes.
W82-01264 5D

STOCHASTIC HYDROLOGY
Simulation of Daily Weather Data Using Theoretical Probability Distributions.
W82-01526 2B

STOCHASTIC PROCESSES
Spatial Variability of Steady-State Infiltration Rates as a Stochastic Process.
W82-01560 2G

STORM RUNOFF
Storm Flow Response to Road Building and Partial Cutting in Small Streams of Northern California.
W82-01295 4C

STORM WATER
Urban Runoff and Combined Sewer Overflow.
W82-01254 5B

STRATIFIED FLOW
Vertical Velocity Profiles in Stratified Flows.
W82-01171 8B

STREAM EROSION
Debris Flows in Small Mountain Stream Channels of Colorado and Their Hydrologic Implications.
W82-01597 2E

STREAMFLOW
Using Computed Stream Flow in Watershed Analysis.
W82-01538 2A

STREAMS
Dissolved Oxygen in Streams and Reservoirs.
W82-01272 5G

STREPTOCOCCUS
Comparison of Selective Media for the Enumeration and Identification of Fecal Streptococci from Natural Sources.
W82-01564 5A

STRINGFELLOW QUARRY
Use of the Contingency Fund at Stringfellow Hazardous Waste Disposal Site.
W82-01416 5G

STRUCTURAL ENGINEERING
Soil-Bentonite Supply Trench Cutoffs.
W82-01599 8D

SUBMARINE SPRINGS
Multifrequency Radiometer Detection of Submarine Freshwater Sources Along the Puerto Rican Coastline.
W82-01349 3B

SUBSURFACE MAPPING
Mapping Contaminated Soil Plumes by Kriging.
W82-01423 5G

SULFUR COMPOUNDS
Oxidation of SO2 in Aqueous Droplets: Mass Transport Limitation in Laboratory Studies and the Ambient Atmosphere.
W82-01470 2K

SUMMER RAINFALL
An Index of Arizona Summer Rainfall Developed Through Eigenvector Analysis.
W82-01528 2B

SUPERCOOLING
A Balloonborne Instrument for the Measurement of Vertical Profiles of Supercooled Liquid Water Concentration.
W82-01524 7B

SURFACE-GROUNDWATER RELATIONS
Design and Merit of a River-Aquifer Model for Optimal Use of Agricultural Water.
W82-01193 6A

SURFACE RUNOFF
Soluble N and P Concentrations in Surface Runoff Water.
W82-01413 5B

The Release of Soil Phosphorous to Runoff in Relation to the Kinetics of Desorption.
W82-01477 5B

SURFACE WATER
Water Resources Data for Texas, Water Year 1980--Volume 1. Arkansas River Basin, Red River Basin, Sabine River Basin, Neches River Basin, Trinity River Basin and Intervening Coastal Basins.
W82-01201 7C

Water Resources Data for Texas, Water Year 1980--Volume 2. San Jacinto River Basin, Brazos River Basin, San Bernard River Basin and Intervening Coastal Basins.
W82-01202 7C

Water Resources Data for Texas, Water Year 1980--Volume 3. Colorado River Basin, Lavaca River Basin, Guadalupe River Basin, Nueces River Basin, Rio Grande Basin and Intervening Coastal Basins.
W82-01203 7C

Water Resources Data for California, Water Year 1980--Volume 1. Colorado River Basin, Southern Great Basin from Mexican Border to Mono Lake Basin, and Pacific Slope Basins from Tijuana River to Santa Maria River.
W82-01204 7C

Water Resources Data for California, Water Year 1980--Volume 2. Pacific Slope Basins from Arroyo Grande to Oregon State Line Except Central Valley.
W82-01205 7C

Water Resources Data for California, Water Year 1980--Volume 3. Southern Central Valley Basins and the Great Basin from Walker River to Truckee River.
W82-01206 7C

Water Resources Data for California, Water Year 1980--Volume 4. Northern Central Valley Basins and the Great Basin from Honey Lake Basin to Oregon State Line.
W82-01207 7C

Water Resources Data for Hawaii and Other Pacific Areas, Water Year 1980 - Volume 1. Hawaii.
W82-01208 7C

Water Resources Data for Hawaii and Other Pacific Areas, Water Year 1980 - Volume 2. Trust Territory of the Pacific Islands, Guam, American Samoa, and Northern Mariana Islands.
W82-01209 7C

Water Resources Data for South Carolina, Water Year 1980.
W82-01211 7C

Water Resources Data for Pennsylvania, Water Year 1980--Volume 2. Susquehanna and Potomac River Basins.
W82-01212 7C

Water Resources Data for Montana, Water Year 1980--Volume 1. Hudson Bay Basin, Missouri River Basin.
W82-01213 7C

Water Resources Data for Montana, Water Year 1980--Volume 2. Upper Columbia River Basin.
W82-01214 7C

Water Resources Data for Florida, Water Year 1980--Volume 3A: Southwest Florida Surface Water.
W82-01215 7C

Water Resources Data for Colorado, Water Year 1980--Volume 2. Colorado River Basin Above Dolores River.
W82-01217 7C

Tenax-GC Extraction Technique for Residual Polychlorinated Biphenyl and Polyaromatic Hydrocarbon Analysis in Biodegradation Assays.
W82-01235 5A

SUSPENDED LOAD
Developments in Sedimentation and Flotation.
W82-01391 5F

SUSPENDED SEDIMENTS
Unsteady One-Dimensional Settling of Suspended Sediment.
W82-01463 2J

Nepheloid and Suspended Particulate Matter in South-Eastern Lake Michigan.
W82-01499 2H

Suspended Sediment Production from Forested Watersheds on Oahu, Hawaii.
W82-01531 2J

SWIMMING POOLS
Persistence of Pseudomonas Aeruginosa in Chlorinated Swimming Pools.
W82-01124 5A

SYNTHESIS
Open-Pore Polyurethane as a Medium for Coal Conversion Process Aqueous Effluent Cleanup.
W82-01577 5D

SYNTHETIC FUELS
Synthetic Fuel Effluents.
W82-01263 5B

SYSTEMS ANALYSIS
Systems Analysis.
W82-01303 6A

Study of a Complex Water Resources System with Screening and Simulation Models.
W82-01309 6A

TAILINGS
Siting and Design of Tailings Impoundments.
W82-01588 8A

Rosario Dominicana's Cyanide Tailings Dam Construction and Operation.
W82-01589 5D

TAMPA
Demonstration Testing of Alum Recovery by Liquid Ion Exchange.
W82-01167 5D

TEMPERATURE
Canopy Temperature as a Crop Water Stress Indicator.
W82-01106 2I

TEMPORAL DISTRIBUTION
Time Distribution of Clock Hour Rainfall.
W82-01402 2A

Recent Acidification of Precipitation in North America.
W82-01514 5B

Zooplankton Abundance and Diversity in Central Florida Grass Carp Ponds.
W82-01520 2H

TEXAS
Water Resources Data for Texas, Water Year 1980--Volume 1. Arkansas River Basin, Red River Basin, Sabine River Basin, Neches River Basin, Trinity River Basin and Intervening Coastal Basins.
W82-01201 7C

Water Resources Data for Texas, Water Year 1980--Volume 2. San Jacinto River Basin, Brazos River Basin, San Bernard River Basin and Intervening Coastal Basins.
W82-01202 7C

Water Resources Data for Texas, Water Year 1980--Volume 3. Colorado River Basin, Lavaca River Basin, Guadalupe River Basin, Nueces River Basin, Rio Grande Basin and Intervening Coastal Basins.
W82-01203 7C

TEXTILE MILL WASTES
Textile Wastes.
W82-01259 5D

THERMAL POLLUTION
A Quantitative Study of Shoreline Marsh Communities Along Lake Huron in Ontario,
W82-01122 2H

Power Industry Wastes,
W82-01265 5B

Thermal Effects,
W82-01275 5C

THERMAL STRESS
Postspawning Mortality of Rainbow Smelt in Western Lake Superior,
W82-01189 5C

THERMAL WATER
Thermal Energy Storage in a Confined Aquifer: Second Cycle,
W82-01473 4B

THERMODYNAMICS
A Study of Regional Temperature and Thermohydrologic Effects of an Underground Repository for Nuclear Wastes in Hard Rock,
W82-01347 5E

TIDES
Linearized Solution to Inlet Equation with Inertia,
W82-01183 2L

TIDEWATER
The Workings of the Control of Pollution Act in Tidal Waters: A View of the Ministry of Agriculture, Fisheries and Food,
W82-01383 6E

TILE DRAINAGE
Phosphorus Concentration-Water Flow Interactions in Tile Effluent from Manured Land,
W82-01340 5B

Effects of Dairy Manure on Phosphorus Concentrations and Losses in Tile Effluent,
W82-01479 5B

TILE DRAINS
Measuring the Hydraulic Conductivity of Soil Adjacent to Tile Drains in a Heavy Clay Soil in the Netherlands,
W82-01323 2G

TIME SERIES ANALYSIS
Modeling Hydrologic Time Series from the Arctic,
W82-01198 2A

TOMATOES
Drought Susceptibility of Two Tomato (Lycopersicum Esculentum) Varieties,
W82-01369 2I

TOTAL ORGANIC CARBON
Organics,
W82-01239 5A

TOXICITY
Acute Toxicity of Leachates from Coal Gasification and Liquefaction Solid Wastes to the Fathead Minnow, Pimephales Promelas,
W82-01108 5C

Interactive Effects of Metals in Mixtures on Biomass Production Kinetics of Freshwater Copepods,
W82-01125 5C

Toxicity and Bioaccumulation of Endrin and Methoxychlor in Aquatic Invertebrates and Fish,
W82-01160 5C

Abundance of Organic Compounds in Water,
W82-01162 5A

Substrate Associated Microfauna,
W82-01283 5C

Mercury and Lead Concentrations in Some Species of Fish From the Tuscan Coasts (Italy),
W82-01368 5B

Preliminary Risk Evaluation for Suspected Hazardous Waste Disposal Sites in Connecticut,
W82-01417 5G

Abate: Effects of the Organophosphate Insecticide on Bluegills and Invertebrates in Ponds,
W82-01445 5C

Collapsing Aphanizomenon Flos-Aquae Blooms: Possible Contributions of Photo-Oxidation, O2 Toxicity, and Cyanophages,
W82-01595 2H

Strategies of Response to Copper, Cadmium, and Lead by a Blue-Green and a Green Alga,
W82-01598 5C

TOXINS
Bioassays - Procedures and Results,
W82-01277 5A

TRACE ELEMENTS
Ferromanganese Nodules from Lake Ontario (Bay of Quinte): Minor Element Geochemistry,
W82-01143 2H

Soluble Element Concentrations and Complexation in Southeastern Lake Michigan,
W82-01147 2H

Preconcentration for Trace Element Determination in Aqueous Samples,
W82-01574 5A

TRACE METALS
Trace Metal Mineral Equilibria in Lake Erie Sediments,
W82-01191 2H

Determination of Labilities of Soluble Trace Metal Species in Aqueous Environmental Samples by Anodic Stripping Voltammetry and Chelex Column and Batch Methods,
W82-01229 5A

TRACERS
Groundwater Contamination by Sanitary Landfill Leachate and Domestic Wastewater in Carbonate Terrain: Principal Source Diagnosis, Chemical Transport Characteristics and Design Implications,
W82-01223 5B

An Approach to Determining Pathways and Residence Time of Groundwaters: Dual Radiotracer Dating,
W82-01348 2F

TRANSMISSIVITY
A Comparison of the Incomplete Cholesky-Conjugate Gradient Method with the Strongly Implicit Method as Applied to the Solution of Two-Dimensional Groundwater Flow Equations,
W82-01315 2F

TRAP EFFICIENCY
Sediment and Nutrient Trap Efficiency of a Small Flood-Detention Reservoir,
W82-01471 4A

TREATMENT PLANTS
Advanced Wastewater Plant is Energy Saver,
W82-01177 5D

TRIBUTARIES
Drainage Network Structure and the Diameter-Magnitude Relation,
W82-01308 2A

TRICKLE IRRIGATION
Trickle Irrigation Lateral Design on Sloping Fields,
W82-01537 8C

Significant Features of Emitter Flushing Mode Characteristics,
W82-01576 3F

TRITIUM
Studies on Unsaturated Zone Hydrology and Radionuclide Migration at a Shallow-Land Burial Site,
W82-01172 5B

TROUT
Evidence of Natural Reproduction by Planted Lake Trout in Lake Michigan,
W82-01194 8I

Influence of PCBs in Water on Uptake and Elimination of DDT and DDE by Lake Trout,
W82-01342 5C

Mercury in the Muscle Tissue of Fish from Three Northern Maine lakes,
W82-01459 5B

TURBIDITY
Mineral Impact of Lakes as Background for Their Biogenic Dynamics,
W82-01359 2H

TURBIDITY CURRENTS
Plume Development Using Lagrangian Marker Method,
W82-01182 5B

TURBULENT FLOW
Wave Formation and Heat Transfer at an Ice-Water Interface in the Presence of a Turbulent Flow,
W82-01128 2C

TUSCAN COASTS
Mercury and Lead Concentrations in Some Species of Fish From the Tuscan Coasts (Italy),
W82-01368 5B

ULTRAFILTRATION
High Temperature Ultrafiltration with Kynar Poly(Vinylidene Fluoride) Membranes,
W82-01566 5D

UNDERGROUND WASTE DISPOSAL
Artificial Groundwater Recharge,
W82-01110 4B

Onsite Alternatives for Treatment and Disposal,
W82-01248 5D

UNITED KINGDOM
The Workings of the Control of Pollution Act in Tidal Waters: A View of the Ministry of Agriculture, Fisheries and Food,
W82-01383 6E

Thoughts on the Need to Control Discharges to Estuarial and Coastal Waters,
W82-01384 6E

Groundwater Investigations in the Vale of Stathmore,
W82-01400 2F

UNOX PROCESS
Treatment of Pulp and Papermill Wastewaters and the Use of the Oxygen Activated Sludge System,
W82-01594 5D

UNSATURATED FLOW
Hydrodynamic Dispersion During Constant Rate Absorption of Water by Soil,
W82-01174 2G

UNSTEADY FLOW
A Model for Simulation of Flow in Singular and Interconnected Channels,
W82-01210 2E

URANIUM
Uranium Isotopes as a Natural Tracer in the Waters of the Bet Shean-Harod Valleys, Israel.
W82-01328 2F

URBAN RUNOFF
Studies for Abatement of Pollution from Combined Sewer Overflows in Canada.
W82-01200 5G

Urban Runoff and Combined Sewer Overflow.
W82-01254 5B

Estimation of Impervious-Area Washoff Parameters.
W82-01465 4C

USER CHARGES
On Water Tariff Equalization Policies.
W82-01175 6C

UTAH
The Effects of a New Reservoir on the Attached Diatom Communities in Huntington Creek, Utah, U.S.A..
W82-01521 2H

VEGETABLE CROPS
Factors Affecting Radionuclide Availability to Vegetables Grown at Los Alamos.
W82-01109 5B

VEGETATION
Vegetation Selection and Management for Overland Flow Systems.
W82-01500 5E

VELOCITY DISTRIBUTION
Vertical Velocity Profiles in Stratified Flows.
W82-01171 8B

VIRUSES
A Simple Low Cost Apparatus for Conditioning Large Volumes of Water for Virological Analysis.
W82-01123 5A

Microbiology: Detection, Occurrence, and Removal of Viruses.
W82-01290 5A

Microbiology of Wastewater Treatment.
W82-01291 5D

Mechanism of Enteroviral Inactivation by Ozone.
W82-01482 5D

A Note on the Use of Membrane Faecal Coliform Medium for Enhancing Resolution and Accuracy When Enumerating a Small Plaquing Coliphage.
W82-01507 5A

WAKEBY DISTRIBUTION
Determination of the Confidence Intervals of the Wakeby Distribution Using Order Statistics.
W82-01317 2E

WALES
The Effect of Pollutants from the Coal Industry on the Fish Fauna of a Small River in the South Wales Coalfield.
W82-01389 5C

WASTE DISPOSAL
Solid Wastes and Water Quality.
W82-01269 5B

A Study of Regional Temperature and Thermohydrologic Effects of an Underground Repository for Nuclear Wastes in Hard Rock.
W82-01347 5E

Rural Sanitation in Developing Countries.
W82-01392 5D

The Stringfellow Industrial Waste Disposal Site: A Technical Assessment of Environmental Impact.
W82-01415 5B

Use of the Contingency Fund at Stringfellow Hazardous Waste Disposal Site.
W82-01416 5G

Preliminary Risk Evaluation for Suspected Hazardous Waste Disposal Sites in Connecticut.
W82-01417 5G

Rating the Hazard Potential of Waste Disposal Facilities.
W82-01418 5G

The National Assessment of the Ground-Water Contamination Potential of Wastewater Impoundments.
W82-01419 5G

Evaluation of Hydrogeologic Conditions.
W82-01420 5G

Practical Aspects of Ground Water Monitoring at Existing Disposal Sites.
W82-01421 5G

Site Assessment: Improving Confidence Levels with Surface Remote Sensing.
W82-01422 5G

Case Studies on the Migration of Pollutants in Ground Water.
W82-01424 5B

Geological Studies of Industrially-Related Contamination: Soil and Ground Water Investigations.
W82-01425 5B

Remedial Options for Ground Water Protection at Abandoned Solid Waste Disposal Facilities.
W82-01426 5G

Remedial Technique of Controlling and Treating Low Volume Leachate Discharge.
W82-01428 5G

Surface Water Management at Hazardous Waste Sites.
W82-01429 5G

Stabilization/Solidification of Waste from Uncontrolled Disposal Sites.
W82-01432 5E

Evaluation of Remedial Treatment, Detoxification and Stabilization Alternatives.
W82-01434 5D

Preliminary Design and Cost Estimates for Remedial Actions at Hazardous Waste Disposal Sites.
W82-01435 5G

Electro-Osmosis Chemistry and Water Quality.
W82-01518 5E

WASTE DUMPS
Bench Scale Assessment of Technologies for Contaminated Ground Water Treatment.
W82-01433 5G

Love Canal: Chemical Contamination and Migration.
W82-01436 5B

WASTE IDENTIFICATION
Abundance of Organic Compounds in Water.
W82-01162 5A

WASTE WATER TREATMENT
High Temperature Ultrafiltration with Kynar Poly(Vinylidene Fluoride) Membranes.
W82-01566 5D

Rosario Dominicana's Cyanide Tailings Dam Construction and Operation.
W82-01589 5D

WASTEWATER ANALYSIS
Continuous Monitoring, Automated Analysis, and Sampling Procedures.
W82-01240 5A

WASTEWATER COLLECTION
O & M Wastewater Collection and Treatment Facilities.
W82-01249 5D

Wastewater Collection.
W82-01251 5D

The Wayne County, Michigan, Wastewater Collection and Treatment System.
W82-01505 5D

WASTEWATER DISPOSAL
Onsite Alternatives for Treatment and Disposal.
W82-01248 5D

Health Effects Associated with Wastewater Treatment and Disposal.
W82-01255 5C

A Hydrobiological Survey of a Polluted Canal.
W82-01356 5C

Groundwater Contamination by Trace Level Organics from a Rapid Infiltration Site.
W82-01496 5B

WASTEWATER FACILITIES
O & M Wastewater Collection and Treatment Facilities.
W82-01249 5D

A Survey of Mathematical Optimization Models and Algorithms for Designing and Extending Irrigation and Wastewater Networks.
W82-01296 6A

Comparative Evaluation of Processes for the Treatment of Concentrated Wastewaters at Uncontrolled Hazardous Waste Sites.
W82-01430 5D

Stability of Activated Sludge Processes Based on Statistical Measures.
W82-01489 5D

WASTEWATER LAGOONS
The National Assessment of the Ground-Water Contamination Potential of Wastewater Impoundments.
W82-01419 5G

WASTEWATER MANAGEMENT
The Problems of Non-Return and the Use of Valves in Drinking Water Protection Against Waste Water Return, Applying the Regulations in Force.
W82-01142 5F

WASTEWATER RENOVATION
A Look at Some Water Reclamation Plants in Southern Africa.
W82-01352 5D

WASTEWATER TREATMENT
Reclamation of Wastewater with a Soil-Turf Filter: I: Removal of Nitrogen.
W82-01101 5D

Reclamation of Wastewater with a Soil-Turf Filter: II: Removal of Phosphorus, Boron, Sodium and Chlorine.
W82-01102 5D

Pharmaceutical Company's Aeration System Saves Energy.
W82-01180 5D

High-Solubility Gas Flotation.
W82-01184 5D

Energy Requirement for Small Wastewater Treatment Systems.
W82-01185 5D

Data Base Development for the Design of a Radium-226 Removal Process.
W82-01188 5D

Denitrification of Blackwater with Greywater.
W82-01225 5D

Potential Health Hazards from Microbial Aerosols in Densely Populated Urban Regions.
W82-01232 5C

Physical and Chemical Methods.
W82-01241 5D

Biological Filters.
W82-01242 5D

Activated Sludge.
W82-01243 5D

Dentrification.
W82-01246 5D

Onsite Alternatives for Treatment and Disposal.
W82-01248 5D

Disinfection.
W82-01250 5D

Health Effects Associated with Wastewater Treatment and Disposal.
W82-01255 5C

Meat-, Fish-, and Poultry-Processing Wastes.
W82-01256 5D

Fermentation Industry.
W82-01257 5D

Dairy Wastes.
W82-01258 5D

Textile Wastes.
W82-01259 5D

Petroleum Processing Wastes.
W82-01262 5D

Steel Industry Wastes.
W82-01264 5D

Chemicals and Allied Products.
W82-01267 5D

Microbiology of Wastewater Treatment.
W82-01291 5D

Formation of N-Nitrosodimethylamine During Treatment of Municipal Waste Water by Simulated Land Application.
W82-01343 5D

Removal of Phosphorus from Waste Water by Soil Under Aerobic and Anaerobic Conditions.
W82-01344 5D

Sanitation Service Management in France (La Gestion des Services d'Assainissement en France).
W82-01351 6F

Design and Construction of Shieldhall Sewage-Treatment Works, Glasgow.
W82-01385 5D

Scaynes Hill STW Extensions Include Plastic Media Filtration.
W82-01386 5D

Rural Sanitation in Developing Countries.
W82-01392 5D

New Approaches to Anaerobic Sludge Digestion.
W82-01398 5D

Remedial Technique of Controlling and Treating Low Volume Leachate Discharge.
W82-01428 5G

Comparative Evaluation of Processes for the Treatment of Concentrated Wastewaters at Uncontrolled Hazardous Waste Sites.
W82-01430 5D

Environmental Impact and Health Effects of Wastewater Chlorination.
W82-01451 5D

Anaerobic Carbon Filter for Degradation of Phenols.
W82-01454 5D

Purification of Municipal Wastewater by Subsequent Reverse Osmosis and Anaerobic Digestion.
W82-01468 5D

Mechanism of Enteroviral Inactivation by Ozone.
W82-01482 5D

The Wayne County, Michigan, Wastewater Collection and Treatment System.
W82-01505 5D

Detroit - Fresh Clean Water.
W82-01506 5D

Utilization Efficiency of Nitrogen from Sewage Effluent and Fertilizer Applied to Corn Plants Growing in a Clay Soil.
W82-01515 3C

Dynamic Nutrient Cycle Model for Waste Stabilization Ponds.
W82-01541 5D

Design and Cost Comparison of Biological Nitrogen Removal Processes.
W82-01544 5D

Pipeline Friction Losses for Wastewater Sludges.
W82-01545 5D

Operational Problems with Rotating Biological Contactors.
W82-01549 5D

Open-Pore Polyurethane as a Medium for Coal Conversion Process Aqueous Effluent Cleanup.
W82-01577 5D

Siting and Design of Tailings Impoundments.
W82-01588 8A

Treatment of Pulp and Papermill Wastewaters and the Use of the Oxygen Activated Sludge System.
W82-01594 5D

Land Treatment Site Evaluation in Southeastern Mountainous Areas.
W82-01596 5D

WASTEWATER TREATMENT FACILITIES
Advanced Wastewater Plant is Energy Saver.
W82-01177 5D

Survey of Treatment Plant Design and Operation Deficiencies.
W82-01543 5D

WATER
Balance of Biogenic Elements in the Aral Sea Upon a Drop of Its Level.
W82-01370 2H

WATER ANALYSIS
A Simple Low Cost Apparatus for Conditioning Large Volumes of Water for Virological Analysis.
W82-01123 5A

Some Recent Studies on Groundwater Radon Content as an Earthquake Precursor.
W82-01127 2F

Use of Excised Root Cultures as Bioindicators of Water Pollution (Utilisation Des Cultures de Racines Isolees Comme Test Biologique de Pollution des Eaux).
W82-01133 5A

Fixed Endpoint Alkalinity Determination.
W82-01187 7B

Determination of Labilities of Soluble Trace Metal Species in Aqueous Environmental Samples by Anodic Stripping Voltammetry and Chelex Column and Batch Methods.
W82-01229 5A

Inorganics.
W82-01238 5A

Organics.
W82-01239 5A

Continuous Monitoring, Automated Analysis, and Sampling Procedures.
W82-01240 5A

Water-Quality Monitoring: A Global Approach.
W82-01339 7A

The Application of Mutagenicity Testing to Drinking Water.
W82-01487 5A

Determination of Nanogram Quantities of Mercury in Water with a Gold-Plated Piezoelectric Crystal Detector.
W82-01509 5A

Concentrating Organics in Water for Biological Testing.
W82-01591 5A

WATER CIRCULATION
Hypolimnion Flow Between the Central and Eastern Basins of Lake Erie During 1977 (Interbasin Hypolimnion Flows)
W82-01153 2H

WATER CONSERVATION
A Look at Some Water Reclamation Plants in Southern Africa.
W82-01352 5D

Organic Contamination of Ground Water: Tell it All.
W82-01474 5C

Mandatory or Voluntary Water Conservation: A Case Study of Iowa Communities During Drought.
W82-01553 3D

WATER CONTENT
An Improved Method for Obtaining the Water Content Values of Ice Hydrometeors from Aircraft and Radar Data.
W82-01523 7B

A Balloonborne Instrument for the Measurement of Vertical Profiles of Supercooled Liquid Water Concentration.
W82-01524 7B

Experimental Verification of the Linear Relationship Between IR Extinction and Liquid Water Content of Clouds.
W82-01525 7B

Lidar Determinations of Atmospheric Ice Crystal Layers at South Pole During Clear-Sky Precipitation.
W82-01529 2C

WATER DEMAND
Water Multipliers--Regional Impact Analysis.
W82-01138 6A

Supply-Demand Coordination in Water Resources Management.
W82-01299 6C

WATER DEPTH
Seasonal Features of Zooplankton Assemblages in the Nearshore Area of Southeastern Lake Michigan.
W82-01192 2H

WATER DISTRIBUTION
Malawi: A Community Approach.
W82-01365 5F

WATER LAW
Nebraska Ground Water Law and Administration.
W82-01236 6E

Law,
W82-01302 6E

Middlesex County Sewerage Authority V. National Sea Clammers Association: Implied Private Rights of Action for Damages under the Federal Water Pollution Control Act Amendments of 1972.
W82-01455 6E

A Water Rights Strategy for Mining Operations in the Western US.
W82-01587 6E

Compelled Self-Incrimination and the Federal Water Pollution Control Act,
W82-01600 6E

WATER LEVEL
Yield Verification of a Dolomite Aquifer in Northeast Illinois.
W82-01334 2F

Geohydrologic Models of the Houston District, Texas,
W82-01335 2F

Balance of Biogenic Elements in the Aral Sea Upon a Drop of Its Level.
W82-01370 2H

WATER LEVEL FLUCTUATIONS
Computer Modeling of Los Angeles Water Resources.
W82-01168 6A

Ecology of Larval Fishes in Lake Oahe, South Dakota.
W82-01444 6G

WATER LEVELS
An Example of the Application of Statistical Techniques to Predict Lake Level Elevations.
W82-01111 6A

WATER MANAGEMENT
Potential Use of a Stream-Aquifer Model for Management of a River Basin: Case of the South Platte River in Colorado.
W82-01301 6A

Systems Analysis.
W82-01303 6A

Generating Alternative Solutions for Dynamic Programming Models of Water Resources Problems.
W82-01450 6A

Water Management Model Evaluation for North Central Ohio.
W82-01536 4A

Managing Land to Meet Water Quality Goals.
W82-01557 4D

WATER POLICY
On Water Tariff Equalization Policies.
W82-01175 6C

WATER POLLUTION
Abundance of Organic Compounds in Water.
W82-01162 5A

WATER POLLUTION CONTROL
Public Concerns and PLUARG: Selected findings and Discussion.
W82-01137 5G

Modelling Effects of Remedial Programs to Aid Great Lakes Environmental Management,
W82-01146 5G

Bacteria: Man's Allies in Water Pollution Control,
W82-01158 5D

Coal and Coal Mine Drainage,
W82-01261 5G

Analysis of National Water Pollution Control Policies 1. A National Network Model,
W82-01292 6A

Analysis of National Water Pollution Control Policies 2. Agricultural Sediment Control,
W82-01293 6A

Law,
W82-01302 6E

Systems Analysis,
W82-01303 6A

Economics,
W82-01304 5G

Federal Common Law of Nuisance Expands,
W82-01337 6E

Sanitation Service Management in France (La Gestion des Services d'Assainissement en France),
W82-01351 6F

Use of the Contingency Fund at Stringfellow Hazardous Waste Disposal Site,
W82-01416 5G

Geological Studies of Industrially-Related Contamination: Soil and Ground Water Investigations.
W82-01425 5B

Top-Sealing to Minimize Leachate Generation, Case Study of the Windham, Connecticut, Landfill.
W82-01427 5G

Remedial Technique of Controlling and Treating Low Volume Leachate Discharge.
W82-01428 5G

Evaluation of Remedial Treatment, Detoxification and Stabilization Alternatives.
W82-01434 5D

Preliminary Design and Cost Estimates for Remedial Actions at Hazardous Waste Disposal Sites.
W82-01435 5G

Middlesex County Sewerage Authority V. National Sea Clammers Association: Implied Private Rights of Action for Damages under the Federal Water Pollution Control Act Amendments of 1972.
W82-01455 6E

New Opportunities for In-Plant Reduction of Pollutants Through Process Changes.
W82-01559 5G

WATER POLLUTION EFFECTS
Effects of Logging on Macroinvertebrates in Streams with and Without Buffer Strips.
W82-01227 5C

Pulp and Paper Industry Effluent Management.
W82-01260 5D

Coal and Coal Mine Drainage,
W82-01261 5G

Effects of Pollution on Freshwater Invertebrates,
W82-01280 5C

Freshwater Macroinvertebrates,
W82-01281 5C

The Effects of Pollution on Freshwater Fish,
W82-01282 5C

A Hydrobiological Survey of a Polluted Canal.
W82-01356 5C

Historical Changes and Relationship to Internal Loading of Sediment Phosphorus Forms in Hypertrophic Prairie Lakes.
W82-01516 2H

WATER POLLUTION PREVENTION
Preliminary Risk Evaluation for Suspected Hazardous Waste Disposal Sites in Connecticut.
W82-01417 5G

Surface Water Management at Hazardous Waste Sites,
W82-01429 5G

Stabilization/Solidification of Waste from Uncontrolled Disposal Sites.
W82-01432 5E

Remedial Action Controls Groundwater Contamination at a Paper Mill Sludge Disposal Site.
W82-01582 5G

WATER POLLUTION SOURCES
Marine and Estuarine Pollution.
W82-01274 5C

Microbiology of Wastewater Treatment.
W82-01291 5D

Predicting Stream Salinity Changes in South-Western Australia.
W82-01350 6A

Enrichment Ratios for Water Quality Modeling.
W82-01410 2J

Cadmium, Lead, Mercury, Arsenic, and Selenium Concentrations in Freshwater Fish, 1976-77-National Pesticide Monitoring Program.
W82-01584 5B

WATER POLLUTON SOURCES
Gully Erosion.
W82-01407 2J

WATER QUALITY
Changes in Soil Water Quality Resulting from Three Timber Cutting Methods and Three Levels of Fiber Utilization.
W82-01135 2G

Transports in the Duluth-Superior Harbor.
W82-01136 5B

Water Quality from Two Small Forested Watersheds in Southern Illinois.
W82-01140 4C

Some Effects of Agricultural Land Use on Stream Insect Communities.
W82-01159 5C

Biogeochemical Investigation of Big Creek Marsh, Lake Erie, Ontario.
W82-01163 2H

Alterations in the BOD Procedure for the 15th Edition of 'Standard Methods for the Examination of Water and Wastewater'.
W82-01186 5A

Water Resources Data for Texas, Water Year 1980--Volume 1. Arkansas River Basin, Red

WATER QUALITY

River Basin, Sabine River Basin, Neches River Basin, Trinity River Basin and Intervening Coastal Basins.
W82-01201 7C

Water Resources Data for Texas, Water Year 1980--Volume 2. San Jacinto River Basin, Brazos River Basin, San Bernard River Basin and Intervening Coastal Basins.
W82-01202 7C

Water Resources Data for Texas, Water Year 1980--Volume 3. Colorado River Basin, Lavaca River Basin, Guadalupe River Basin, Nueces River Basin, Rio Grande Basin and Intervening Coastal Basins.
W82-01203 7C

Water Resources Data for California, Water Year 1980--Volume 1. Colorado River Basin, Southern Great Basin from Mexican Border to Mono Lake Basin, and Pacific Slope Basins from Tijuana River to Santa Maria River.
W82-01204 7C

Water Resources Data for California, Water Year 1980--Volume 2. Pacific Slope Basins from Arroyo Grande to Oregon State Line Except Central Valley.
W82-01205 7C

Water Resources Data for California, Water Year 1980--Volume 3. Southern Central Valley Basins and the Great Basin from Walker River to Truckee River.
W82-01206 7C

Water Resources Data for California, Water Year 1980--Volume 4. Northern Central Valley Basins and the Great Basin from Honey Lake Basin to Oregon State Line.
W82-01207 7C

Water Resources Data for Hawaii and Other Pacific Areas, Water Year 1980 - Volume 1. Hawaii.
W82-01208 7C

Water Resources Data for Hawaii and Other Pacific Areas, Water Year 1980 - Volume 2. Trust Territory of the Pacific Islands, Guam, American Samoa, and Northern Mariana Islands.
W82-01209 7C

Water Resources Data for South Carolina, Water Year 1980.
W82-01211 7C

Water Resources Data for Pennsylvania, Water Year 1980--Volume 2. Susquehanna and Potomac River Basins.
W82-01212 7C

Water Resources Data for Montana, Water Year 1980--Volume 1. Hudson Bay Basin, Missouri River Basin.
W82-01213 7C

Water Resources Data for Montana, Water Year 1980--Volume 2. Upper Columbia River Basin.
W82-01214 7C

Water Resources Data for Florida, Water Year 1980--Volume 3A: Southwest Florida Surface Water
W82-01215 7C

Water Resources Data for Florida, Water Year 1980--Volume 3B: Southwest Florida Ground Water
W82-01216 7C

Water Resources Data for Colorado, Water Year 1980--Volume 2. Colorado River Basin Above Dolores River
W82-01217 7C

Continuous Monitoring, Automated Analysis, and Sampling Procedures,
W82-01240 5A

Solid Wastes and Water Quality,
W82-01269 5B

Microbiology of Water,
W82-01284 5B

Analysis of National Water Pollution Control Policies 1. A National Network Model,
W82-01292 6A

Factors Affecting the Chemistry of Precipitation and River Water in an Upland Catchment,
W82-01322 2K

A Hydrobiological Survey of a Polluted Canal,
W82-01356 5C

Periphyton Analysis for the Evaluation of Water Quality in Running Waters of Greece,
W82-01358 5A

Comparative Limnology of Nine Lakes of Jammu and Kashmir Himalayas,
W82-01361 2H

Hydrobiological Studies on the Ajwa Reservoir, the Source of Raw Water Supply to the Baroda Water Works,
W82-01364 2H

Diurnal, Depth-Wise, and Seasonal Changes of Physico-Chemical Factors in Sathiar Reservoir,
W82-01372 2H

Estimation of Impervious-Area Washoff Parameters,
W82-01465 4C

Hydrochemical Facies in a Tertiary Basin in the Milligan Canyon Area, Southwest Montana,
W82-01481 2F

WATER QUALITY CONTROL
Remedial Options for Ground Water Protection at Abandoned Solid Waste Disposal Facilities,
W82-01426 5G

WATER RENOVATION
Water Reclamation and Reuse,
W82-01252 3C

WATER REQUIREMENTS
A Parametric Crop Water Use Model,
W82-01310 2I

WATER RESOURCES DEVELOPMENT
Computer Modeling of Los Angeles Water Resources,
W82-01168 6A

Study of a Complex Water Resources System with Screening and Simulation Models,
W82-01309 6A

Rural Water Supply and Related Services in Developing Countries-Comparative Analysis of Several Approaches,
W82-01330 6A

A Look at Some Water Reclamation Plants in Southern Africa,
W82-01352 5D

Water Resources Appraisals for Hydroelectric Licensing: Brazos River Basin, Texas-New Mexico
W82-01439 6D

Water Resources Appraisals for Hydroelectric Licensing: Savannah and Edisto River Basins Area: Georgia-South Carolina-North Carolina,
W82-01440 6D

Water Resources Appraisals for Hydroelectric Licensing: American River Basin, California,
W82-01441 6D

Methods for Generating Alternative Solutions to Water Resources Planning Problems,
W82-01449 6A

Managing Land to Meet Water Quality Goals,
W82-01557 4D

Discussion-Engineering Geology of Arid Areas,
W82-01568 4B

Hydropower--An Old Technology for a New Era,
W82-01593 4A

WATER RESOURCES MANAGEMENT
Supply-Demand Coordination in Water Resources Management,
W82-01299 6C

WATER REUSE
Water Reclamation and Reuse,
W82-01252 3C

Petroleum Processing Wastes,
W82-01262 5D

A Look at Some Water Reclamation Plants in Southern Africa,
W82-01352 5D

Optimum Recycle and Reuse Cooling System Designs Using the BCT Process,
W82-01503 3E

Closeup of Whitewater System Helps Menasha Meet Effluent Standards,
W82-01579 5D

WATER RIGHTS
A Water Rights Strategy for Mining Operations in the Western US,
W82-01587 6E

WATER SAMPLING
An All-Teflon Bailer and an Air-Driven Pump for Evacuating Small-Diameter Ground-Water Wells,
W82-01333 7B

Some Factors Affecting the Determination of Particulate Carbon and Nitrogen in River Water,
W82-01532 5A

WATER SHORTAGE
Mandatory or Voluntary Water Conservation: A Case Study of Iowa Communities During Drought,
W82-01553 3D

WATER SOFTENING
Chemical Equilibria in Split-Treatment Softening of Water,
W82-01165 5F

WATER SPORTS
Management Concerns for Swimming, Tubing, and Wading in the Great Smoky Mountains National Park,
W82-01475 6A

WATER STRESS
Canopy Temperature as a Crop Water Stress Indicator,
W82-01106 2I

WATER SUPPLY
Supply-Demand Coordination in Water Resources Management,
W82-01299 6C

Multifrequency Radiometer Detection of Submarine Freshwater Sources Along the Puerto Rican Coastline,
W82-01349 3B

Hydrobiological Studies on the Ajwa Reservoir, the Source of Raw Water Supply to the Baroda Water Works.
W82-01364 2H

Organic Contamination of Ground Water: Tell it All.
W82-01474 5C

Small Water Systems: Role of Technology,
W82-01542 5F

WATER SUPPLY DEVELOPMENT
Effect of Investments in Water Supply and Sanitation on Health Status: A Threshold-Saturation Theory.
W82-01331 6B

Malawi: A Community Approach.
W82-01365 5F

The Water Decade (1981-1990).
W82-01534 6E

WATER SUPPLY SYSTEMS
The Problems of Non-Return and the Use of Valves in Drinking Water Protection Against Waste Water Return, Applying the Regulations in Force.
W82-01142 5F

WATER TABLE FLUCTUATIONS
A Mathematical Model of Water Table Fluctuation in a Semi-Infinite Aquifer Induced by Localized Transient Recharge,
W82-01319 2F

WATER TREATMENT
Chemical Equilibria in Split-Treatment Softening of Water,
W82-01165 5F

Interpreting Laboratory Results for the Design of Rapid Mixing and Flocculation Systems,
W82-01166 5F

Microbiology: Detection, Occurrence, and Removal of Viruses.
W82-01290 5A

Developments in Sedimentation and Flotation.
W82-01391 5F

Bench Scale Assessment of Technologies for Contaminated Ground Water Treatment.
W82-01433 5G

Regeneration of Anion Exchange Resins by Calcium Carbonate and Carbon Dioxide.
W82-01484 5F

Chemical Control of Mussel Settlement in a Cooling Water System Using Acrolein.
W82-01501 5F

Organics in Water - An Engineering Challenge.
W82-01540 5F

WATER TREATMENT FACILITIES
Expansion of Effluent Constrained Treatment Plants.
W82-01355 5D

The River Ouse Water Supply Scheme.
W82-01371 5F

Scaynes Hill STW Extensions Include Plastic Media Filtration.
W82-01386 5D

Small Water Systems: Role of Technology.
W82-01542 5F

WATER USE EFFICIENCY
Mandatory or Voluntary Water Conservation: A Case Study of Iowa Communities During Drought.
W82-01553 3D

WATER YIELD
Results of Acidizing Water Wells in Arizona,
W82-01199 4B

WATERPROOFING
Redesign Controls Manhole Leakage,
W82-01237 8G

WATERSHED MODELS
Managing Land to Meet Water Quality Goals,
W82-01557 4D

WATERSHEDS
Suspended Sediment Production from Forested Watersheds on Oahu, Hawaii,
W82-01531 2J

Using Computed Stream Flow in Watershed Analysis,
W82-01538 2A

WAVE PROPAGATION
Wave Formation and Heat Transfer at an Ice-Water Interface in the Presence of a Turbulent Flow.
W82-01128 2C

WAVES
Wave Climate and Potential Longshore Sediment Transport Patterns, Nottawasaga Bay, Ontario,
W82-01156 2J

WAYNE COUNTY
The Wayne County, Michigan, Wastewater Collection and Treatment System,
W82-01505 5D

WEATHER DATA SIMULATION
Simulation of Daily Weather Data Using Theoretical Probability Distributions,
W82-01526 2B

WEATHER MODIFICATION
Weather Modification from Cooling Towers. A Test Based on the Distributional Properties of Rainfall.
W82-01527 2B

WEED CONTROL
A Comparison of Chemical and Cultural Control of Weeds in Irrigation Ditchbanks,
W82-01120 4A

WELL DATA
An All-Teflon Bailer and an Air-Driven Pump for Evacuating Small-Diameter Ground-Water Wells.
W82-01333 7B

WELL HYDRALICS
On Identification and Validation of Some Geothermal Models.
W82-01467 6A

WELL YIELD
Results of Acidizing Water Wells in Arizona.
W82-01199 4B

Yield Verification of a Dolomite Aquifer in Northeast Illinois,
W82-01334 2F

WELLS
Geologic and Hydrologic Factors Controlling Radon-222 in Ground Water in Maine.
W82-01222 2F

Identification of the Wairakei Geothermal System.
W82-01312 2F

Practical Aspects of Ground Water Monitoring at Existing Disposal Sites.
W82-01421 5G

WEST AFRICA
The Crustacean Zooplankton of Mali (West Africa),
W82-01379 2H

WETLANDS
Avoyelles Sportsmen's League V. Alexander,
W82-01456 6E

WHITE WATER
Preferences for Allocating River Recreation Use,
W82-01181 6D

Closeup of Whitewater System Helps Menasha Meet Effluent Standards.
W82-01579 5D

WILDERNESS AREAS
Mercury in the Muscle Tissue of Fish from Three Northern Maine lakes.
W82-01459 5B

WINDHAM
Top-Sealing to Minimize Leachate Generation. Case Study of the Windham, Connecticut, Landfill,
W82-01427 5G

WISCONSIN
Seasonal Reversals of Groundwater Flow Around Lakes and the Relevance to Stagnation Points and Lake Budgets,
W82-01103 2F

A Successful Low Technology Wastewater Process,
W82-01178 5D

Changes in Sediment Storage in the Coon Creek Basin, Driftless Area, Wisconsin, 1853 to 1975.
W82-01563 2J

YANGTZE RIVER
Yangtze Gorges Scheme Could Yield 110 TWh/Year.
W82-01394 8A

YORKSHIRE WATER AUTHORITY
The River Ouse Water Supply Scheme.
W82-01371 5F

YUGOSLAVIA
Evaluation of the Polluted River Savinja with the Help of Macrophytes.
W82-01377 5C

ZINC
Mercury and Zinc in the Sediments of Seneca Lake, Seneca River, and Keuka Outlet, New York.
W82-01151 5B

Atomic Absorption Spectrophotometric Studies of Cadmium and Zinc in Commercial Fertilisers, Soils and River Waters.
W82-01388 5B

ZOOPLANKTON
A Bioassay Study of Effects of Zooplankton, Iron and NTA on the Phytoplankton Productivity of a Marl Lake.
W82-01157 2H

Seasonal Features of Zooplankton Assemblages in the Nearshore Area of Southeastern Lake Michigan.
W82-01192 2H

The Crustacean Zooplankton of Mali (West Africa).
W82-01379 2H

Zooplankton Abundance and Diversity in Central Florida Grass Carp Ponds.
W82-01520 2H

ZOOPLANKTON

LIBRARY U. S. GEOLOGICAL SURVEY

AUTHOR INDEX

ABERNATHY, A. R.
Stream Nutrient Levels and Proximity of Agricultural and Forest Land to Streams: Some Relationships.
W82-01554 5B

ABSALON, J. R.
Practical Aspects of Ground Water Monitoring at Existing Disposal Sites,
W82-01421 5G

ADDISON, R.
Rosario Dominicana's Cyanide Tailings Dam Construction and Operation.
W82-01589 5D

AGRAWAL, R. P.
The Water Balance of the Betwa Basin, India.
W82-01354 2A

AHLQUIST, A. J.
Factors Affecting Radionuclide Availability to Vegetables Grown at Los Alamos.
W82-01109 5B

AHMAD, A.
Atomic Absorption Spectrophotometric Studies of Cadmium and Zinc in Commercial Fertilisers, Soils and River Waters.
W82-01388 5B

AHUJA, L. R.
The Depth of Rainfall-Runoff-Soil Interaction as Determined by P32.
W82-01318 5B

The Release of Soil Phosphorous to Runoff in Relation to the Kinetics of Desorption.
W82-01477 5B

AIKEN, J. D.
Nebraska Ground Water Law and Administration.
W82-01236 6E

AJMAL, M.
Atomic Absorption Spectrophotometric Studies of Cadmium and Zinc in Commercial Fertilisers, Soils and River Waters.
W82-01388 5B

AKIELASZEK, J. J.
Mercury in the Muscle Tissue of Fish from Three Northern Maine lakes.
W82-01459 5B

AL-JEBOURI, M. M.
The Escherichia Coli Content of Mytilus Edulis from Analysis of Whole Tissue or Digestive Tract.
W82-01508 5A

ALBIGNAT, J. P.
The Use of the Equilibrium Temperature to Establish the Heat Balance of a Water Surface (Sur l'Utilization de la Temperature d'Equilibre pour l'Etablissement du Bilan Thermique d'Un Plan d'Eau).
W82-01353 2H

ALDOUS, K.
Love Canal: Chemical Contamination and Migration.
W82-01436 5B

ALEXANDER, M.
Formation of N-Nitrosodimethylamine During Treatment of Municipal Waste Water by Simulated Land Application.
W82-01343 5D

ALLAN, R. J.
Historical Changes and Relationship to Internal Loading of Sediment Phosphorus Forms in Hypertrophic Prairie Lakes.
W82-01516 2H

ALLEMAN, J. E.
Activated Sludge.
W82-01243 5D

ALLEN, E. T.
Treatment of Sewage Plant Effluent for Use as Makeup Water,
W82-01585 3C

ALLEN, M. J.
Microbiology of Ground Water,
W82-01286 5B

Microbiology of Potable Water,
W82-01287 5F

ALLEY, W. M.
Estimation of Impervious-Area Washoff Parameters.
W82-01465 4C

ALONSO, C. V.
Selecting a Formula to Estimate Sediment Transport Capacity in Nonvegetated Channels.
W82-01405 2J

AMOOZEGAR-FARD, A.
The Movement of Salts from Soils Following Heavy Application of Feedlot Wastes.
W82-01132 5B

ANDERSEN, P. F.
Thermal Energy Storage in a Confined Aquifer: Second Cycle,
W82-01473 4B

ANDERSON, E. L.
Reclamation of Wastewater with a Soil-Turf Filter: I: Removal of Nitrogen,
W82-01101 5D

Reclamation of Wastewater with a Soil-Turf Filter: II: Removal of Phosphorus, Boron, Sodium and Chlorine.
W82-01102 5D

ANDERSON, M. P.
Seasonal Reversals of Groundwater Flow Around Lakes and the Relevance to Stagnation Points and Lake Budgets.
W82-01103 2F

ANDERSON, R. L.
Toxicity and Bioaccumulation of Endrin and Methoxychlor in Aquatic Invertebrates and Fish.
W82-01160 5C

ARCHER, D. R.
A Catchment Approach to Flood Estimation.
W82-01397 2E

ARNOLD, L. E.
Water Quality from Two Small Forested Watersheds in Southern Illinois.
W82-01140 4C

ARUMUGAM, P. T.
Physico-Chemistry, Destratification and Nutrient Budget of a Lowland Eutrophicated Malaysian Reservoir and Its Limnological Implications.
W82-01360 2H

AUCLAIR, B.
Sanitation Service Management in France (La Gestion des Services d'Assainissement en France).
W82-01351 6F

AUER, M. T.
Phosphorus Uptake Dynamics as Related to Mathematical Modeling of Cladophora at a Site on Lake Huron.
W82-01149 5C

AVERILL, D. W.
Data Base Development for the Design of a Radium-226 Removal Process.
W82-01188 5D

BABALOLA, O.
Drought Susceptibility of Two Tomato (Lycopersicum Esculentum) Varieties.
W82-01369 2I

BAJARD, Y.
Rural Water Supply and Related Services in Developing Countries-Comparative Analysis of Several Approaches,
W82-01330 6A

BALTZER, R. A.
A Model for Simulation of Flow in Singular and Interconnected Channels,
W82-01210 2E

BANDT, K. E.
An All-Teflon Bailer and an Air-Driven Pump for Evacuating Small-Diameter Ground-Water Wells,
W82-01333 7B

BARACOS, P. C.
Modeling Hydrologic Time Series from the Arctic,
W82-01198 2A

BARNES, A. A. JR.
An Improved Method for Obtaining the Water Content Values of Ice Hydrometeors from Aircraft and Radar Data,
W82-01523 7B

BARROW, N. J.
A Study of a Method for Displacing Soil Solution by Centrifuging with an Immiscible Liquid.
W82-01131 5B

BARTHOLOMEW, W. C.
Limnetic Larval Fish of the Maumee and Sandusky River Estuaries,
W82-01197 7A

BAZARAA, A.
Design and Merit of a River-Aquifer Model for Optimal Use of Agricultural Water,
W82-01193 6A

BEAMS, J.
Open-Pore Polyurethane as a Medium for Coal Conversion Process Aqueous Effluent Cleanup.
W82-01577 5D

BEAR, J.
A Numerical Solution for the Movement of an Interface in a Layered Coastal Aquifer,
W82-01327 2F

BEATTIE, D. M.
Investigations into the Occurrence of Midge Plagues in the Vicinity of Harderwijk (Netherlands).
W82-01378 2H

BEAUPRE, R. T.
Advanced Wastewater Plant is Energy Saver.
W82-01177 5D

BECK, W. W. JR.
Top-Sealing to Minimize Leachate Generation, Case Study of the Windham, Connecticut, Landfill.
W82-01427 5G

BEDARD, P.
018 Modelling of Freshwater Inputs in Baffin Bay and Canadian Arctic Coastal Waters.
W82-01590 2C

BEN-ASHER, J.
Estimating Evapotranspiration from the Sonoita Creek Watershed near Patagonia, Arizona.
W82-01306 2D

BENFIELD, E. F.
Effects of Pollution on Freshwater Invertebrates.
W82-01280 5C

BENNETT, O. L.
Effects of Sanitary Landfill Leachage on Some Soil Chemical Properties.
W82-01480 5E

BENSON, C. R.
Yield Verification of a Dolomite Aquifer in Northeast Illinois.
W82-01334 2F

BENSON, R. C.
Site Assessment: Improving Confidence Levels with Surface Remote Sensing.
W82-01422 5G

BENZINGER, W. D.
High Temperature Ultrafiltration with Kynar Poly(Vinylidene Fluoride) Membranes.
W82-01566 5D

BERGERON, M. P.
Hydrochemical Facies in a Tertiary Basin in the Milligan Canyon Area, Southwest Montana.
W82-01481 2F

BERGLUND, S. H.
Soil Erosion Control in Idaho's Cow Creek Watershed: An Economic Analysis.
W82-01556 4D

BERMAN, J.
Volatile C1-C7 Organic Compounds in Surface Sediments from Walvis Bay.
W82-01367 5B

BERTHEL, R. O.
An Improved Method for Obtaining the Water Content Values of Ice Hydrometeors from Aircraft and Radar Data.
W82-01523 7B

BEZDEK, J. C.
Characterizing Sprinkler Distribution Patterns with a Clustering Algorithm.
W82-01575 3F

Significant Features of Emitter Flushing Mode Characteristics.
W82-01576 3F

BIBBY, R.
Mass Transport of Solutes in Dual-Porosity Media.
W82-01104 5B

BIEHL, T. G.
The Wayne County, Michigan, Wastewater Collection and Treatment System.
W82-01505 5D

BIERIG, H. W.
Detroit - Fresh Clean Water.
W82-01506 5D

BITTINGER, M. W.
Potential Use of a Stream-Aquifer Model for Management of a River Basin: Case of the South Platte River in Colorado.
W82-01301 6A

BLACHUT, S. P.
The Behavior of a Polar Ice-Dammed Lake, Ellesmere Island, N.W.T., Canada.
W82-01511 2C

BLACKBURN, T. R.
Mercury and Zinc in the Sediments of Seneca Lake, Seneca River, and Keuka Outlet, New York.
W82-01151 5B

BLANCHAR, R. W.
Prediction of Diffusion Coefficients from the Electrical Conductance of Soil.
W82-01224 2G

BLASING, T. J.
A Dendroclimatic Reconstruction of Annual Precipitation Amounts in Iowa Since 1680.
W82-01314 2B

BLAYLOCK, B. G.
Radioactive Wastes.
W82-01268 5D

BLUME, H. J. C.
Multifrequency Radiometer Detection of Submarine Freshwater Sources Along the Puerto Rican Coastline.
W82-01349 3B

BOBBA, A. G.
Parameterization of Contaminant Transport Through an Anisotropic Unconfined Aquifer.
W82-01570 5B

BOBEE, B.
Determination of the Confidence Intervals of the Wakeby Distribution Using Order Statistics.
W82-01317 2E

BOELHOUWER, C.
Purification of Municipal Wastewater by Subsequent Reverse Osmosis and Anaerobic Digestion.
W82-01468 5D

BOHAC, C. E.
Dissolved Oxygen in Streams and Reservoirs.
W82-01272 5G

BOLTON, E. F.
Climatic Factors Contributing to Year-To-Year Variation in Grain Yield of Corn on Brookston Clay.
W82-01115 2I

BORDNER, R. H.
Microbiology: Methodology and Quality Assurance.
W82-01285 5A

BOREMAN, J.
An Empirical Methodology for Estimating Entrainment Losses at Power Plants Sited on Estuaries.
W82-01173 6G

BORGMANN, U.
Interactive Effects of Metals in Mixtures on Biomass Production Kinetics of Freshwater Copepods.
W82-01125 5C

BORTNIK, V. N.
Balance of Biogenic Elements in the Aral Sea Upon a Drop of Its Level.
W82-01370 2H

BOST, J-F.
Sanitation Service Management in France (La Gestion des Services d'Assainissement en France).
W82-01351 6F

BOUCHER, P.
Determination of the Confidence Intervals of the Wakeby Distribution Using Order Statistics.
W82-01317 2E

BOULDIN, D. R.
Effects of Dairy Manure on Phosphorus Concentrations and Losses in Tile Effluent.
W82-01479 5B

Phosphorus Concentration-Water Flow Interactions in Tile Effluent from Manured Land.
W82-01340 5B

BOUMA, J.
Measuring the Hydraulic Conductivity of Soil Adjacent to Tile Drains in a Heavy Clay Soil in the Netherlands.
W82-01323 2G

BOUTIN, C.
The Use of the Equilibrium Temperature to Establish the Heat Balance of a Water Surface (Sur l'Utilization de la Temperature d'Equilibre pour l'Etablissement du Bilan Thermique d'Un Plan d'Eau).
W82-01353 2H

BOWMAN, K. O.
Weather Modification from Cooling Towers. A Test Based on the Distributional Properties of Rainfall.
W82-01527 2B

BOYCE, F. M.
Hypolimnion Flow Between the Central and Eastern Basins of Lake Erie During 1977 (Interbasin Hypolimnion Flows)
W82-01153 2H

BOYLE, W. C.
Onsite Alternatives for Treatment and Disposal.
W82-01248 5D

BRAAM, F.
Effect of Copper on Nitrification in Activated Sludge.
W82-01497 5C

BRAIDS, O. C.
Ground Water.
W82-01273 2F

BRAKENSIEK, D. L.
Statistical Analysis of the Brooks-Corey and the Green-Ampt Parameters Across Soil Textures.
W82-01107 2G

BRAND, J. I.
Open-Pore Polyurethane as a Medium for Coal Conversion Process Aqueous Effluent Cleanup.
W82-01577 5D

BRANDL, J. S.
Pharmaceutical Company's Aeration System Saves Energy.
W82-01180 5D

BRATBY, J. R.
Interpreting Laboratory Results for the Design of Rapid Mixing and Flocculation Systems.
W82-01166 5F

BRAUD, H. J.
Trickle Irrigation Lateral Design on Sloping Fields.
W82-01537 8C

BRAUN, H. E.
Organochlorine Insecticides and PCB in Surficial Sediments of Lake Michigan (1975).
W82-01190 5A

BRAY, D. I.
Evaluation of Effective Boundary Roughness for Gravel-Bed Rivers.
W82-01161 8B

BRENNIMAN, G. R.
Environmental Impact and Health Effects of Wastewater Chlorination.
W82-01451 5D

BRILL, E. D. JR.
Generating Alternative Solutions for Dynamic Programming Models of Water Resources Problems.
W82-01450 6A

Methods for Generating Alternative Solutions to Water Resources Planning Problems.
W82-01449 6A

BROCKSEN, R. W.
Entrainment and Impingement in Power Plant Cooling Systems.
W82-01276 6G

BROWER, G. R.
Solid Wastes and Water Quality.
W82-01269 5B

BROWNE, F. X.
Non-Point Sources.
W82-01270 5B

BROZKA, R. J.
Water Quality from Two Small Forested Watersheds in Southern Illinois.
W82-01140 4C

BRUCE, A. M.
New Approaches to Anaerobic Sludge Digestion,
W82-01398 5D

BRUEHL, D. H.
Geological Studies of Industrially-Related Contamination: Soil and Ground Water Investigations,
W82-01425 5B

BRUHN, J. A.
Simulation of Daily Weather Data Using Theoretical Probability Distributions,
W82-01526 2B

BRUTSAERT, W. F.
Geologic and Hydrologic Factors Controlling Radon-222 in Ground Water in Maine,
W82-01222 2F

Radon-222, In Potable Water Supplies of New England,
W82-01221 5B

BRYSON, H. C.
Preliminary Design and Cost Estimates for Remedial Actions at Hazardous Waste Disposal Sites,
W82-01435 5G

BUCHANAN, B.
Closeup of Whitewater System Helps Menasha Meet Effluent Standards,
W82-01579 5D

BUDD, W. W.
Aluminum in Precipitation, Streams, and Shallow Groundwater in the New Jersey Pine Barrens,
W82-01297 5B

BUGGIANI, S. S.
Mercury and Lead Concentrations in Some Species of Fish From the Tuscan Coasts (Italy),
W82-01368 5B

BUIKEMA, A. L. JR.
Effects of Pollution on Freshwater Invertebrates,
W82-01280 5C

BUKATA, R. P.
Parameterization of Contaminant Transport Through an Anisotropic Unconfined Aquifer,
W82-01570 5B

BURDAN, P.
Organic Contamination of Ground Water: Tell it All,
W82-01474 5C

BURGESS, M. D.
Automatic Class-A Pan-Filling System,
W82-01326 7B

BURT, J. E.
A Parametric Crop Water Use Model,
W82-01310 2I

BURTON, D. T.
The Interaction of Treated Bleached Kraft Mill Effluent and Dissolved Oxygen Concentration on the Survival of the Developmental Stages of the Sheepshead Minnow (Cyprinodon Variegatus).
W82-01494 5C

BUSS, D. F.
An All-Teflon Bailer and an Air-Driven Pump for Evacuating Small-Diameter Ground-Water Wells.
W82-01333 7B

BUTLER, T. J.
Recent Acidification of Precipitation in North America.
W82-01514 5B

BUTTS, T. A.
Sediment Oxygen Demand and Its Effect on Dissolved Oxygen in a Cutoff Meander of the Kaskaskia River,
W82-01448 4A

CALVERT, J. W.
Anaerobic Carbon Filter for Degradation of Phenols,
W82-01454 5D

CAMERON, D. R.
Nonpoint N Runoff from Agricultural Watersheds into the Great Lakes,
W82-01148 5B

CAMPBELL, R. S.
Abate: Effects of the Organophosphate Insecticide on Bluegills and Invertebrates in Ponds,
W82-01445 5C

CANALE, R. P.
Comparison of First-Order Error Analysis and Monte Carlo Simulation in Time-Dependent Lake Eutrophication Models,
W82-01460 2H

Phosphorus Uptake Dynamics as Related to Mathematical Modeling of Cladophora at a Site on Lake Huron,
W82-01149 5C

CARPENTER, A. B.
Groundwater Contamination by Sanitary Landfill Leachate and Domestic Wastewater in Carbonate Terrain: Principal Source Diagnosis, Chemical Transport Characteristics and Design Implications,
W82-01223 5B

CASH, F. M.
Pipeline Friction Losses for Wastewater Sludges,
W82-01545 5D

CASPARIUS, R. E.
Radon-222, In Potable Water Supplies of New England,
W82-01221 5B

CHAMBERS, R. L.
Nepheloid and Suspended Particulate Matter in South-Eastern Lake Michigan,
W82-01499 2H

CHANEY, R. C.
Cyclic Strengths Compared for Two Sampling Techniques,
W82-01170 8D

CHANG, C.
Water and Salt Movement in a Saline-Sodic Soil in Southern Alberta,
W82-01119 2G

CHANG, H-M.
O2 Bleaching Shows Potential for Reducing Costs and Effluent Problems,
W82-01578 5D

CHANG, S-Y.
Methods for Generating Alternative Solutions to Water Resources Planning Problems,
W82-01449 6A

CHATTERJEE, S.
Wastewater Collection,
W82-01251 5D

CHATTOPADHYAY, G. N.
Effect of Different Levels of Water Salinity on the Decomposition of Organic Manures in a Brackish Water Fish Pond Soil.
W82-01363 3C

CHATURVEDI, M. C.
Study of a Complex Water Resources System with Screening and Simulation Models.
W82-01309 6A

CHENG, K. C.
Wave Formation and Heat Transfer at an Ice-Water Interface in the Presence of a Turbulent Flow,
W82-01128 2C

CHERKAUER, D. S.
The Effect of Flyash Disposal on a Shallow Ground-Water System,
W82-01220 5B

CHERRY, J. A.
Origin, Age and Movement of Pore Water in Agrillaceous Quaternary Deposits at Four Sites in Southwestern Ontario,
W82-01321 2F

CHIAN, E. S. K.
Mechanism of Enteroviral Inactivation by Ozone.
W82-01482 5D

Organics,
W82-01239 5A

CHING, C. T. K.
Water Multipliers--Regional Impact Analysis,
W82-01138 6A

CHIOCCHIO, F.
Hypolimnion Flow Between the Central and Eastern Basins of Lake Erie During 1977 (Interbasin Hypolimnion Flows)
W82-01153 2H

CHOUDHURY, B. J.
Remote Sensing of Soil Moisture Content Over Bare Field at 1.4 GHz Frequency,
W82-01345 7B

CHOW, W.
Entrainment and Impingement in Power Plant Cooling Systems,
W82-01276 6G

CHRISTENSEN, S. W.
An Empirical Methodology for Estimating Entrainment Losses at Power Plants Sited on Estuaries,
W82-01173 6G

CHU, T-Y. J.
Power Industry Wastes,
W82-01265 5B

CHUNG, A. K.
Factors Affecting the Fate of Heavy Metals in the Activated Sludge Process,
W82-01547 5D

CHUNG, N. K.
Geological Studies of Industrially-Related Contamination: Soil and Ground Water Investigations,
W82-01425 5B

CIBIK, C.
Urban Runoff and Combined Sewer Overflow,
W82-01254 5B

CLARK, L.
Groundwater Investigations in the Vale of Stathmore,
W82-01400 2F

CLARK, R. M.
Small Water Systems: Role of Technology,
W82-01542 5F

CLARK, R. N.
Water Frost and Ice: The Near-Infrared Spectral Reflectance 0.65-2.5 Microns.
W82-01346 2C

CLARKE, W. G.
Studies for Abatement of Pollution from Combined Sewer Overflows in Canada.
W82-01200 5G

CLAYTON, A. J.
A Look at Some Water Reclamation Plants in Southern Africa,
W82-01352 5D

CLINE, G. C.
Demonstration Testing of Alum Recovery by Liquid Ion Exchange,
W82-01167 5D

COLQUHOUN, J. R.
Preliminary Report of Stream Sampling for Acidification Studies 1980,
W82-01453 5A

COLWELL, R. R.
Effect of Kepone on Estuarine Microbial Activity,
W82-01231 5C

An Estuarine Agar Medium for Enumeration of Aerobic Heterotrophic Bacteria Associated with Water, Sediment, and Shellfish,
W82-01565 5A

COLYER, R. S.
Metal Ion Concentrations Associated with Late Summer Sediments of the Ohio River,
W82-01300 5A

COMEAU, J. C.
Modelling Effects of Remedial Programs to Aid Great Lakes Environmental Management,
W82-01146 5G

CONFORTI, P. M.
Chrysotile Asbestos Fibers in Drinking Water from Asbestos-Cement Pipe,
W82-01592 5B

CONNORS, S. D.
Application of Aerial Photographs and Surficial Geologic Maps to the Determination of Suitability of Land for Septic Tank Systems,
W82-01569 7B

CONRAD, J. R.
Anaerobic Processes,
W82-01245 5D

CONROY, N. I.
A Classification and Description of Some Northeastern Ontario Lakes Influenced by Acid Precipitation,
W82-01145 5B

CONTRACTOR, D. N.
A One-Dimensional, Finite Element Salt Water Intrusion Model,
W82-01452 7A

CONWAY, R. A.
High-Solubility Gas Flotation,
W82-01184 5D

COOK, C. J.
Groundwater Contamination by Trace Level Organics from a Rapid Infiltration Site,
W82-01496 5B

COOK, N. G.
A Study of Regional Temperature and Thermohydrologic Effects of an Underground Repository for Nuclear Wastes in Hard Rock,
W82-01347 5E

COOLEY, K. R.
Erosivity 'R' for Individual Design Storms,
W82-01403 2J

COOMBS, E. G.
Radon-222, In Potable Water Supplies of New England,
W82-01221 5B

COOPER, C. L.
Limnetic Larval Fish of the Maumee and Sandusky River Estuaries,
W82-01197 7A

COPAS, S. R.
Pipeline Friction Losses for Wastewater Sludges,
W82-01545 5D

CORNELL, J. C.
Mercury and Zinc in the Sediments of Seneca Lake, Seneca River, and Keuka Outlet, New York,
W82-01151 5B

CORNWELL, D. A.
Demonstration Testing of Alum Recovery by Liquid Ion Exchange,
W82-01167 5D

COSTA, J. E.
Debris Flows in Small Mountain Stream Channels of Colorado and Their Hydrologic Implications,
W82-01597 2E

COSTELLO, R.
Denitrification of Blackwater with Greywater,
W82-01225 5D

COULOMBE, A. M.
Collapsing Aphanizomenon Flos-Aquae Blooms: Possible Contributions of Photo-Oxidation, O2 Toxicity, and Cyanophages,
W82-01595 2H

COWLING, E. B.
Acid Precipitation: Basic Principles and Ecological Consequences,
W82-01586 5C

COX, W. E.
Law,
W82-01302 6E

CRAMPTON, C. B.
Variations of pH with Annual Cumulative Precipitation in Acid Forest Soils,
W82-01118 2G

CRANOR, R. O.
Rosario Dominicana's Cyanide Tailings Dam Construction and Operation.
W82-01589 5D

CRAUN, G. F.
Disease Outbreaks Caused by Drinking Water,
W82-01289 5C

CRAVENS, J. B.
Thermal Effects,
W82-01275 5C

CRESSER, M. S.
Factors Affecting the Chemistry of Precipitation and River Water in an Upland Catchment,
W82-01322 2K

CRITTENDEN, J. C.
Modeling of Activated Carbon and Coal Gasification Char Adsorbents in Single-Solute and Bisolute Systems,
W82-01447 1B

CRONHOLM, L. S.
Potential Health Hazards from Microbial Aerosols in Densely Populated Urban Regions,
W82-01232 5C

CROSS, S. F.
Environmental Recovery in a Marine Ecosystem Impacted by a Sulfite Process Pulp Mill,
W82-01548 5B

CROSS, W. H.
Anaerobic Carbon Filter for Degradation of Phenols,
W82-01454 5D

CULLEY, J. L.
Nonpoint N Runoff from Agricultural Watersheds into the Great Lakes,
W82-01148 5B

CULVER, C. F.
Hydropower Losses from Navigation in the Snake-Columbia Rivers: 1978-79,
W82-01139 6D

CURRAN, C.
Groundwater Contamination by Trace Level Organics from a Rapid Infiltration Site,
W82-01496 5B

D'APPOLONIA, D. J.
Soil-Bentonite Supply Trench Cutoffs,
W82-01599 8D

DAHLBERG, M. D.
Nearshore Spatial Distribution of Fishes in Gill Net Samples, Cayuga Lake, New York,
W82-01195 7A

DAIGH, R. V.
Survey of Treatment Plant Design and Operation Deficiencies,
W82-01543 5D

DALY, C. J.
Design and Merit of a River-Aquifer Model for Optimal Use of Agricultural Water,
W82-01193 6A

DAMIANI, V.
PCB Residues in Bottom Sediments Collected From the Bay of Quinte, Lake Ontario 1972-1973,
W82-01155 5B

DANCE, K. W.
Some Effects of Agricultural Land Use on Stream Insect Communities,
W82-01159 5C

DANIEL, J. R. K.
Drainage Density as an Index of Climatic Geomorphology,
W82-01324 2A

DATTA, B.
Performance Evaluation of a Stochastic Optimization Model for Reservoir Design and Management with Explicit Reliability Criteria,
W82-01462 8A

DAUCHY, J.
Groundwater Contamination by Trace Level Organics from a Rapid Infiltration Site,
W82-01496 5B

DAVANZO, A. C.
Detroit - Fresh Clean Water,
W82-01506 5D

DAVEY, C. B.
Acid Precipitation: Basic Principles and Ecological Consequences,
W82-01586 5C

DAVIDSON-ARNOTT, R. G. D.
Wave Climate and Potential Longshore Sediment Transport Patterns, Nottawasaga Bay, Ontario,
W82-01156 2J

DAVIES, T. T.
Organochlorine Insecticides and PCB in Surficial Sediments of Lake Michigan (1975),
W82-01190 5A

DAVIS, C. O.
Phytoplankton Productivity and Standing Crop in the Vicinity of the Lake Huron-Saginaw Bay Front,
W82-01164 2H

DE HEER, H.
Methyl Bromide and Bromide-Ion in Drainage Water After Leaching of Glasshouse Soils,
W82-01492 5B

DEFOE, D. L.
Toxicity and Bioaccumulation of Endrin and Methoxychlor in Aquatic Invertebrates and Fish,
W82-01160 5C

DENKHAUS, R.
Relationship of the Raw Water Quality to Mutagens Detectable by the Ames Salmonella/Microsome Assay in a Drinking-Water Supply,
W82-01493 5A

DENTON, M. S.
Open-Pore Polyurethane as a Medium for Coal Conversion Process Aqueous Effluent Cleanup,
W82-01577 5D

DEPINTO, J. V.
Aquatic Sediments,
W82-01279 5B

DESAULNIERS, D. E.
Origin, Age and Movement of Pore Water in Agrillaceous Quaternary Deposits at Four Sites in Southwestern Ontario,
W82-01321 2F

DEUDNEY, D.
Hydropower--An Old Technology for a New Era,
W82-01593 4A

DEWALLE, F. B.
Organics,
W82-01239 5A

DHAMOTHARAN, S.
Unsteady One-Dimensional Settling of Suspended Sediment,
W82-01463 2J

DIACON, A.
Daily Optimization of Power Generation in Cascade Hydrosystems (A Stochastic Approach),
W82-01320 6A

DIESL, W. F.
Geological Studies of Industrially-Related Contamination: Soil and Ground Water Investigations,
W82-01425 5B

DIKMEN, S. U.
Liquefaction Analysis for Multidirectional Shaking,
W82-01169 8D

DINSMORE, S. R.
Open-Pore Polyurethane as a Medium for Coal Conversion Process Aqueous Effluent Cleanup,
W82-01577 5D

DIRKS, V. A.
Climatic Factors Contributing to Year-To-Year Variation in Grain Yield of Corn on Brookston Clay,
W82-01115 2I

DOBSON, R.
The River Ouse Water Supply Scheme,
W82-01371 5F

DOLAN, R.
Geomorphology of the Colorado River in the Grand Canyon,
W82-01338 2J

DOLSKE, D. A.
Nutrient Loading of Southern Lake Michigan by Dry Deposition of Atmospheric Aerosol,
W82-01152 5B

DORAN, J. W.
Chemical and Bacteriological Quality of Pasture Runoff,
W82-01555 5B

DOTY, R. D.
Suspended Sediment Production from Forested Watersheds on Oahu, Hawaii,
W82-01531 2J

DOWIAK, N. J.
Remedial Options for Ground Water Protection at Abandoned Solid Waste Disposal Facilities,
W82-01426 5G

DOYLE, T. J.
Surface Water Management at Hazardous Waste Sites,
W82-01429 5G

DOZIER, J.
Effect of Grain Size and Snowpack Water Equivalence on Visible and Near-Infrared Satellite Observations of Snow,
W82-01311 7B

DRAKE, R. J.
Reclamation of Wastewater with a Soil-Turf Filter: II: Removal of Phosphorus, Boron, Sodium and Chlorine,
W82-01102 5D

DRAPER, M.
Rural Water Supply and Related Services in Developing Countries-Comparative Analysis of Several Approaches,
W82-01330 6A

DRURY, D. D.
O & M Wastewater Collection and Treatment Facilities,
W82-01249 5D

DUFFY, D.
Cyclic Strengths Compared for Two Sampling Techniques,
W82-01170 8D

DUMONT, H. J.
The Crustacean Zooplankton of Mali (West Africa),
W82-01379 2H

DUNNE, T.
Snowmelt Prediction in a Subarctic Drainage Area,
W82-01571 2C

DUVICK, D. N.
A Dendroclimatic Reconstruction of Annual Precipitation Amounts in Iowa Since 1680,
W82-01314 2B

DYLLA, A. S.
Nitrogen Leaching as Influenced by Nitrogen Management and Supplement Irrigation Level,
W82-01472 5B

EADIE, B.
Fatty Acid and Hydrocarbon Content of Settling Sediments in Lake Michigan,
W82-01154 2H

EADIE, B. J.
Nepheloid and Suspended Particulate Matter in South-Eastern Lake Michigan,
W82-01499 2H

ECONOMOU-AMILLI, A.
Periphyton Analysis for the Evaluation of Water Quality in Running Waters of Greece,
W82-01358 5A

EDWARDS, R. W.
The Effect of Pollutants from the Coal Industry on the Fish Fauna of a Small River in the South Wales Coalfield,
W82-01389 5C

EDWARDS, S. J.
Fatty Acid and Hydrocarbon Content of Settling Sediments in Lake Michigan,
W82-01154 2H

EGELAND, D. R.
The Wayne County, Michigan, Wastewater Collection and Treatment System,
W82-01505 5D

EICHELBERGER, J. L.
High Temperature Ultrafiltration with Kynar Poly(Vinylidene Fluoride) Membranes,
W82-01566 5D

EID, B.
Hypolimnion Flow Between the Central and Eastern Basins of Lake Erie During 1977 (Interbasin Hypolimnion Flows)
W82-01153 2H

ELLIOTT, R. A.
Nitrogen Balances for an Effluent Irrigation Area,
W82-01478 3C

ELLIS, D. V.
Environmental Recovery in a Marine Ecosystem Impacted by a Sulfite Process Pulp Mill,
W82-01548 5B

EMRICH, G. H.
Top-Sealing to Minimize Leachate Generation, Case Study of the Windham, Connecticut, Landfill,
W82-01427 5G

ENGELBRECHT, R. S.
Mechanism of Enteroviral Inactivation by Ozone.
W82-01482 5D

ENK, M. D.
Evidence of Natural Reproduction by Planted Lake Trout in Lake Michigan,
W82-01194 8I

ERMAN, D. C.
Effects of Logging on Macroinvertebrates in Streams with and Without Buffer Strips,
W82-01227 5C

ESCOFFIER, F. F.
Linearized Solution to Inlet Equation with Inertia,
W82-01183 2L

ESPANA, C.
Cyclic Strengths Compared for Two Sampling Techniques,
W82-01170 8D

ESSINGTON, E. H.
Studies on Unsaturated Zone Hydrology and Radionuclide Migration at a Shallow-Land Burial Site,
W82-01172 5B

EVANS, M. S.
Seasonal Features of Zooplankton Assemblages in the Nearshore Area of Southeastern Lake Michigan,
W82-01192 2H

EVANS, N. A.
Potential Use of a Stream-Aquifer Model for Management of a River Basin: Case of the South Platte River in Colorado,
W82-01301 6A

FAHSELT, D.
A Quantitative Study of Shoreline Marsh Communities Along Lake Huron in Ontario,
W82-01122 2H

FANNIN, K. F.
Anaerobic Processes,
W82-01245 5D

FAUSEY, N. R.
Water Management Model Evaluation for North Central Ohio,
W82-01536 4A

FAUST, C. R.
Computer Modeling and Ground-Water Protection,
W82-01336 2F

FAWUSI, M. O. A.
Drought Susceptibility of Two Tomato (Lycopersicum Esculentum) Varieties,
W82-01369 2I

FEDORS, J. C.
Multifrequency Radiometer Detection of Submarine Freshwater Sources Along the Puerto Rican Coastline,
W82-01349 3B

FEIGENBAUM, S.
Utilization Efficiency of Nitrogen from Sewage Effluent and Fertilizer Applied to Corn Plants Growing in a Clay Soil,
W82-01515 3C

FEIGIN, A.
Utilization Efficiency of Nitrogen from Sewage Effluent and Fertilizer Applied to Corn Plants Growing in a Clay Soil,
W82-01515 3C

FERGUSON, B. K.
Erosion and Sedimentation Control in Regional and Site Planning,
W82-01552 4D

FERRARA, R. A.
Dynamic Nutrient Cycle Model for Waste Stabilization Ponds,
W82-01541 5D

FEURER, J.
Preliminary Report of Stream Sampling for Acidification Studies 1980,
W82-01453 5A

FICK, G. W.
Simulation of Daily Weather Data Using Theoretical Probability Distributions,
W82-01526 2B

FIELD, R.
Urban Runoff and Combined Sewer Overflow,
W82-01254 5B

FIGURA, P.
Determination of Labilities of Soluble Trace Metal Species in Aqueous Environmental Samples by Anodic Stripping Voltammetry and Chelex Column and Batch Methods,
W82-01229 5A

FITZGIBBON, J. E.
Snowmelt Prediction in a Subarctic Drainage Area,
W82-01571 2C

FOGG, T. R.
Mercury and Zinc in the Sediments of Seneca Lake, Seneca River, and Keuka Outlet, New York,
W82-01151 5B

FONG, M.
Anaerobic Carbon Filter for Degradation of Phenols,
W82-01454 5D

FORE, C. S.
Radioactive Wastes,
W82-01268 5D

FORGE, P.
Data on the Stagnant Ponds of the Savannah of Lamto (Ivory Coast) (Donnees sur les Milieux Limniques Stagnants des Savanes de Lamto (Cote d'Ivoire)),
W82-01357 2H

FORSTER, R.
The Application of Mutagenicity Testing to Drinking Water,
W82-01487 5A

FOSTER, G. R.
Concentrated Flow Relationships,
W82-01409 2J

Sediment Transport Capacity of Overland Flow,
W82-01408 2J

FOWLER, E. B.
Studies on Unsaturated Zone Hydrology and Radionuclide Migration at a Shallow-Land Burial Site,
W82-01172 5B

FRADKIN, L. J.
Identification of the Wairakei Geothermal System,
W82-01312 2F

On Identification and Validation of Some Geothermal Models,
W82-01467 6A

FRANK, R.
Organochlorine Insecticides and PCB in Surficial Sediments of Lake Michigan (1975),
W82-01190 5A

PCB Residues in Bottom Sediments Collected From the Bay of Quinte, Lake Ontario 1972-1973,
W82-01155 5B

FRANK, U.
Rapid Methods of Chemical Analysis Used in Emergency Response Mobile Laboratory Activities,
W82-01431 5A

FRASER, A. S.
Changes in Lake Ontario Total Phosphorus Concentrations, 1976-1978,
W82-01126 2H

FRASER, D. J.
Persistence of Pseudomonas Aeruginosa in Chlorinated Swimming Pools,
W82-01124 5A

FREA, J. I.
Sediment Distribution of Methanogenic Bacteria in Lake Erie and Cleveland Harbor,
W82-01233 2H

FREEDMAN, S. D.
Urban Runoff and Combined Sewer Overflow,
W82-01254 5B

FREESTONE, F. J.
Comparative Evaluation of Processes for the Treatment of Concentrated Wastewaters at Uncontrolled Hazardous Waste Sites,
W82-01430 5D

FREIBERG, J. E.
Oxidation of SO2 in Aqueous Droplets: Mass Transport Limitation in Laboratory Studies and the Ambient Atmosphere,
W82-01470 2K

FRENKEL, H.
Determination of Solution Electrical Conductivity from Bulk Soil Electrical Conductivity Measurements by the Four-Electrode Method,
W82-01458 2G

FRIND, E. O.
Carbon 14 Dating of Groundwater in Confined Aquifers: Implications of Aquitard Diffusion,
W82-01464 2F

FRITZ, E. S.
Cooling Water Intake Screening Devices Used to Reduce Entrainment and Impingement,
W82-01442 8I

FRITZ, P.
Origin, Age and Movement of Pore Water in Agrillaceous Quaternary Deposits at Four Sites in Southwestern Ontario,
W82-01321 2F

FRY, D. L.
Zooplankton Abundance and Diversity in Central Florida Grass Carp Ponds,
W82-01520 2H

FRY, W. E.
Simulation of Daily Weather Data Using Theoretical Probability Distributions,
W82-01526 2B

FUGGLE, R. W.
Treatment of Pulp and Papermill Wastewaters and the Use of the Oxygen Activated Sludge System,
W82-01594 5D

FULLER, W. H.
The Movement of Salts from Soils Following Heavy Application of Feedlot Wastes,
W82-01132 5B

FULTON, J. M.
Estimating Evapotranspiration from Irrigated Crops in Southwestern Ontario,
W82-01116 2D

FUNKE, J. W.
A Look at Some Water Reclamation Plants in Southern Africa,
W82-01352 5D

FURTADO, J. I.
Physico-Chemistry, Destratification and Nutrient Budget of a Lowland Eutrophicated Malaysian Reservoir and Its Limnological Implications,
W82-01360 2H

FYFE, W. S.
Ferromanganese Nodules from Lake Ontario (Bay of Quinte): Minor Element Geochemistry,
W82-01143 2H

GARCIA, O.
A Comparison of Two Satellite Rainfall Estimates for GATE,
W82-01533 7B

GARDNER, W. S.
Release of Phosphorus by Certain Benthic Invertebrates,
W82-01502 2H

GARNETT, P. H.
Thoughts on the Need to Control Discharges to Estuarial and Coastal Waters,
W82-01384 6E

GEESEY, G. G.
Marine and Estuarine Pollution,
W82-01274 5C

GELDREICH, E. E.
Microbiology of Water,
W82-01284 5B

GEORGE, D. B.
Lagoons and Oxidation Ponds,
W82-01244 5D

GERAGHTY, J. J.
Evaluation of Hydrogeologic Conditions,
W82-01420 5G

GERRARD, E. D.
Bioassays - Procedures and Results,
W82-01277 5A

GERTLER, A. W.
Experimental Verification of the Linear Relationship Between IR Extinction and Liquid Water Content of Clouds,
W82-01525 7B

GHABOUSSI, J.
Liquefaction Analysis for Multidirectional Shaking,
W82-01169 8D

GHASSEMI, M.
Comparative Evaluation of Processes for the Treatment of Concentrated Wastewaters at Uncontrolled Hazardous Waste Sites,
W82-01430 5D

GIABBAI, M.
Organics,
W82-01239 5A

GIANESSI, L. P.
Analysis of National Water Pollution Control Policies 1. A National Network Model,
W82-01292 6A

Analysis of National Water Pollution Control Policies 2. Agricultural Sediment Control,
W82-01293 6A

GIBBS, R. J.
Sites of River-Derived Sedimentation in the Ocean,
W82-01332 7B

GILPIN, R. R.
Wave Formation and Heat Transfer at an Ice-Water Interface in the Presence of a Turbulent Flow,
W82-01128 2C

GLACCUM, R. A.
Site Assessment: Improving Confidence Levels with Surface Remote Sensing,
W82-01422 5G

GOLABI, K.
Extraction Timing and Economic Incentives for Geothermal Reservoir Management,
W82-01504 4B

GOLDBERG, D. E.
A Model for Simulation of Flow in Singular and Interconnected Channels,
W82-01210 2E

GOLIBER, P.
Case Studies on the Migration of Pollutants in Ground Water,
W82-01424 5B

GOODISON, B. E.
Compatibility of Canadian Snowfall and Snow Cover Data,
W82-01466 2C

GOODYEAR, C. P.
An Empirical Methodology for Estimating Entrainment Losses at Power Plants Sited on Estuaries,
W82-01173 6G

GOSH, S.
Anaerobic Processes,
W82-01245 5D

GOTO, S.
Periodic Operation for Desalination with Thermally Regenerable Ion-Exchange Resin. Dynamic Studies,
W82-01341 3A

GOULD, J. P.
Disinfection,
W82-01250 5D

GOVE, G. W.
Pulp and Paper Industry Effluent Management,
W82-01260 5D

GRABOW, N. A.
Relationship of the Raw Water Quality to Mutagens Detectable by the Ames Salmonella/Microsome Assay in a Drinking-Water Supply,
W82-01493 5A

GRABOW, W. O. K.
Relationship of the Raw Water Quality to Mutagens Detectable by the Ames Salmonella/Microsome Assay in a Drinking-Water Supply,
W82-01493 5A

GRAETZ, D. A.
Nitrate Reduction in an Organic Soil-Water System,
W82-01129 5B

GRAF, W. L.
Channel Instability in a Braided, Sand Bed River,
W82-01316 2J

GRAVES, W. C.
The Interaction of Treated Bleached Kraft Mill Effluent and Dissolved Oxygen Concentration on the Survival of the Developmental Stages of the Sheepshead Minnow (Cyprinodon Variegatus),
W82-01494 5C

GREEN, J. C.
A Water Rights Strategy for Mining Operations in the Western US,
W82-01587 6E

GREENE, S.
Formation of N-Nitrosodimethylamine During Treatment of Municipal Waste Water by Simulated Land Application,
W82-01343 5D

GREER, W. T.
Design and Construction of Shieldhall Sewage-Treatment Works, Glasgow,
W82-01385 5D

GREIS, N. P.
Regional Flood Frequency Estimation and Network Design,
W82-01294 2E

GREVE, P. A.
Methyl Bromide and Bromide-Ion in Drainage Water After Leaching of Glasshouse Soils,
W82-01492 5B

GRIFFIN, J. S.
The Inference of Gate Convective Rainfall from SMS-1 Imagery,
W82-01519 7B

GRIFFIN, R. A.
Acute Toxicity of Leachates from Coal Gasification and Liquefaction Solid Wastes to the Fathead Minnow, Pimephales Promelas,
W82-01108 5C

GRIFFITH, C. G.
The Inference of Gate Convective Rainfall from SMS-1 Imagery,
W82-01519 7B

GRISAK, G. E.
An Analytical Solution for Solute Transport Through Fractured Media with Matrix Diffusion,
W82-01179 2F

GRISSINGER, E. H.
Gully Erosion,
W82-01407 2J

GRIZZARD, T.
Hydraulic Properties of Fullerton Cherty Silt Loam,
W82-01561 2G

GROENEWOLD, J. C.
Dairy Wastes,
W82-01258 5D

GROSS, D. L.
Organochlorine Insecticides and PCB in Surficial Sediments of Lake Michigan (1975),
W82-01190 5A

GROSSE, R. N.
Effect of Investments in Water Supply and Sanitation on Health Status: A Threshold-Saturation Theory,
W82-01331 6B

GROVER, R.
A Comparison of Chemical and Cultural Control of Weeds in Irrigation Ditchbanks,
W82-01120 4A

GRUENFELD, M.
Rapid Methods of Chemical Analysis Used in Emergency Response Mobile Laboratory Activities,
W82-01431 5A

GUARISO, G.
Supply-Demand Coordination in Water Resources Management,
W82-01299 6C

GUILBAULT, G. G.
Determination of Nanogram Quantities of Mercury in Water with a Gold-Plated Piezoelectric Crystal Detector,
W82-01509 5A

GUITRON, A.
Hydroelectrical Model for Optimal Operation of a Single Multipurpose Reservoir,
W82-01329 6A

GULLIVER, J. S.
Unsteady One-Dimensional Settling of Suspended Sediment,
W82-01463 2J

GUPTA, S. K.
An Approach to Determining Pathways and Residence Time of Groundwaters: Dual Radiotracer Dating,
W82-01348 2F

HAAN, C. T.
A Verification Study on a Reservoir Sediment Deposition Model,
W82-01176 2J

HAAS, C. N.
Disinfection,
W82-01250 5D

HAINES, T. A.
Mercury in the Muscle Tissue of Fish from Three Northern Maine lakes,
W82-01459 5B

HAIRSTON, J. R.
Relationship Between Increased Crop Acreage and Nonpoint-Source Pollution: A Georgia Case Study,
W82-01550 5B

HAKONSON, T. E.
Factors Affecting Radionuclide Availability to Vegetables Grown at Los Alamos,
W82-01109 5B

HAMAKER, P.
Methyl Bromide and Bromide-Ion in Drainage Water After Leaching of Glasshouse Soils,
W82-01492 5B

HAMMITT, W. E.
Management Concerns for Swimming, Tubing, and Wading in the Great Smoky Mountains National Park,
W82-01475 6A

HANKE, S. H.
On Water Tariff Equalization Policies,
W82-01175 6C

HANSON, C. L.
Automatic Class-A Pan-Filling System,
W82-01326 7B

HARDY, G. M.
Comparison of Selective Media for the Enumeration and Identification of Fecal Streptococci from Natural Sources,
W82-01564 5A

HARGIS, D. R.
Results of Acidizing Water Wells in Arizona,
W82-01199 4B

HARLEMAN, D. R. F.
Dynamic Nutrient Cycle Model for Waste Stabilization Ponds,
W82-01541 5D

HARRISON, R. M.
The Physicochemical Speciation of Cd, Pb, Cu, Fe, and Mn in the Final Effluent of a Sewage Treatment Works and Its Impact on Speciation in the Receiving River,
W82-01498 5B

HARRISS, R. C.
The Role of Atmospheric Deposition in an Eastern U.S. Deciduous Forest,
W82-01491 5B

HARTLEY, P. E.
Deuterium/Hydrogen Ratios in Australian Rainfall,
W82-01325 2B

HARVEY, B. L.
Yield and Phenotypic Traits of Semidwarf and Normal-Statured Barley (Hordeum Vulgare L.) Genotypes Grown Under Differing Levels of Moisture Stress,
W82-01121 2I

HARVEY, W. T.
Advanced Wastewater Plant is Energy Saver,
W82-01177 5D

HAWKINS, B. E.
Seasonal Features of Zooplankton Assemblages in the Nearshore Area of Southeastern Lake Michigan,
W82-01192 2H

HAYDEN, C. M.
Determination of Moisture from NOAA Polar Orbiting Satellite Sounding Radiances,
W82-01535 2B

HAYES, J. T.
A Parametric Crop Water Use Model,
W82-01310 2I

HEATON, T. H. E.
Gaseous Nitrogen as Evidence for Denitrification in Groundwater,
W82-01485 2K

HECKMANN, R. A.
Postspawning Mortality of Rainbow Smelt in Western Lake Superior,
W82-01189 5C

HEIDTKE, T. M.
Modelling Effects of Remedial Programs to Aid Great Lakes Environmental Management,
W82-01146 5G

HEINEMANN, H. G.
A Verification Study on a Reservoir Sediment Deposition Model,
W82-01176 2J

HELLER, R.
Use of Excised Root Cultures as Bioindicators of Water Pollution (Utilisation Des Cultures de Racines Isolees Comme Test Biologique de Pollution des Eaux),
W82-01133 5A

HELMER, R.
Water-Quality Monitoring: A Global Approach,
W82-01339 7A

HEMSLEY, W. T.
Remedial Technique of Controlling and Treating Low Volume Leachate Discharge,
W82-01428 5G

HEMYARI, P.
Super Slurper Effects on Crust Strength, Water Retention, and Water Infiltration of Soils,
W82-01562 2G

HERBERT, I.
The Distribution of Mercury in the Sediments of the Plym Estuary,
W82-01390 5B

HERDENDORF, C. E.
Limnetic Larval Fish of the Maumee and Sandusky River Estuaries,
W82-01197 7A

HERGERT, G. W.
Effects of Dairy Manure on Phosphorus Concentrations and Losses in Tile Effluent,
W82-01479 5B

Phosphorus Concentration-Water Flow Interactions in Tile Effluent from Manured Land,
W82-01340 5B

HESS, C. T.
Geologic and Hydrologic Factors Controlling Radon-222 in Ground Water in Maine,
W82-01222 2F

Radon-222, In Potable Water Supplies of New England,
W82-01221 5B

HESSELBERG, R. J.
Influence of PCBs in Water on Uptake and Elimination of DDT and DDE by Lake Trout,
W82-01342 5C

HEUER, T.
Wastewater Collection,
W82-01251 5D

HILL, D. E.
Removal of Phosphorus from Waste Water by Soil Under Aerobic and Anaerobic Conditions,
W82-01344 5D

HILL, G.
Physical and Chemical Studies of Lago Tupe; A Central Amazonian Black Water 'Ria Lake',
W82-01381 2H

HILL, G. E.
A Balloonborne Instrument for the Measurement of Vertical Profiles of Supercooled Liquid Water Concentration,
W82-01524 7B

HILLARE-MARCEL, C.
018 Modelling of Freshwater Inputs in Baffin Bay and Canadian Arctic Coastal Waters,
W82-01590 2C

HILLMAN, R. M.
Land and Stream Salinity in Western Australia,
W82-01374 5B

HINRICHS, R.
Case Studies on the Migration of Pollutants in Ground Water,
W82-01424 5B

HIPEL, K. W.
Modeling Hydrologic Time Series from the Arctic,
W82-01198 2A

HIRATA, T.
Wave Formation and Heat Transfer at an Ice-Water Interface in the Presence of a Turbulent Flow,
W82-01128 2C

HITDLEBAUGH, J. A.
Operational Problems with Rotating Biological Contactors,
W82-01549 5D

HITE, J. C.
Economics,
W82-01304 5G

HJELMFELT, A. T.
Time Distribution of Clock Hour Rainfall,
W82-01402 2A

HO, M. H.
Determination of Nanogram Quantities of Mercury in Water with a Gold-Plated Piezoelectric Crystal Detector,
W82-01509 5A

HOLDRINET, M. V. H.
PCB Residues in Bottom Sediments Collected From the Bay of Quinte, Lake Ontario 1972-1973,
W82-01155 5B

HOLL, W.
Regeneration of Anion Exchange Resins by Calcium Carbonate and Carbon Dioxide,
W82-01484 5F

HOLMES, N. T. H.
Phytoplankton of Four Rivers, the Tyne, Wear, Tees and Swale,
W82-01376 2E

HOLT, R. F.
Soluble N and P Concentrations in Surface Runoff Water,
W82-01413 5B

HOOD, M. A.
The Effects of Organophosphorus Pesticides on Estuarine Ammonium Oxidizers,
W82-01567 5C

HOPKINS, L. D.
Generating Alternative Solutions for Dynamic Programming Models of Water Resources Problems,
W82-01450 6A

Methods for Generating Alternative Solutions to Water Resources Planning Problems,
W82-01449 6A

HOUCK, M. H.
Performance Evaluation of a Stochastic Optimization Model for Reservoir Design and Management with Explicit Reliability Criteria,
W82-01462 8A

HOUSMAN, J.
Preliminary Risk Evaluation for Suspected Hazardous Waste Disposal Sites in Connecticut,
W82-01417 5G

HOUSTON, K. L.
Hydraulic Model Study of Daule-Peripa Spillway and Outlet Works,
W82-01446 8A

HOWARD, A.
Geomorphology of the Colorado River in the Grand Canyon,
W82-01338 2J

HRUDEV, S. E.
Water Reclamation and Reuse,
W82-01252 3C

HUBBELL, J. W.
Detroit - Fresh Clean Water,
W82-01506 5D

HUCK, P. M.
Data Base Development for the Design of a Radium-226 Removal Process,
W82-01188 5D

HUDSON, M. C.
Factors Affecting the Fate of Heavy Metals in the Activated Sludge Process,
W82-01547 5D

HUISKES, A. H. L.
Holland's Eastern Scheldt Estuary Barrier Scheme: Some Ecological Considerations,
W82-01375 2L

HUNT, G. E.
Preliminary Design and Cost Estimates for Remedial Actions at Hazardous Waste Disposal Sites,
W82-01435 5G

HUNT, J. M.
Volatile C1-C7 Organic Compounds in Surface Sediments from Walvis Bay,
W82-01367 5B

HUPPERT, H. E.
Ice Blocks Melting Into a Salinity Gradient,
W82-01530 2C

HUSS, J. B.
Aluminum in Precipitation, Streams, and Shallow Groundwater in the New Jersey Pine Barrens,
W82-01297 5B

HUSSONG, D.
An Estuarine Agar Medium for Enumeration of Aerobic Heterotrophic Bacteria Associated with Water, Sediment, and Shellfish,
W82-01565 5A

HUTCHINS, S.
Groundwater Contamination by Trace Level Organics from a Rapid Infiltration Site,
W82-01496 5B

HYNES, H. B. N.
Some Effects of Agricultural Land Use on Stream Insect Communities,
W82-01159 5C

IBANEZ, F.
Immediate Detection of Heterogeneities in Continuous Multivariate, Oceanographic Recordings. Application to Time Series Analysis of Changes in the Bay of Villefranche sur Mer,
W82-01393 7A

IDSO, S. B.
Canopy Temperature as a Crop Water Stress Indicator,
W82-01106 2I

ILLANGASEKARE, T.
Design and Merit of a River-Aquifer Model for Optimal Use of Agricultural Water,
W82-01193 6A

Potential Use of a Stream-Aquifer Model for Management of a River Basin: Case of the South Platte River in Colorado,
W82-01301 6A

IRVINE, R. B.
Yield and Phenotypic Traits of Semidwarf and Normal-Statured Barley (Hordeum Vulgare L.) Genotypes Grown Under Differing Levels of Moisture Stress,
W82-01121 2I

IRVINE, R. L.
Fermentation Industry,
W82-01257 5D

ISAKA, H.
The Use of the Equilibrium Temperature to Establish the Heat Balance of a Water Surface (Sur l'Utilization de la Temperature d'Equilibre pour l'Etablissement du Bilan Thermique d'Un Plan d'Eau),
W82-01353 2H

JACKSON, F. H.
Interdisciplinary Environmental Analysis for Timber Sale Planning,
W82-01539 6A

JACKSON, L. A.
Chrysotile Asbestos Fibers in Drinking Water from Asbestos-Cement Pipe,
W82-01592 5B

JACKSON, R. D.
Canopy Temperature as a Crop Water Stress Indicator,
W82-01106 2I

JAIN, S. C.
River Bed Aggradation Due to Overloading,
W82-01486 2J

JAMEEL, H.
New Opportunities for In-Plant Reduction of Pollutants Through Process Changes,
W82-01559 5G

JAMES, S. C.
Bench Scale Assessment of Technologies for Contaminated Ground Water Treatment,
W82-01433 5G

JANARDAN, K. G.
Abundance of Organic Compounds in Water,
W82-01162 5A

JARRETT, R. D.
Debris Flows in Small Mountain Stream Channels of Colorado and Their Hydrologic Implications,
W82-01597 2E

JARVIS, R. S.
Drainage Network Structure and the Diameter-Magnitude Relation,
W82-01308 2A

JAYANGOUDAR, I.
Hydrobiological Studies on the Ajwa Reservoir, the Source of Raw Water Supply to the Baroda Water Works,
W82-01364 2H

JEFFREE, R. A.
Mining Pollution and the Diet of the Purple-Striped Gudgeon Mogurnda Mogurnda Richardson (Eleotridae) in the Finniss River, Northern Territory, Australia,
W82-01366 5C

JENKINS, D.
Alterations in the BOD Procedure for the 15th Edition of 'Standard Methods for the Examination of Water and Wastewater',
W82-01186 5A

JENKINS, T. F.
Vegetation Selection and Management for Overland Flow Systems,
W82-01500 5E

JERGER, D. E.
Anaerobic Processes,
W82-01245 5D

JOB, S. V.
Diurnal, Depth-Wise, and Seasonal Changes of Physico-Chemical Factors in Sathiar Reservoir,
W82-01372 2H

JOHNSON, A. H.
Aluminum in Precipitation, Streams, and Shallow Groundwater in the New Jersey Pine Barrens,
W82-01297 5B

JOHNSON, B. T.
Laboratory Procedure for Estimating Residue Dynamics of Xenobiotic Contaminants in a Freshwater Food Chain,
W82-01443 5B

JOHNSON, D. M.
An Index of Arizona Summer Rainfall Developed Through Eigenvector Analysis,
W82-01528 2B

JOHNSON, M. G.
Modelling Effects of Remedial Programs to Aid Great Lakes Environmental Management,
W82-01146 5G

JOHNSON, S. M.
Application of Capillary Gas Chromatography Mass Spectrometry/Computer Techniques to Synoptic Survey of Organic Material in Bed Sediment,
W82-01573 5A

JOLLEY, R. L.
Concentrating Organics in Water for Biological Testing,
W82-01591 5A

JONAS, T. D.
Year-to-Year Changes in the Salinity of the Eastern English Channel, 1948-1973: A Budget,
W82-01399 2A

JONES, R. D.
The Effects of Organophosphorus Pesticides on Estuarine Ammonium Oxidizers,
W82-01567 5C

JORGENSEN, D. G.
Geohydrologic Models of the Houston District, Texas,
W82-01335 2F

JOSEPH, J. B.
Artificial Groundwater Recharge,
W82-01110 4B

JOSHI, S. R.
Historical Changes and Relationship to Internal Loading of Sediment Phosphorus Forms in Hypertrophic Prairie Lakes,
W82-01516 2H

JUDE, D. J.
Evidence of Natural Reproduction by Planted Lake Trout in Lake Michigan,
W82-01194 8I

JUDKINS, J. F. JR.
Textile Wastes,
W82-01259 5D

JURINAK, J. J.
A Combined Salt Transport-Chemical Equilibrium Model for Calcareous and Cypsiferous Soils,
W82-01230 5B

KANAREK, M. S.
Chrysotile Asbestos Fibers in Drinking Water from Asbestos-Cement Pipe,
W82-01592 5B

KANNAN, V.
Diurnal, Depth-Wise, and Seasonal Changes of Physico-Chemical Factors in Sathiar Reservoir,
W82-01372 2H

KAPULER, I.
A Numerical Solution for the Movement of an Interface in a Layered Coastal Aquifer,
W82-01327 2F

KASSAKHIAN, G. H.
Data Base Development for the Design of a Radium-226 Removal Process,
W82-01188 5D

KEAN, W. F.
Monitoring Ground-Water Contamination at a Fly Ash Disposal Site Using Surface Electrical Resistivity Methods,
W82-01218 5B

Monitoring Leachate in Ground Water by Corrected Resistivity Methods,
W82-01219 5A

KELLEHER, D. L.
Investigation of Volatile Organics Removal,
W82-01490 5F

KELLER, W.
A Classification and Description of Some Northeastern Ontario Lakes Influenced by Acid Precipitation,
W82-01145 5B

KENDALL, B. M.
Multifrequency Radiometer Detection of Submarine Freshwater Sources Along the Puerto Rican Coastline,
W82-01349 3B

KENNEDY, C. W.
Effects of Atmospheric Precipitation Additions on Phytoplankton Photosynthesis in Lake Michigan Water Samples,
W82-01196 2H

KEYS, C. H.
The Effect of Snow Trapping and Cropping Sequence on Moisture Conservation and Utilization in West-Central Saskatchewan,
W82-01117 3F

KHAN, M. A.
Comparative Limnology of Nine Lakes of Jammu and Kashmir Himalayas,
W82-01361 2H

KHAN, N. A.
Atomic Absorption Spectrophotometric Studies of Cadmium and Zinc in Commercial Fertilisers, Soils and River Waters,
W82-01388 5B

KHERA, K. L.
Irrigation Needs and Yield of Rice on a Sandy-Loam Soil as Affected by Continuous and Intermittent Submergence,
W82-01382 3F

KIEHLING, B.
Regeneration of Anion Exchange Resins by Calcium Carbonate and Carbon Dioxide,
W82-01484 5F

KIM, C. S.
Love Canal: Chemical Contamination and Migration,
W82-01436 5B

KIRKLAND, K. J.
The Effect of Snow Trapping and Cropping Sequence on Moisture Conservation and Utilization in West-Central Saskatchewan,
W82-01117 3F

KISSEL, D. E.
Nitrate Production, Uptake, and Leaching,
W82-01411 5B

KLAPWIJK, A.
Effect of Copper on Nitrification in Activated Sludge,
W82-01497 5C

KLAUSNER, S. D.
Effects of Dairy Manure on Phosphorus Concentrations and Losses in Tile Effluent,
W82-01479 5B

Phosphorus Concentration-Water Flow Interactions in Tile Effluent from Manured Land,
W82-01340 5B

KLEMETSON, S. L.
Biological Filters,
W82-01242 5D

KLINGER, S. A.
Evidence of Natural Reproduction by Planted Lake Trout in Lake Michigan,
W82-01194 8I

KNEEBONE, W. R.
Reclamation of Wastewater with a Soil-Turf Filter: I: Removal of Nitrogen,
W82-01101 5D

Reclamation of Wastewater with a Soil-Turf Filter: II: Removal of Phosphorus, Boron, Sodium and Chlorine,
W82-01102 5D

KNOCKE, W. R.
Electroplating and Cyanide Wastes,
W82-01266 5D

KOENIG, L. R.
Anomalous Snowfall Caused by Natural-Draft Cooling Towers,
W82-01512 2B

KOPPULA, S. D.
An Example of the Application of Statistical Techniques to Predict Lake Level Elevations,
W82-01111 6A

KORDIC, J. R.
Pipeline Friction Losses for Wastewater Sludges,
W82-01545 5D

KORVEN, H. C.
A Comparison of Chemical and Cultural Control of Weeds in Irrigation Ditchbanks,
W82-01120 4A

KOSTER, W. C.
Remedial Technique of Controlling and Treating Low Volume Leachate Discharge,
W82-01428 5G

KOTHARI, M. S.
Development of Upton Intake Works, River Severn Supply Scheme, With the Aid of a Model,
W82-01395 8B

KOVOOR, A.
Use of Excised Root Cultures as Bioindicators of Water Pollution (Utilisation Des Cultures de Racines Isolees Comme Test Biologique de Pollution des Eaux),
W82-01133 5A

KOWAL, N. E.
Health Effects Associated with Wastewater Treatment and Disposal,
W82-01255 5C

KRALJ, M.
Evaluation of the Polluted River Savinja with the Help of Macrophytes,
W82-01377 5C

KRONBERG, B. I.
Ferromanganese Nodules from Lake Ontario (Bay of Quinte): Minor Element Geochemistry,
W82-01143 2H

KRONFELD, J.
Uranium Isotopes as a Natural Tracer in the Waters of the Bet Shean-Harod Valleys, Israel,
W82-01328 2F

KROTHE, N. C.
Hydrochemical Facies in a Tertiary Basin in the Milligan Canyon Area, Southwest Montana,
W82-01481 2F

KRUP, M.
Dentrification,
W82-01246 5D

KUEBLER, B. W.
Computer Modeling of Los Angeles Water Resources,
W82-01168 6A

KUEHL, D. W.
Polychlorinated Biphenyls and Other Organic Chemical Residues in Fish from Major United States Watersheds Near the Great Lakes, 1978,
W82-01583 5A

KUFS, C.
Rating the Hazard Potential of Waste Disposal Facilities,
W82-01418 5G

KUIPER, L. K.
A Comparison of the Incomplete Cholesky-Conjugate Gradient Method with the Strongly Implicit Method as Applied to the Solution of Two-Dimensional Groundwater Flow Equations,
W82-01315 2F

KURTZ, J.
An Analysis of Acidic Precipitation in South-Central Ontario Using Air Parcel Trajectories,
W82-01513 5B

KUSHNER, D. J.
Strategies of Response to Copper, Cadmium, and Lead by a Blue-Green and a Green Alga,
W82-01598 5C

KWIATKOWSKI, R. E.
Regionalization of the Upper Great Lakes with Respect to Surveillance Eutrophication Data,
W82-01150 7A

A Survey of ATP Concentrations in Lake Ontario, 1975-1976,
W82-01144 2H

LAAK, R.
Denitrification of Blackwater with Greywater,
W82-01225 5D

LACKEY, S. L.
Design and Cost Comparison of Biological Nitrogen Removal Processes,
W82-01544 5D

LAL, D.
An Approach to Determining Pathways and Residence Time of Groundwaters: Dual Radiotracer Dating,
W82-01348 2F

LAMB, T. J.
Northfield Mountain Pumped Storage Project: Performance,
W82-01517 8A

LANCASTER, R. L.
Optimum Recycle and Reuse Cooling System Designs Using the BCT Process,
W82-01503 3E

LANE, L. J.
Concentrated Flow Relationships,
W82-01409 2J

LANGER, G.
Ice Nucleus Concentrations Measured During the 1975 Florida Area Cumulus Experiment (FACE),
W82-01522 7B

LANZA, G. R.
Substrate Associated Microfauna,
W82-01283 5C

LARSON, G. L.
Management Concerns for Swimming, Tubing, and Wading in the Great Smoky Mountains National Park,
W82-01475 6A

LARSON, R. J.
Stabilization/Solidification of Waste from Uncontrolled Disposal Sites,
W82-01432 5E

LAUBE, V. M.
Strategies of Response to Copper, Cadmium, and Lead by a Blue-Green and a Green Alga,
W82-01598 5C

LAWS, E. A.
Application of Nutrient-Saturated Growth Model to Phytoplankton Management in Freshwater Prawn (Macrobrachium Rosenbergii) Ponds in Hawaii,
W82-01483 2H

LAXEN, D. P. H.
The Physicochemical Speciation of Cd, Pb, Cu, Fe, and Mn in the Final Effluent of a Sewage Treatment Works and Its Impact on Speciation in the Receiving River,
W82-01498 5B

LEE, M. Y.
Mandatory or Voluntary Water Conservation: A Case Study of Iowa Communities During Drought,
W82-01553 3D

LEGGETT, D.
Formation of N-Nitrosodimethylamine During Treatment of Municipal Waste Water by Simulated Land Application,
W82-01343 5D

LEHMAN, W. F.
Irrigation Management of Colorado River Water with Increase in Salinity,
W82-01226 3C

LEMKE, A. E.
The Effects of Pollution on Freshwater Fish,
W82-01282 5C

LENTZ, J. J.
Apportionment of Net Recharge in Landfill Covering Layer into Separate Components of Vertical Leakage and Horizontal Seepage,
W82-01298 2G

LEONARD, E. N.
Polychlorinated Biphenyls and Other Organic Chemical Residues in Fish from Major United States Watersheds Near the Great Lakes, 1978,
W82-01583 5A

LEONARD, R. A.
Pesticide Concentrations in Agricultural Runoff: Available Data and an Approximation Formula,
W82-01414 5B

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LEPPARD, G. G.
Ferromanganese Nodules from Lake Ontario (Bay of Quinte): Minor Element Geochemistry,
W82-01143 2H

LESTER, J. N.
The Influence of Chemical Conditioning and Dewatering on the Distribution of Polychlorinated Biphenyls and Organochlorine Insecticides in Sewage Sludges,
W82-01387 5E

LEUTHART, C. A.
Metal Ion Concentrations Associated with Late Summer Sediments of the Ohio River,
W82-01300 5A

LEVESQUE-MADORE, C. S.
Infrared Spectroscopic Study of the Water-Soluble Fraction of Sewage Sludge-Soil Mixtures During Incubation,
W82-01130 5E

LEYDEN, D. E.
Preconcentration for Trace Element Determination in Aqueous Samples,
W82-01574 5A

LIKENS, G. E.
Recent Acidification of Precipitation in North America,
W82-01514 5B

LIMONI, H.
Utilization Efficiency of Nitrogen from Sewage Effluent and Fertilizer Applied to Corn Plants Growing in a Clay Soil,
W82-01515 3C

LIN, H.
Bacteria: Man's Allies in Water Pollution Control,
W82-01158 5D

LINDBERG, S. E.
The Role of Atmospheric Deposition in an Eastern U.S. Deciduous Forest,
W82-01491 5B

LINDSAY, A. H.
Trace Metal Mineral Equilibria in Lake Erie Sediments,
W82-01191 2H

LITCHFIELD, J. H.
Meat-, Fish-, and Poultry-Processing Wastes,
W82-01256 5D

LITTLE, L. W.
Bioassays - Procedures and Results,
W82-01277 5A

LOH, I. C.
Predicting Stream Salinity Changes in South-Western Australia,
W82-01350 6A

LUDWIGS, R. S.
Yield Verification of a Dolomite Aquifer in Northeast Illinois,
W82-01334 2F

LUND, L. J.
Infrared Spectroscopic Study of the Water-Soluble Fraction of Sewage Sludge-Soil Mixtures During Incubation,
W82-01130 5E

Nitrogen Balances for an Effluent Irrigation Area,
W82-01478 3C

LUTHIN, J. N.
Irrigation Management of Colorado River Water with Increase in Salinity,
W82-01226 3C

LUTHY, R. G.
Chemical Equilibria in Split-Treatment Softening of Water,
W82-01165 5F

LUXMOORE, R. J.
Hydraulic Properties of Fullerton Cherty Silt Loam,
W82-01561 2G

MACIOROWSKI, A. F.
Bioassays - Procedures and Results,
W82-01277 5A

MACKINNON, M.
A Survey of ATP Concentrations in Lake Ontario, 1975-1976,
W82-01144 2H

MACLEOD, D. A.
Factors Affecting the Chemistry of Precipitation and River Water in an Upland Catchment,
W82-01322 2K

MAEYER-CLEEMPOEL, S. DE
Faecal Pollution of Belgian Coastal Water,
W82-01373 5A

MAHAJAN, R. K.
Note on Probability Approach to Study the Occurrence of Rainfall at Hyderabad,
W82-01380 2B

MAIDMENT, D.
Supply-Demand Coordination in Water Resources Management,
W82-01299 6C

MALCYZK, J. M.
Release of Phosphorus by Certain Benthic Invertebrates,
W82-01502 2H

MALE, L. M.
Stream Nutrient Levels and Proximity of Agricultural and Forest Land to Streams: Some Relationships,
W82-01554 5B

MALECHA, S. R.
Application of Nutrient-Saturated Growth Model to Phytoplankton Management in Freshwater Prawn (Macrobrachium Rosenbergii) Ponds in Hawaii,
W82-01483 2H

MALONE, P. G.
Stabilization/Solidification of Waste from Uncontrolled Disposal Sites,
W82-01432 5E

MANDAL, L. N.
Effect of Different Levels of Water Salinity on the Decomposition of Organic Manures in a Brackish Water Fish Pond Soil,
W82-01363 3C

MANDEL, R. M.
Use of the Contingency Fund at Stringfellow Hazardous Waste Disposal Site,
W82-01416 5G

MANDL, C. E.
A Survey of Mathematical Optimization Models and Algorithms for Designing and Extending Irrigation and Wastewater Networks,
W82-01296 6A

MANNING, P. J.
Middlesex County Sewerage Authority V. National Sea Clammers Association: Implied Private Rights of Action for Damages under the Federal Water Pollution Control Act Amendments of 1972,
W82-01455 6E

MARGREY, S. L.
The Interaction of Treated Bleached Kraft Mill Effluent and Dissolved Oxygen Concentration on the Survival of the Developmental Stages of the Sheepshead Minnow (Cyprinodon Variegatus),
W82-01494 5C

MARRY, J. R.
Advanced Wastewater Plant is Energy Saver,
W82-01177 5D

MARSH, T. J.
Year-to-Year Changes in the Salinity of the Eastern English Channel, 1948-1973: A Budget,
W82-01399 2A

MARTEL, C. J.
Vegetation Selection and Management for Overland Flow Systems,
W82-01500 5E

MARTIN, D. L.
Effects of Water and Nitrogen Management on Nitrate Leaching Loss from Sands,
W82-01581 5B

MARTIN, S. C.
Aquatic Sediments,
W82-01279 5B

MARTINCIC, A.
Evaluation of the Polluted River Savinja with the Help of Macrophytes,
W82-01377 5C

MASON, R. J.
Public Concerns and PLUARG: Selected findings and Discussion,
W82-01137 5G

MATHER, J. R.
Using Computed Stream Flow in Watershed Analysis,
W82-01538 2A

MATHIS, B. J.
Sediment Oxygen Demand and Its Effect on Dissolved Oxygen in a Cutoff Meander of the Kaskaskia River,
W82-01448 4A

MATIS, S.
Trace Metal Mineral Equilibria in Lake Erie Sediments,
W82-01191 2H

MATISOFF, G.
Trace Metal Mineral Equilibria in Lake Erie Sediments,
W82-01191 2H

MATSUDA, H.
Periodic Operation for Desalination with Thermally Regenerable Ion-Exchange Resin. Dynamic Studies,
W82-01341 3A

MATTHIAS, J. A.
Electro-Osmosis Chemistry and Water Quality,
W82-01518 5E

MAUN, M. A.
A Quantitative Study of Shoreline Marsh Communities Along Lake Huron in Ontario,
W82-01122 2H

MAY, T. W.
Cadmium, Lead, Mercury, Arsenic, and Selenium Concentrations in Freshwater Fish, 1976-77-National Pesticide Monitoring Program,
W82-01584 5B

MAYBERRY, K. S.
Irrigation Management of Colorado River Water with Increase in Salinity,
W82-01226 3C

MAYS, L. W.
Optimal Risk-Based Design of Flood Levee Systems,
W82-01313 8B

Risk Models for Flood Levee Design,
W82-01307 8A

MCCANN, S. B.
The Behavior of a Polar Ice-Dammed Lake, Ellesmere Island, N.W.T., Canada,
W82-01511 2C

MCCARTY, P. L.
Organics in Water - An Engineering Challenge,
W82-01540 5F

MCCAULEY, C. A.
Results of Acidizing Water Wells in Arizona,
W82-01199 4B

MCCOOL, S. F.
Preferences for Allocating River Recreation Use,
W82-01181 6D

MCCUEN, R. H.
Statistical Analysis of the Brooks-Corey and the Green-Ampt Parameters Across Soil Textures,
W82-01107 2G

MCCUTCHEON, S. C.
Vertical Velocity Profiles in Stratified Flows,
W82-01171 8B

MCDERMOTT, G. N.
Alterations in the BOD Procedure for the 15th Edition of 'Standard Methods for the Examination of Water and Wastewater',
W82-01186 5A

MCDOWELL, L. L.
Estimating Soluble (PO4-P) and Labile Phosphorus in Runoff from Croplands,
W82-01412 5B

MCDUFFIE, B.
Determination of Labilities of Soluble Trace Metal Species in Aqueous Environmental Samples by Anodic Stripping Voltammetry and Chelex Column and Batch Methods,
W82-01229 5A

MCGINNIS, D. F. JR.
Effect of Grain Size and Snowpack Water Equivalence on Visible and Near-Infrared Satellite Observations of Snow,
W82-01311 7B

MCINTYRE, A. E.
The Influence of Chemical Conditioning and Dewatering on the Distribution of Polychlorinated Biphenyls and Organochlorine Insecticides in Sewage Sludges,
W82-01387 5E

MCKENZIE, C. N.
Strategies of Response to Copper, Cadmium, and Lead by a Blue-Green and a Green Alga,
W82-01598 5C

MCKINLEY, J. W.
Some Factors Affecting the Determination of Particulate Carbon and Nitrogen in River Water,
W82-01532 5A

MCKINNEY, G. L.
Cadmium, Lead, Mercury, Arsenic, and Selenium Concentrations in Freshwater Fish, 1976-77-National Pesticide Monitoring Program,
W82-01584 5B

MCLACHLAN, C. N. S.
U.V.-DOC Characterization of Pulp and Paper Bleach Effluents,
W82-01495 5A

MCLAUGHLIN, D. B.
Mapping Contaminated Soil Plumes by Kriging,
W82-01423 5G

MCLEOD, A. I.
Modeling Hydrologic Time Series from the Arctic,
W82-01198 2A

MCNABB, A.
On Identification and Validation of Some Geothermal Models,
W82-01467 6A

MCVEY, J.
Compelled Self-Incrimination and the Federal Water Pollution Control Act,
W82-01600 6E

MEARNS, A. J.
Marine and Estuarine Pollution,
W82-01274 5C

MEDINE, A. J.
Eutrophication,
W82-01271 2H

MEDLAR, S.
The Significance of Snowmelt on Water Supplies in the Northeast,
W82-01488 2A

MELEAR, E. L.
Physical and Chemical Methods,
W82-01241 5D

MENSER, H. A.
Effects of Sanitary Landfill Leachage on Some Soil Chemical Properties,
W82-01480 5E

MENZEL, R. G.
The Depth of Rainfall-Runoff-Soil Interaction as Determined by P32,
W82-01318 5B

Enrichment Ratios for Water Quality Modeling,
W82-01410 2J

The Release of Soil Phosphorous to Runoff in Relation to the Kinetics of Desorption,
W82-01477 5B

MERCER, J. W.
Computer Modeling and Ground-Water Protection,
W82-01336 2F

MERRIAM, R. A.
Suspended Sediment Production from Forested Watersheds on Oahu, Hawaii,
W82-01531 2J

MEYER, J.
Microbiology: Detection, Occurrence, and Removal of Viruses,
W82-01290 5A

MEYERS, P. A.
Fatty Acid and Hydrocarbon Content of Settling Sediments in Lake Michigan,
W82-01154 2H

Petroleum Hydrocarbons in Sediments of Saginaw Bay, Lake Huron,
W82-01141 5A

MEYERS, T. E.
Stabilization/Solidification of Waste from Uncontrolled Disposal Sites,
W82-01432 5E

MICHALSON, E. L.
Soil Erosion Control in Idaho's Cow Creek Watershed: An Economic Analysis,
W82-01556 4D

MIDDLEBROOKS, C. H.
Energy Requirement for Small Wastewater Treatment Systems,
W82-01185 5D

MIDDLEBROOKS, E. J.
Energy Requirement for Small Wastewater Treatment Systems,
W82-01185 5D

MILLER, R. D.
Operational Problems with Rotating Biological Contactors,
W82-01549 5D

MILLHAM, C. B.
Hydropower Losses from Navigation in the Snake-Columbia Rivers: 1978-79,
W82-01139 6D

MILLWARD, G. E.
The Distribution of Mercury in the Sediments of the Plym Estuary,
W82-01390 5B

MITCHELL, S. F.
A Bioassay Study of Effects of Zooplankton, Iron and NTA on the Phytoplankton Productivity of a Marl Lake,
W82-01157 2H

MOFFA, P. E.
Urban Runoff and Combined Sewer Overflow,
W82-01254 5B

MOFFETT, D.
Data Base Development for the Design of a Radium-226 Removal Process,
W82-01188 5D

MOHAMMAD, M-B. M.
A Hydrobiological Survey of a Polluted Canal,
W82-01356 5C

MOLL, R. A.
Phytoplankton Productivity and Standing Crop in the Vicinity of the Lake Huron-Saginaw Bay Front,
W82-01164 2H

MOLZ, F. J.
Thermal Energy Storage in a Confined Aquifer: Second Cycle,
W82-01473 4B

MOODY, J. L.
Comparison of First-Order Error Analysis and Monte Carlo Simulation in Time-Dependent Lake Eutrophication Models,
W82-01460 2H

MOORE, S. F.
Mapping Contaminated Soil Plumes by Kriging,
W82-01423 5G

MOREL-SEYTOUX, H. J.
Design and Merit of a River-Aquifer Model for Optimal Use of Agricultural Water,
W82-01193 6A

Potential Use of a Stream-Aquifer Model for Management of a River Basin: Case of the South Platte River in Colorado,
W82-01301 6A

MORGAN, C. H.
Preliminary Design and Cost Estimates for Remedial Actions at Hazardous Waste Disposal Sites,
W82-01435 5G

MORLEY, B. M.
Lidar Determinations of Atmospheric Ice Crystal Layers at South Pole During Clear-Sky Precipitation,
W82-01529 2C

MUDROCH, A.
Biogeochemical Investigation of Big Creek Marsh, Lake Erie, Ontario,
W82-01163 2H

MULBARGER, M. C.
Pipeline Friction Losses for Wastewater Sludges,
W82-01545 5D

MUNTER, J. A.
Seasonal Reversals of Groundwater Flow Around Lakes and the Relevance to Stagnation Points and Lake Budgets,
W82-01103 2F

MURARKA, I. P.
Entrainment and Impingement in Power Plant Cooling Systems,
W82-01276 6G

MURPHREE, C. E.
Modeling Erosion and Sediment Yield from Flatland Watersheds,
W82-01406 2J

MURPHY, C. B. JR.
Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements,
W82-01278 5C

MURPHY, K. L.
Design and Cost Comparison of Biological Nitrogen Removal Processes,
W82-01544 5D

MURRAY, J. P.
Groundwater Contamination by Sanitary Landfill Leachate and Domestic Wastewater in Carbonate Terrain: Principal Source Diagnosis, Chemical Transport Characteristics and Design Implications,
W82-01223 5B

MUSSER, W. N.
Relationship Between Increased Crop Acreage and Nonpoint-Source Pollution: A Georgia Case Study,
W82-01550 5B

MUTCHLER, C. K.
Modeling Erosion and Sediment Yield from Flatland Watersheds,
W82-01406 2J

NADLER, A.
Determination of Solution Electrical Conductivity from Bulk Soil Electrical Conductivity Measurements by the Four-Electrode Method,
W82-01458 2G

NALEPA, T. F.
Release of Phosphorus by Certain Benthic Invertebrates,
W82-01502 2H

NARANG, R.
Love Canal: Chemical Contamination and Migration,
W82-01436 5B

NASS, H. G.
Comparison of Tests Characterizing Varieties of Barley and Wheat for Moisture Stress Resistance,
W82-01114 2I

NEIBLING, W. H.
Sediment Transport Capacity of Overland Flow,
W82-01408 2J

NEILSEN, G. H.
Nonpoint N Runoff from Agricultural Watersheds into the Great Lakes,
W82-01148 5B

NELSON, C. O.
Nitrogen Balances for an Effluent Irrigation Area,
W82-01478 3C

NELSON, P. O.
Factors Affecting the Fate of Heavy Metals in the Activated Sludge Process,
W82-01547 5D

NELSON, R. F.
High-Solubility Gas Flotation,
W82-01184 5D

NELSON, W. R.
Ecology of Larval Fishes in Lake Oahe, South Dakota,
W82-01444 6G

NEWBOLD, J. D.
Effects of Logging on Macroinvertebrates in Streams with and Without Buffer Strips,
W82-01227 5C

NICHOLSON, L. W.
Influence of PCBs in Water on Uptake and Elimination of DDT and DDE by Lake Trout,
W82-01342 5C

NIEDERLEHNER, B. R.
Effects of Pollution on Freshwater Invertebrates,
W82-01280 5C

NIKU, S.
Stability of Activated Sludge Processes Based on Statistical Measures,
W82-01489 5D

NOFZIGER, D. L.
Super Slurper Effects on Crust Strength, Water Retention, and Water Infiltration of Soils,
W82-01562 2G

NOLTE, B. H.
Water Management Model Evaluation for North Central Ohio,
W82-01536 4A

NOMANI, A. A.
Atomic Absorption Spectrophotometric Studies of Cadmium and Zinc in Commercial Fertilisers, Soils and River Waters,
W82-01388 5B

NORMAN, D.
Organics,
W82-01239 5A

NORTON, S. A.
Geologic and Hydrologic Factors Controlling Radon-222 in Ground Water in Maine,
W82-01222 2F

Radon-222, In Potable Water Supplies of New England,
W82-01221 5B

O'BANNON, C. E.
Electro-Osmosis Chemistry and Water Quality,
W82-01518 5E

O'KEEFE, P.
Love Canal: Chemical Contamination and Migration,
W82-01436 5B

O'ROURKE, P. A.
A Parametric Crop Water Use Model,
W82-01310 2I

OHLE, W.
Mineral Impact of Lakes as Background for Their Biogenic Dynamics,
W82-01359 2H

OLEM, H.
Coal and Coal Mine Drainage,
W82-01261 5G

Power Industry Wastes,
W82-01265 5B

OMAN, G. J.
Plume Development Using Lagrangian Marker Method,
W82-01182 5B

OMERNIK, J. M.
Stream Nutrient Levels and Proximity of Agricultural and Forest Land to Streams: Some Relationships,
W82-01554 5B

ONSTAD, C. A.
Residue and Tillage Effects on SCS Runoff Curve Numbers,
W82-01404 4D

ORNDORFF, S. A.
Effect of Kepone on Estuarine Microbial Activity,
W82-01231 5C

OSBORNE, J. A.
Zooplankton Abundance and Diversity in Central Florida Grass Carp Ponds,
W82-01520 2H

OSHEKA, J. W.
Bench Scale Assessment of Technologies for Contaminated Ground Water Treatment,
W82-01433 5G

OSHIDA, P. S.
Marine and Estuarine Pollution,
W82-01274 5C

OSTEEN, C.
Managing Land to Meet Water Quality Goals,
W82-01557 4D

OTIS, R. J.
Onsite Alternatives for Treatment and Disposal,
W82-01248 5D

OWENS, E. M.
Urban Runoff and Combined Sewer Overflow,
W82-01254 5B

PAGE, A. L.
Nitrogen Balances for an Effluent Irrigation Area,
W82-01478 3C

PAGE, P.
018 Modelling of Freshwater Inputs in Baffin Bay and Canadian Arctic Coastal Waters,
W82-01590 2C

PAGEL, J. E.
Comparison of Selective Media for the Enumeration and Identification of Fecal Streptococci from Natural Sources,
W82-01564 5A

PAHREN, H. R.
Health Effects Associated with Wastewater Treatment and Disposal,
W82-01255 5C

PAIGE, S.
Rating the Hazard Potential of Waste Disposal Facilities,
W82-01418 5G

PAIGE, S. F.
Preliminary Design and Cost Estimates for Remedial Actions at Hazardous Waste Disposal Sites,
W82-01435 5G

PAJAK, A. P.
Bench Scale Assessment of Technologies for Contaminated Ground Water Treatment,
W82-01433 5G

PALAZZO, A. J.
Vegetation Selection and Management for Overland Flow Systems,
W82-01500 5E

PAREKH, B. S.
High Temperature Ultrafiltration with Kynar Poly(Vinylidene Fluoride) Membranes,
W82-01566 5D

PARESE, M. A.
Denitrification of Blackwater with Greywater,
W82-01225 5D

PARKER, B. C.
Evaluation of Ultraviolet Spectrophotometric Determination of Nitrate-Nitrogen in Glacial Snow, Firn and Ice,
W82-01572 5A

PARKER, J. I.
Effects of Atmospheric Precipitation Additions on Phytoplankton Photosynthesis in Lake Michigan Water Samples,
W82-01196 2H

PARKER, W. F.
A Note on the Use of Membrane Faecal Coliform Medium for Enhancing Resolution and Accuracy When Enumerating a Small Plaquing Coliphage,
W82-01507 5A

PARR, A. D.
Thermal Energy Storage in a Confined Aquifer: Second Cycle,
W82-01473 4B

PARTENHEIMER, E. J.
Economic Impacts of Erosion and Sedimentation Control Plans: Case Studies of Pennsylvania Dairy Farms,
W82-01134 4D

PARTON, W. J.
Impact of Management Practices on the Tallgrass Prairie,
W82-01580 4A

PATI, S.
Observations on the Hydrography and Inshore Plankton of the Bay of Bengal off Balasore,
W82-01362 2A

PATRINOS, A. A. N.
Weather Modification from Cooling Towers. A Test Based on the Distributional Properties of Rainfall,
W82-01527 2B

PATTERSON, M. R.
Hydraulic Properties of Fullerton Cherty Silt Loam,
W82-01561 2G

PAYMENT, P.
A Simple Low Cost Apparatus for Conditioning Large Volumes of Water for Virological Analysis,
W82-01123 5A

PEARSON, F.
Fixed Endpoint Alkalinity Determination,
W82-01187 7B

PEI, D.
Systems Analysis,
W82-01303 6A

PEIRCE, M.
Ferromanganese Nodules from Lake Ontario (Bay of Quinte): Minor Element Geochemistry,
W82-01143 2H

PENICKA, F.
Hypolimnion Flow Between the Central and Eastern Basins of Lake Erie During 1977 (Interbasin Hypolimnion Flows)
W82-01153 2H

PENSAERT, J.
The Crustacean Zooplankton of Mali (West Africa),
W82-01379 2H

PEPPER, I. L.
Reclamation of Wastewater with a Soil-Turf Filter: I: Removal of Nitrogen,
W82-01101 5D

Reclamation of Wastewater with a Soil-Turf Filter: II: Removal of Phosphorus, Boron, Sodium and Chlorine,
W82-01102 5D

PEREIRA, W. E.
Application of Capillary Gas Chromatography Mass Spectrometry/Computer Techniques to Synoptic Survey of Organic Material in Bed Sediment,
W82-01573 5A

PERKINS, H. F.
Relationship Between Increased Crop Acreage and Nonpoint-Source Pollution: A Georgia Case Study,
W82-01550 5B

PERROUX, K. M.
Hydrodynamic Dispersion During Constant Rate Absorption of Water by Soil,
W82-01174 2G

PERRY, B. H.
Effect of Investments in Water Supply and Sanitation on Health Status: A Threshold-Saturation Theory,
W82-01331 6B

PERRY, R.
The Influence of Chemical Conditioning and Dewatering on the Distribution of Polychlorinated Biphenyls and Organochlorine Insecticides in Sewage Sludges,
W82-01387 5E

PESKIN, H. M.
Analysis of National Water Pollution Control Policies 1. A National Network Model,
W82-01292 6A

Analysis of National Water Pollution Control Policies 2. Agricultural Sediment Control,
W82-01293 6A

PFEIFFER, M.
Preliminary Report of Stream Sampling for Acidification Studies 1980,
W82-01453 5A

PHILLIPS, R. B.
New Opportunities for In-Plant Reduction of Pollutants Through Process Changes,
W82-01559 5G

PICKENS, J. F.
An Analytical Solution for Solute Transport Through Fractured Media with Matrix Diffusion,
W82-01179 2F

PICKERING, Q. H.
The Effects of Pollution on Freshwater Fish,
W82-01282 5C

PIEST, R. F.
Gully Erosion,
W82-01407 2J

PINTER, P. J. JR.
Canopy Temperature as a Crop Water Stress Indicator,
W82-01106 2I

PIONKE, H. B.
Estimating Soluble (PO4-P) and Labile Phosphorus in Runoff from Croplands,
W82-01412 5B

PIPES, W. O.
Microbiology of Wastewater Treatment,
W82-01291 5D

PITBLADO, J. R.
A Classification and Description of Some Northeastern Ontario Lakes Influenced by Acid Precipitation,
W82-01145 5B

PITT JR, W. W.
Continuous Monitoring, Automated Analysis, and Sampling Procedures,
W82-01240 5A

PLAMER, C. J.
Prediction of Diffusion Coefficients from the Electrical Conductance of Soil,
W82-01224 2G

PLANK, V. G.
An Improved Method for Obtaining the Water Content Values of Ice Hydrometeors from Aircraft and Radar Data,
W82-01523 7B

POLCYN, D. S.
Inorganics,
W82-01238 5A

POLLARD, F.
Detroit - Fresh Clean Water,
W82-01506 5D

POLLARD, W. H.
Wave Climate and Potential Longshore Sediment Transport Patterns, Nottawasaga Bay, Ontario,
W82-01156 2J

POLZER, W. L.
Studies on Unsaturated Zone Hydrology and Radionuclide Migration at a Shallow-Land Burial Site,
W82-01172 5B

POPA, R.
Daily Optimization of Power Generation in Cascade Hydrosystems (A Stochastic Approach),
W82-01320 6A

PORCELLA, D. B.
Eutrophication,
W82-01271 2H

PORTIER, K. M.
A Stochastic Approach for Describing Convective-Dispersive Solute Transport in Saturated Porous Media,
W82-01461 5B

POSSIDENTO, M.
Preliminary Risk Evaluation for Suspected Hazardous Waste Disposal Sites in Connecticut,
W82-01417 5G

POWERS, W. F.
Comparison of First-Order Error Analysis and Monte Carlo Simulation in Time-Dependent Lake Eutrophication Models,
W82-01460 2H

PRAKASAM, B. S.
Dentrification,
W82-01246 5D

PRATT, G.
Polychlorinated Biphenyls and Other Organic Chemical Residues in Fish from Major United States Watersheds Near the Great Lakes, 1978,
W82-01583 5A

PRICE, R. I.
Scaling of Infiltration Behavior in Dissimilar Porous Materials,
W82-01105 2G

PRIHAR, S.S.
Irrigation Needs and Yield of Rice on a Sandy-Loam Soil as Affected by Continuous and Intermittent Submergence,
W82-01382 3F

PROKOPOVICH, N. P.
Discussion-Engineering Geology of Arid Areas,
W82-01568 4B

PRZYBYLA, J. M.
Demonstration Testing of Alum Recovery by Liquid Ion Exchange,
W82-01167 5D

QUIGLEY, M. A.
Freshwater Macroinvertebrates,
W82-01281 5C

Release of Phosphorus by Certain Benthic Invertebrates,
W82-01502 2H

QUINLIVAN, S.
Comparative Evaluation of Processes for the Treatment of Concentrated Wastewaters at Uncontrolled Hazardous Waste Sites,
W82-01430 5D

RAATS, P. A. C.
Hydrodynamic Dispersion During Constant Rate Absorption of Water by Soil,
W82-01174 2G

RAI, H.
Physical and Chemical Studies of Lago Tupe; A Central Amazonian Black Water 'Ria Lake',
W82-01381 2H

RAI, S. N.
A Mathematical Model of Water Table Fluctuation in a Semi-Infinite Aquifer Induced by Localized Transient Recharge,
W82-01319 2F

RAMKRISHNADAS, R.
Solid Wastes and Water Quality,
W82-01269 5B

RAMSEY, W. L.
Identification and Reclamation of Chromium Sludge Disposal Sites,
W82-01437 5E

RAO, A. V.
Note on Probability Approach to Study the Occurrence of Rainfall at Hyderabad,
W82-01380 2B

RAO, P. S. C.
A Stochastic Approach for Describing Convective-Dispersive Solute Transport in Saturated Porous Media,
W82-01461 5B

RAO, P. V.
A Stochastic Approach for Describing Convective-Dispersive Solute Transport in Saturated Porous Media,
W82-01461 5B

RAUSCH, D. L.
Sediment and Nutrient Trap Efficiency of a Small Flood-Detention Reservoir,
W82-01471 4A

A Verification Study on a Reservoir Sediment Deposition Model,
W82-01176 2J

RAWLS, W. J.
Residue and Tillage Effects on SCS Runoff Curve Numbers,
W82-01404 4D

Statistical Analysis of the Brooks-Corey and the Green-Ampt Parameters Across Soil Textures,
W82-01107 2G

REASONER, D. J.
Microbiology: Detection of Bacterial Pathogens and Their Occurrence,
W82-01288 5B

REDDY, K. R.
Nitrate Reduction in an Organic Soil-Water System,
W82-01129 5B

REDHEAD, A. A.
An Investigation Into the Effects of Thermal Movement in the Walls of Service Reservoirs,
W82-01396 8F

REED, J. F.
Relationship Between Increased Crop Acreage and Nonpoint-Source Pollution: A Georgia Case Study,
W82-01550 5B

REED, S. C.
Energy Requirement for Small Wastewater Treatment Systems,
W82-01185 5D

REGINATO, R. J.
Canopy Temperature as a Crop Water Stress Indicator,
W82-01106 2I

REID, J. M.
Factors Affecting the Chemistry of Precipitation and River Water in an Upland Catchment,
W82-01322 2K

REID, P. C.
Year-to-Year Changes in the Salinity of the Eastern English Channel, 1948-1973: A Budget,
W82-01399 2A

REISH, D. J.
Marine and Estuarine Pollution,
W82-01274 5C

REITER, G. A.
Use of the Contingency Fund at Stringfellow Hazardous Waste Disposal Site,
W82-01416 5G

REMETA, D. P.
Rapid Methods of Chemical Analysis Used in Emergency Response Mobile Laboratory Activities,
W82-01431 5A

RENARD, J. J.
New Opportunities for In-Plant Reduction of Pollutants Through Process Changes,
W82-01559 5G

REUTTER, J. M.
Limnetic Larval Fish of the Maumee and Sandusky River Estuaries,
W82-01197 7A

REYNOLDS, J. H.
Land Application of Municipal Wastewater,
W82-01253 5D

RICHARDS, A.
Love Canal: Chemical Contamination and Migration,
W82-01436 5B

RICHARDSON, H. H.
Residue and Tillage Effects on SCS Runoff Curve Numbers,
W82-01404 4D

RICHARDSON, L. B.
The Interaction of Treated Bleached Kraft Mill Effluent and Dissolved Oxygen Concentration on the Survival of the Developmental Stages of the Sheepshead Minnow (Cyprinodon Variegatus),
W82-01494 5C

RICHEZ, M.
Use of Excised Root Cultures as Bioindicators of Water Pollution (Utilisation Des Cultures de Racines Isolees Comme Test Biologique de Pollution des Eaux),
W82-01133 5A

RIJSTENBIL, J. W.
Chemical Control of Mussel Settlement in a Cooling Water System Using Acrolein,
W82-01501 5F

RINALDI, S.
Supply-Demand Coordination in Water Resources Management,
W82-01299 6C

RISSER, P. G.
Impact of Management Practices on the Tallgrass Prairie,
W82-01580 4A

ROAKE, A F.
Studies for Abatement of Pollution from Combined Sewer Overflows in Canada,
W82-01200 5G

ROBBINS, C. W.
A Combined Salt Transport-Chemical Equilibrium Model for Calcareous and Cypsiferous Soils,
W82-01230 5B

ROBBINS, J. A.
Petroleum Hydrocarbons in Sediments of Saginaw Bay, Lake Huron,
W82-01141 5A

ROBINSON, F. E.
Irrigation Management of Colorado River Water with Increase in Salinity,
W82-01226 3C

ROBINSON, G. G. C.
Collapsing Aphanizomenon Flos-Aquae Blooms: Possible Contributions of Photo-Oxidation, O2 Toxicity, and Cyanophages,
W82-01595 2H

ROBY, K. B.
Effects of Logging on Macroinvertebrates in Streams with and Without Buffer Strips,
W82-01227 5C

ROCHETTE, B.
The Problems of Non-Return and the Use of Valves in Drinking Water Protection Against Waste Water Return, Applying the Regulations in Force,
W82-01142 5F

ROGERS, G. L.
Biological Filters,
W82-01242 5D

ROGERS, R. B.
Monitoring Ground-Water Contamination at a Fly Ash Disposal Site Using Surface Electrical Resistivity Methods,
W82-01218 5B

Monitoring Leachate in Ground Water by Corrected Resistivity Methods,
W82-01219 5A

ROGOSHEWSKI, P. J.
Preliminary Design and Cost Estimates for Remedial Actions at Hazardous Waste Disposal Sites,
W82-01435 5G

ROLFE, G. L.
Water Quality from Two Small Forested Watersheds in Southern Illinois,
W82-01140 4C

ROSA, F.
Hypolimnion Flow Between the Central and Eastern Basins of Lake Erie During 1977 (Interbasin Hypolimnion Flows)
W82-01153 2H

ROSENBAUM, K. L.
Avoyelles Sportsmen's League V. Alexander,
W82-01456 6E

ROSENTHAL, E.
Uranium Isotopes as a Natural Tracer in the Waters of the Bet Shean-Harod Valleys, Israel,
W82-01328 2F

ROSS, L. E.
The Effects of a New Reservoir on the Attached Diatom Communities in Huntington Creek, Utah, U.S.A.,
W82-01521 2H

ROSSMANN, R.
Soluble Element Concentrations and Complexation in Southeastern Lake Michigan,
W82-01147 2H

ROSSNAGEL, B. G.
Yield and Phenotypic Traits of Semidwarf and Normal-Statured Barley (Hordeum Vulgare L.) Genotypes Grown Under Differing Levels of Moisture Stress,
W82-01121 2I

ROUSE, J. V.
Groundwater Contamination by Sanitary Landfill Leachate and Domestic Wastewater in Carbonate Terrain: Principal Source Diagnosis, Chemical Transport Characteristics and Design Implications,
W82-01223 5B

ROUSH, T. H.
The Effects of Pollution on Freshwater Fish,
W82-01282 5C

ROY, D.
Mechanism of Enteroviral Inactivation by Ozone.
W82-01482 5D

Microbiology: Detection, Occurrence, and Removal of Viruses,
W82-01290 5A

RUDIE, A. W.
New Opportunities for In-Plant Reduction of Pollutants Through Process Changes,
W82-01559 5G

RUSHFORTH, S. R.
The Effects of a New Reservoir on the Attached Diatom Communities in Huntington Creek, Utah, U.S.A.,
W82-01521 2H

RUSSO, R. C.
The Effects of Pollution on Freshwater Fish,
W82-01282 5C

SAAR, R. A.
Ground Water,
W82-01273 2F

SACCO, P. D.
Nitrate Reduction in an Organic Soil-Water System,
W82-01129 5B

SANDERS, H. O.
Abate: Effects of the Organophosphate Insecticide on Bluegills and Invertebrates in Ponds,
W82-01445 5C

SANDERSON, W. C.
Optimum Recycle and Reuse Cooling System Designs Using the BCT Process,
W82-01503 3E

SANDHU, B. S.
Irrigation Needs and Yield of Rice on a Sandy-Loam Soil as Affected by Continuous and Intermittent Submergence,
W82-01382 3F

SASMAN, R. T.
Yield Verification of a Dolomite Aquifer in Northeast Illinois,
W82-01334 2F

SAWHNEY, B. L.
Removal of Phosphorus from Waste Water by Soil Under Aerobic and Anaerobic Conditions,
W82-01344 5D

SAYLER, G. S.
Phenanthrene Biodegradation in Freshwater Environments,
W82-01234 5B

Tenax-GC Extraction Technique for Residual Polychlorinated Biphenyl and Polyaromatic Hydrocarbon Analysis in Biodegradation Assays,
W82-01235 5A

SCAVIA, D.
Comparison of First-Order Error Analysis and Monte Carlo Simulation in Time-Dependent Lake Eutrophication Models,
W82-01460 2H

SCHAEFER, W. F.
Postspawning Mortality of Rainbow Smelt in Western Lake Superior,
W82-01189 5C

SCHAEFFER, D. J.
Abundance of Organic Compounds in Water,
W82-01162 5A

SCHAFFRANEK, R. W.
A Model for Simulation of Flow in Singular and Interconnected Channels,
W82-01210 2E

SCHAUMBERG, G. D.
Infrared Spectroscopic Study of the Water-Soluble Fraction of Sewage Sludge-Soil Mixtures During Incubation,
W82-01130 5E

SCHEIDE, E. P.
Determination of Nanogram Quantities of Mercury in Water with a Gold-Plated Piezoelectric Crystal Detector,
W82-01509 5A

SCHEIDER, W. A.
An Analysis of Acidic Precipitation in South-Central Ontario Using Air Parcel Trajectories,
W82-01513 5B

SCHELSKE, C. L.
Phytoplankton Productivity and Standing Crop in the Vicinity of the Lake Huron-Saginaw Bay Front,
W82-01164 2H

SCHEPERS, J. S.
Chemical and Bacteriological Quality of Pasture Runoff,
W82-01555 5B

SCHICHT, R. J.
Yield Verification of a Dolomite Aquifer in Northeast Illinois,
W82-01334 2F

SCHINDLER, D. W.
The Effect of Fertilization with Phosphorus and Nitrogen Versus Phosphorus Alone on Eutrophication of Experimental Lakes,
W82-01457 5C

SCHMIDTKE, N. W.
Steel Industry Wastes,
W82-01264 5D

SCHNEIDER, R.
Case Studies on the Migration of Pollutants in Ground Water,
W82-01424 5B

SCHNEIDER, S. R.
Effect of Grain Size and Snowpack Water Equivalence on Visible and Near-Infrared Satellite Observations of Snow,
W82-01311 7B

SCHRAMM, G.
Input and Output Constraints Affecting Irrigation Development,
W82-01476 6B

SCHREIBER, J. D.
Estimating Soluble (PO4-P) and Labile Phosphorus in Runoff from Croplands,
W82-01412 5B

Sediment and Nutrient Trap Efficiency of a Small Flood-Detention Reservoir,
W82-01471 4A

SCHROEDER, E. D.
Stability of Activated Sludge Processes Based on Statistical Measures,
W82-01489 5D

SCHULLER, R. M.
Acute Toxicity of Leachates from Coal Gasification and Liquefaction Solid Wastes to the Fathead Minnow, Pimephales Promelas,
W82-01108 5C

SCHULZ, R. K.
Studies on Unsaturated Zone Hydrology and Radionuclide Migration at a Shallow-Land Burial Site,
W82-01172 5B

SCHWARTZ, S. E.
Oxidation of SO2 in Aqueous Droplets: Mass Transport Limitation in Laboratory Studies and the Ambient Atmosphere,
W82-01470 2K

SCRUDATO, R. J.
Case Studies on the Migration of Pollutants in Ground Water,
W82-01424 5B

SCULLION, J.
The Effect of Pollutants from the Coal Industry on the Fish Fauna of a Small River in the South Wales Coalfield,
W82-01389 5C

SEGALL, B. A.
Electro-Osmosis Chemistry and Water Quality,
W82-01518 5E

SEILS, C. A.
Effects of Atmospheric Precipitation Additions on Phytoplankton Photosynthesis in Lake Michigan Water Samples,
W82-01196 2H

SEITZ, W. D.
Managing Land to Meet Water Quality Goals,
W82-01557 4D

SELL, D. W.
Seasonal Features of Zooplankton Assemblages in the Nearshore Area of Southeastern Lake Michigan,
W82-01192 2H

SENGER, J. A.
Remedial Action Controls Groundwater Contamination at a Paper Mill Sludge Disposal Site,
W82-01582 5G

SETEANU, I.
Daily Optimization of Power Generation in Cascade Hydrosystems (A Stochastic Approach),
W82-01320 6A

SEYFRIED, P. L.
Persistence of Pseudomonas Aeruginosa in Chlorinated Swimming Pools,
W82-01124 5A

SHAM, C. H.
Drainage Network Structure and the Diameter-Magnitude Relation,
W82-01308 2A

SHARMA, P.
An Approach to Determining Pathways and Residence Time of Groundwaters: Dual Radiotracer Dating,
W82-01348 2F

SHARPLEY, A. N.
The Depth of Rainfall-Runoff-Soil Interaction as Determined by P32,
W82-01318 5B

The Release of Soil Phosphorous to Runoff in Relation to the Kinetics of Desorption,
W82-01477 5B

SHEPPARD, W. L.
Redesign Controls Manhole Leakage,
W82-01237 8G

SHERRAD, J. H.
Activated Sludge,
W82-01243 5D

SHERRILL, T. W.
Phenanthrene Biodegradation in Freshwater Environments,
W82-01234 5B

Tenax-GC Extraction Technique for Residual Polychlorinated Biphenyl and Polyaromatic Hydrocarbon Analysis in Biodegradation Assays,
W82-01235 5A

SHIARIS, M. P.
Tenax-GC Extraction Technique for Residual Polychlorinated Biphenyl and Polyaromatic Hydrocarbon Analysis in Biodegradation Assays,
W82-01235 5A

SHUCKROW, A. J.
Bench Scale Assessment of Technologies for Contaminated Ground Water Treatment,
W82-01433 5G

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SHUVAL, H. I.
Effect of Investments in Water Supply and Sanitation on Health Status: A Threshold-Saturation Theory,
W82-01331 6B

SIDWICK, J. M.
Rural Sanitation in Developing Countries,
W82-01392 5D

SIEGRIST, T. W.
Chemicals and Allied Products,
W82-01267 5D

SIEVERING, H.
Nutrient Loading of Southern Lake Michigan by Dry Deposition of Atmospheric Aerosol,
W82-01152 5B

SILBERMANN, P. T.
Evaluation of Remedial Treatment, Detoxification and Stabilization Alternatives,
W82-01434 5D

SILKA, L. R.
Computer Modeling and Ground-Water Protection,
W82-01336 2F

The National Assessment of the Ground-Water Contamination Potential of Wastewater Impoundments,
W82-01419 5G

SILLS, M. A.
Evaluation of Remedial Treatment, Detoxification and Stabilization Alternatives,
W82-01434 5D

SIMS, J. L.
Bioassays - Procedures and Results,
W82-01277 5A

SINGH, B.
Irrigation Needs and Yield of Rice on a Sandy-Loam Soil as Affected by Continuous and Intermittent Submergence,
W82-01382 3F

SINGH, R. N.
A Mathematical Model of Water Table Fluctuation in a Semi-Infinite Aquifer Induced by Localized Transient Recharge,
W82-01319 2F

SINGH, S. D.
Effect of Water, Nitrogen and Row Spacing on the Yield and Oil Content of Safflower,
W82-01112 2I

SISSON, J. B.
Spatial Variability of Steady-State Infiltration Rates as a Stochastic Process,
W82-01560 2G

SKAGGS, R. W.
Combination Surface-Subsurface Drainage Systems for Humid Regions,
W82-01228 4A

Water Management Model Evaluation for North Central Ohio,
W82-01536 4A

SMIES, M.
Holland's Eastern Scheldt Estuary Barrier Scheme: Some Ecological Considerations,
W82-01375 2L

SMILES, D. E.
Hydrodynamic Dispersion During Constant Rate Absorption of Water by Soil,
W82-01174 2G

SMILEY, V. N.
Lidar Determinations of Atmospheric Ice Crystal Layers at South Pole During Clear-Sky Precipitation,
W82-01529 2C

SMITH, A. E.
A Comparison of Chemical and Cultural Control of Weeds in Irrigation Ditchbanks,
W82-01120 4A

SMITH, D. A.
Activated Sludge,
W82-01243 5D

SMITH, D. L.
Survey of Treatment Plant Design and Operation Deficiencies,
W82-01543 5D

SMITH, E. D.
Water Characteristics,
W82-01305 5B

SMITH, N. D.
The Effect of Changing Sediment Supply on Sedimentation in a Glacier-Fed Lake,
W82-01510 2H

SMITH, S. J.
Nitrate Production, Uptake, and Leaching,
W82-01411 5B

SMITH, W. L.
Determination of Moisture from NOAA Polar Orbiting Satellite Sounding Radiances,
W82-01535 2B

SNOEYINK, V. L.
Modeling of Activated Carbon and Coal Gasification Char Adsorbents in Single-Solute and Bisolute Systems,
W82-01447 1B

SNYDER, F. L.
Limnetic Larval Fish of the Maumee and Sandusky River Estuaries,
W82-01197 7A

SOLOMON, K.
Characterizing Sprinkler Distribution Patterns with a Clustering Algorithm,
W82-01575 3F

Significant Features of Emitter Flushing Mode Characteristics,
W82-01576 3F

SOMMER, E. M.
Federal Common Law of Nuisance Expands,
W82-01337 6E

SOMMERFELDT, T. G.
Water and Salt Movement in a Saline-Sodic Soil in Southern Alberta,
W82-01119 2G

SONCINI-SESSA, R.
Supply-Demand Coordination in Water Resources Management,
W82-01299 6C

SONZOGNI, W. C.
Modelling Effects of Remedial Programs to Aid Great Lakes Environmental Management,
W82-01146 5G

SOOM, A. M.
Trickle Irrigation Lateral Design on Sloping Fields,
W82-01537 8C

SOREY, M. L.
On Identification and Validation of Some Geothermal Models,
W82-01467 6A

SOSTER, F. M.
Trace Metal Mineral Equilibria in Lake Erie Sediments,
W82-01191 2H

SPEHAR, R. L.
The Effects of Pollution on Freshwater Fish,
W82-01282 5C

SPENCER, H. T.
Metal Ion Concentrations Associated with Late Summer Sediments of the Ohio River,
W82-01300 5A

SPOONER, P.
Rating the Hazard Potential of Waste Disposal Facilities,
W82-01418 5G

SPOSITO, G.
Infrared Spectroscopic Study of the Water-Soluble Fraction of Sewage Sludge-Soil Mixtures During Incubation,
W82-01130 5E

SRIVASTAVA, D. K.
Study of a Complex Water Resources System with Screening and Simulation Models,
W82-01309 6A

SRIVASTAVA, V.
Anaerobic Processes,
W82-01245 5D

STAHLBAUM, B. W.
Modelling Effects of Remedial Programs to Aid Great Lakes Environmental Management,
W82-01146 5G

STALL, J. B.
Managing Land to Meet Water Quality Goals,
W82-01557 4D

STARK, N.
Changes in Soil Water Quality Resulting from Three Timber Cutting Methods and Three Levels of Fiber Utilization,
W82-01135 2G

STARR, R. C.
Practical Aspects of Ground Water Monitoring at Existing Disposal Sites,
W82-01421 5G

STECKER, P. P.
A Successful Low Technology Wastewater Process,
W82-01178 5D

STEDINGER, J. R.
Systems Analysis,
W82-01303 6A

STEELE, R. L.
Experimental Verification of the Linear Relationship Between IR Extinction and Liquid Water Content of Clouds,
W82-01525 7B

STEFAN, H. G.
Unsteady One-Dimensional Settling of Suspended Sediment,
W82-01463 2J

STEINHEIMER, T. R.
Application of Capillary Gas Chromatography Mass Spectrometry/Computer Techniques to Synoptic Survey of Organic Material in Bed Sediment,
W82-01573 5A

STEPHENS, J. A.
Year-to-Year Changes in the Salinity of the Eastern English Channel, 1948-1973: A Budget,
W82-01399 2A

STEPHENS, R. D.
The Stringfellow Industrial Waste Disposal Site: A Technical Assessment of Environmental Impact,
W82-01415 5B

STERLING, J. D. E.
Comparison of Tests Characterizing Varieties of Barley and Wheat for Moisture Stress Resistance,
W82-01114 2I

STOFFELSEN, G. H.
Measuring the Hydraulic Conductivity of Soil Adjacent to Tile Drains in a Heavy Clay Soil in the Netherlands,
W82-01323 2G

STOKES, R. A.
Predicting Stream Salinity Changes in South-Western Australia,
W82-01350 6A

STORTZ, K. R.
Transports in the Duluth-Superior Harbor,
W82-01136 5B

STOVER, E. L.
Investigation of Volatile Organics Removal,
W82-01490 5F

Petroleum Processing Wastes,
W82-01262 5D

Synthetic Fuel Effluents,
W82-01263 5B

STROMATT, S. C.
The Inference of Gate Convective Rainfall from SMS-1 Imagery,
W82-01519 7B

STRUZZIERY, J. J.
Evaluation of Remedial Treatment, Detoxification and Stabilization Alternatives,
W82-01434 5D

SUBLA, B. A.
Comparative Limnology of Nine Lakes of Jammu and Kashmir Himalayas,
W82-01361 2H

SUDICKY, E. A.
Carbon 14 Dating of Groundwater in Confined Aquifers: Implications of Aquitard Diffusion,
W82-01464 2F

SUIDAN, M. T.
Anaerobic Carbon Filter for Degradation of Phenols,
W82-01454 5D

SULLIVAN, M.
Investigation of Volatile Organics Removal,
W82-01490 5F

SULOWAY, J. J.
Acute Toxicity of Leachates from Coal Gasification and Liquefaction Solid Wastes to the Fathead Minnow, Pimephales Promelas,
W82-01108 5C

SUNG, J.
Organics,
W82-01239 5A

SUTCLIFFE, J. V.
The Water Balance of the Betwa Basin, India,
W82-01354 2A

SUTTON, P. M.
Design and Cost Comparison of Biological Nitrogen Removal Processes,
W82-01544 5D

SWANSON, N. P.
Chemical and Bacteriological Quality of Pasture Runoff,
W82-01555 5B

SWENSON, W. A.
Postspawning Mortality of Rainbow Smelt in Western Lake Superior,
W82-01189 5C

SWIGER, W. F.
Northfield Mountain Pumped Storage Project: Performance.
W82-01517 8A

SYDOR, M.
Plume Development Using Lagrangian Marker Method,
W82-01182 5B

Transports in the Duluth-Superior Harbor,
W82-01136 5B

SYMULA, J.
Preliminary Report of Stream Sampling for Acidification Studies 1980,
W82-01453 5A

SYVERTSEN, J. P.
Hydraulic Conductivity of Four Commercial Citrus Rootstocks,
W82-01546 2I

TAKEUCHI, N.
Petroleum Hydrocarbons in Sediments of Saginaw Bay, Lake Huron,
W82-01141 5A

TALMA, A. S.
Gaseous Nitrogen as Evidence for Denitrification in Groundwater,
W82-01485 2K

TAN, C. S.
Estimating Evapotranspiration from Irrigated Crops in Southwestern Ontario,
W82-01116 2D

TANJI, K. K.
Irrigation Management of Colorado River Water with Increase in Salinity,
W82-01226 3C

River Basin Hydrosalinity Modeling,
W82-01469 2K

TAYLOR, A. H.
Year-to-Year Changes in the Salinity of the Eastern English Channel, 1948-1973: A Budget,
W82-01399 2A

TAYLOR, G. L. JR.
Land Treatment Site Evaluation in Southeastern Mountainous Areas,
W82-01596 5D

TENG, T-L.
Some Recent Studies on Groundwater Radon Content as an Earthquake Precursor,
W82-01127 2F

TERJUNG, W. H.
A Parametric Crop Water Use Model,
W82-01310 2I

TESHIMA, H.
Periodic Operation for Desalination with Thermally Regenerable Ion-Exchange Resin. Dynamic Studies,
W82-01341 3A

THACKER, W. E.
Modeling of Activated Carbon and Coal Gasification Char Adsorbents in Single-Solute and Bisolute Systems,
W82-01447 1B

THOMAS, R. L.
Organochlorine Insecticides and PCB in Surficial Sediments of Lake Michigan (1975),
W82-01190 5A

PCB Residues in Bottom Sediments Collected From the Bay of Quinte, Lake Ontario 1972-1973,
W82-01155 5B

THOMPSON, W. J.
Evaluation of Ultraviolet Spectrophotometric Determination of Nitrate-Nitrogen in Glacial Snow, Firn and Ice,
W82-01572 5A

THRELFALL, D.
Remedial Options for Ground Water Protection at Abandoned Solid Waste Disposal Facilities,
W82-01426 5G

TILDEN, R. L.
Effect of Investments in Water Supply and Sanitation on Health Status: A Threshold-Saturation Theory,
W82-01331 6B

TIMMONS, D. R.
Nitrogen Leaching as Influenced by Nitrogen Management and Supplement Irrigation Level,
W82-01472 5B

Soluble N and P Concentrations in Surface Runoff Water,
W82-01413 5B

TIPPIN, D.
Demonstration Testing of Alum Recovery by Liquid Ion Exchange,
W82-01167 5D

TISUE, G. T.
Effects of Atmospheric Precipitation Additions on Phytoplankton Photosynthesis in Lake Michigan Water Samples,
W82-01196 2H

TITTLEBAUM, M.
Microbiology: Detection, Occurrence, and Removal of Viruses,
W82-01290 5A

TODHUNTER, P. E.
A Parametric Crop Water Use Model,
W82-01310 2I

TOMSON, M. B.
Groundwater Contamination by Trace Level Organics from a Rapid Infiltration Site,
W82-01496 5B

TORPY, M. F.
Petroleum Processing Wastes,
W82-01262 5D

Synthetic Fuel Effluents,
W82-01263 5B

TRIMBLE, S. W.
Changes in Sediment Storage in the Coon Creek Basin, Driftless Area, Wisconsin, 1853 to 1975,
W82-01563 2J

TROLLOPE, D. R.
The Escherichia Coli Content of Mytilus Edulis from Analysis of Whole Tissue or Digestive Tract,
W82-01508 5A

TRUDEL, M.
A Simple Low Cost Apparatus for Conditioning Large Volumes of Water for Virological Analysis,
W82-01123 5A

TSANG, C. F.
A Study of Regional Temperature and Thermo-hydrologic Effects of an Underground Repository for Nuclear Wastes in Hard Rock,
W82-01347 5E

TUCKER, J. M.
The Water Balance of the Betwa Basin, India,
W82-01354 2A

TUNG, Y. K.
Optimal Risk-Based Design of Flood Levee Systems,
W82-01313 8B

Risk Models for Flood Levee Design,
W82-01307 8A

TURNER, J. S.
Ice Blocks Melting Into a Salinity Gradient,
W82-01530 2C

TURNER, R. S.
Aluminum in Precipitation, Streams, and Shallow Groundwater in the New Jersey Pine Barrens,
W82-01297 5B

TWEDELL, D.
Rating the Hazard Potential of Waste Disposal Facilities,
W82-01418 5G

UNITES, D.
Preliminary Risk Evaluation for Suspected Hazardous Waste Disposal Sites in Connecticut,
W82-01417 5G

UTTER, J.
Preferences for Allocating River Recreation Use,
W82-01181 6D

VACHON, D. T.
Steel Industry Wastes,
W82-01264 5D

VAN DE VELDE, I.
The Crustacean Zooplankton of Mali (West Africa),
W82-01379 2H

VAN DEN HEUVEL, J. C.
Purification of Municipal Wastewater by Subsequent Reverse Osmosis and Anaerobic Digestion,
W82-01468 5D

VAN GALEN, G. C.
Chemical Control of Mussel Settlement in a Cooling Water System Using Acrolein,
W82-01501 5F

VAN HOORN, J. W.
Measuring the Hydraulic Conductivity of Soil Adjacent to Tile Drains in a Heavy Clay Soil in the Netherlands,
W82-01323 2G

VAN LEEUWEN, J.
A Look at Some Water Reclamation Plants in Southern Africa,
W82-01352 5D

VAN ROSSUM, P. G.
Relationship of the Raw Water Quality to Mutagens Detectable by the Ames Salmonella/Microsome Assay in a Drinking-Water Supply,
W82-01493 5A

VAN VUUREN, L. R. J.
A Look at Some Water Reclamation Plants in Southern Africa,
W82-01352 5D

VANNUCCHI, C.
Mercury and Lead Concentrations in Some Species of Fish From the Tuscan Coasts (Italy),
W82-01368 5B

VEITH, G. D.
Polychlorinated Biphenyls and Other Organic Chemical Residues in Fish from Major United States Watersheds Near the Great Lakes, 1978,
W82-01583 5A

VESILIND, P. A.
Sludge Treatment, Utilization, and Disposal,
W82-01247 5E

VICK, S. G.
Siting and Design of Tailings Impoundments,
W82-01588 8A

VIENS, P.
Rural Water Supply and Related Services in Developing Countries-Comparative Analysis of Several Approaches,
W82-01330 6A

VOGEL, J. C.
Gaseous Nitrogen as Evidence for Denitrification in Groundwater,
W82-01485 2K

VRHOVSEK, D.
Evaluation of the Polluted River Savinja with the Help of Macrophytes,
W82-01377 5C

WAGENET, R. J.
A Combined Salt Transport-Chemical Equilibrium Model for Calcareous and Cypsiferous Soils,
W82-01230 5B

WALKER, W. R.
Law,
W82-01302 6E

WALLER, W. T.
Substrate Associated Microfauna,
W82-01283 5C

WALSH, D. F.
Abate: Effects of the Organophosphate Insecticide on Bluegills and Invertebrates in Ponds,
W82-01445 5C

WALTON, T. L. JR.
Linearized Solution to Inlet Equation with Inertia,
W82-01183 2L

WANG, J. R.
Remote Sensing of Soil Moisture Content Over Bare Field at 1.4 GHz Frequency,
W82-01345 7B

WANG, J. S. Y.
A Study of Regional Temperature and Thermohydrologic Effects of an Underground Repository for Nuclear Wastes in Hard Rock,
W82-01347 5E

WANGANEO, A.
Comparative Limnology of Nine Lakes of Jammu and Kashmir Himalayas,
W82-01361 2H

WARBURTON, J. A.
Lidar Determinations of Atmospheric Ice Crystal Layers at South Pole During Clear-Sky Precipitation,
W82-01529 2C

WARD, A. D.
A Verification Study on a Reservoir Sediment Deposition Model,
W82-01176 2J

WARD, T. E.
Sediment Distribution of Methanogenic Bacteria in Lake Erie and Cleveland Harbor,
W82-01233 2H

WARRICK, A. W.
The Movement of Salts from Soils Following Heavy Application of Feedlot Wastes,
W82-01132 5B

WARWICK, W. F.
Historical Changes and Relationship to Internal Loading of Sediment Phosphorus Forms in Hypertrophic Prairie Lakes,
W82-01516 2H

WATTS, D. G.
Effects of Water and Nitrogen Management on Nitrate Leaching Loss from Sands,
W82-01581 5B

WAUCHOPE, R. D.
Pesticide Concentrations in Agricultural Runoff: Available Data and an Approximation Formula,
W82-01414 5B

WEBBER, R. T.
Data Base Development for the Design of a Radium-226 Removal Process,
W82-01188 5D

WEGMAN, R. C. C.
Methyl Bromide and Bromide-Ion in Drainage Water After Leaching of Glasshouse Soils,
W82-01492 5B

WEGSCHEIDER, W.
Preconcentration for Trace Element Determination in Aqueous Samples,
W82-01574 5A

WEINER, R. M.
An Estuarine Agar Medium for Enumeration of Aerobic Heterotrophic Bacteria Associated with Water, Sediment, and Shellfish,
W82-01565 5A

WELCH, K.
Polychlorinated Biphenyls and Other Organic Chemical Residues in Fish from Major United States Watersheds Near the Great Lakes, 1978,
W82-01583 5A

WESTBURY, W.
Treatment of Sewage Plant Effluent for Use as Makeup Water,
W82-01585 3C

WETZEL, R.
Rating the Hazard Potential of Waste Disposal Facilities,
W82-01418 5G

WETZEL, R. G.
A Bioassay Study of Effects of Zooplankton, Iron and NTA on the Phytoplankton Productivity of a Marl Lake,
W82-01157 2H

WHELAN, B. R.
A Study of a Method for Displacing Soil Solution by Centrifuging with an Immiscible Liquid,
W82-01131 5B

WHELAN, J. K.
Volatile C1-C7 Organic Compounds in Surface Sediments from Walvis Bay,
W82-01367 5B

WHITCOMB, B. M.
Lidar Determinations of Atmospheric Ice Crystal Layers at South Pole During Clear-Sky Precipitation,
W82-01529 2C

WHITE, F. C.
Relationship Between Increased Crop Acreage and Nonpoint-Source Pollution: A Georgia Case Study,
W82-01550 5B

WHITE, G. B.
Economic Impacts of Erosion and Sedimentation Control Plans: Case Studies of Pennsylvania Dairy Farms,
W82-01134 4D

WHITE, G. C.
Factors Affecting Radionuclide Availability to Vegetables Grown at Los Alamos,
W82-01109 5B

WHITFIELD, P. H.
Some Factors Affecting the Determination of Particulate Carbon and Nitrogen in River Water,
W82-01532 5A

WHITTON, B. A.
Phytoplankton of Four Rivers, the Tyne, Wear, Tees and Swale,
W82-01376 2E

WIERENGA, P. J.
Spatial Variability of Steady-State Infiltration Rates as a Stochastic Process,
W82-01560 2G

WILD, P. A.
Northfield Mountain Pumped Storage Project: Performance,
W82-01517 8A

WILKES, F. G.
Marine and Estuarine Pollution,
W82-01274 5C

WILLIAMS, B. J.
Expansion of Effluent Constrained Treatment Plants,
W82-01355 5D

WILLIAMS, J. D. H.
Historical Changes and Relationship to Internal Loading of Sediment Phosphorus Forms in Hypertrophic Prairie Lakes,
W82-01516 2H

WILLIAMS, J. R.
Nitrate Production, Uptake, and Leaching,
W82-01411 5B

WILLIAMS, J. S.
Geologic and Hydrologic Factors Controlling Radon-222 in Ground Water in Maine,
W82-01222 2F

WILLIAMS, N. J.
Mining Pollution and the Diet of the Purple-Striped Gudgeon Mogurnda Mogurnda Richardson (Eleotridae) in the Finniss River, Northern Territory, Australia,
W82-01366 5C

WILSON, I.
The Application of Mutagenicity Testing to Drinking Water,
W82-01487 5A

WILSON, R. W.
Design and Cost Comparison of Biological Nitrogen Removal Processes,
W82-01544 5D

WINANT, W. M.
Effects of Sanitary Landfill Leachage on Some Soil Chemical Properties,
W82-01480 5E

WISNER, P. E.
Studies for Abatement of Pollution from Combined Sewer Overflows in Canada,
W82-01200 5G

WISNIEWSKI, J.
Ice Nucleus Concentrations Measured During the 1975 Florida Area Cumulus Experiment (FACE),
W82-01522 7B

WITHERSPOON, P. A.
A Study of Regional Temperature and Thermohydrologic Effects of an Underground Repository for Nuclear Wastes in Hard Rock,
W82-01347 5E

WOFFINDEN, D. S.
A Balloonborne Instrument for the Measurement of Vertical Profiles of Supercooled Liquid Water Concentration,
W82-01524 7B

WONG, B.
Generating Alternative Solutions for Dynamic Programming Models of Water Resources Problems,
W82-01450 6A

WONG, P. K. Y.
Mechanism of Enteroviral Inactivation by Ozone.
W82-01482 5D

WOOD, E. F.
Regional Flood Frequency Estimation and Network Design,
W82-01294 2E

WOOD, H. B.
Suspended Sediment Production from Forested Watersheds on Oahu, Hawaii,
W82-01531 2J

WOOD, P. C.
The Workings of the Control of Pollution Act in Tidal Waters: A View of the Ministry of Agriculture, Fisheries and Food,
W82-01383 6E

WOODLEY, W. L.
The Inference of Gate Convective Rainfall from SMS-1 Imagery,
W82-01519 7B

WOOLF, H. M.
Determination of Moisture from NOAA Polar Orbiting Satellite Sounding Radiances,
W82-01535 2B

YAMAMOTO, M.
The Depth of Rainfall-Runoff-Soil Interaction as Determined by P32,
W82-01318 5B

YAMAMOTO, T.
Periodic Operation for Desalination with Thermally Regenerable Ion-Exchange Resin. Dynamic Studies,
W82-01341 3A

YDE, M.
Faecal Pollution of Belgian Coastal Water,
W82-01373 5A

YOUNG, B. A.
High-Solubility Gas Flotation,
W82-01184 5D

YOUNG, G. J.
Monitoring Glacier Outburst Floods,
W82-01558 2C

YOUNG, J. C.
Alterations in the BOD Procedure for the 15th Edition of 'Standard Methods for the Examination of Water and Wastewater',
W82-01186 5A

YOUNG, T. C.
Aquatic Sediments,
W82-01279 5B

YOUNGS, E. G.
Scaling of Infiltration Behavior in Dissimilar Porous Materials,
W82-01105 2G

YU, K.
Comparative Evaluation of Processes for the Treatment of Concentrated Wastewaters at Uncontrolled Hazardous Waste Sites,
W82-01430 5D

YUSUF, M.
Effect of Water, Nitrogen and Row Spacing on the Yield and Oil Content of Safflower,
W82-01112 2I

ZABEL, T. F.
Developments in Sedimentation and Flotation,
W82-01391 5F

ZEGELIN, S. J.
Hydrodynamic Dispersion During Constant Rate Absorption of Water by Soil,
W82-01174 2G

ZELLER, E. J.
Evaluation of Ultraviolet Spectrophotometric Determination of Nitrate-Nitrogen in Glacial Snow, Firn and Ice,
W82-01572 5A

ZIEMER, R. R.
Storm Flow Response to Road Building and Partial Cutting in Small Streams of Northern California,
W82-01295 4C

ZIPF, K. A. JR.
Chemical Equilibria in Split-Treatment Softening of Water,
W82-01165 5F

ZOETEMEYER, R. J.
Purification of Municipal Wastewater by Subsequent Reverse Osmosis and Anaerobic Digestion,
W82-01468 5D

ZOLTEK, J. JR.
Physical and Chemical Methods,
W82-01241 5D

ZOOK, R. L.
Cost Effective Ground Water Monitoring,
W82-01113 4B

ZOSKI, J. E.
Treatment of Sewage Plant Effluent for Use as Makeup Water,
W82-01585 3C

ZUTSHI, D. P.
Comparative Limnology of Nine Lakes of Jammu and Kashmir Himalayas,
W82-01361 2H

ZWERMAN, P. J.
Effects of Dairy Manure on Phosphorus Concentrations and Losses in Tile Effluent,
W82-01479 5B

Phosphorus Concentration-Water Flow Interactions in Tile Effluent from Manured Land,
W82-01340 5B

LIBRARY U. S. D. A.-FOREST SERV.

ORGANIZATIONAL INDEX

ABERDEEN UNIV. (SCOTLAND). DEPT. OF SOIL SCIENCE.
Factors Affecting the Chemistry of Precipitation and River Water in an Upland Catchment,
W82-01322 2K

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, PA. BENEDICT ESTUARINE RESEARCH LAB.
The Interaction of Treated Bleached Kraft Mill Effluent and Dissolved Oxygen Concentration on the Survival of the Developmental Stages of the Sheepshead Minnow (Cyprinodon Variegatus),
W82-01494 5C

AES ENGINEERS, INC., WILLOW SPRINGS, IL.
Wastewater Collection,
W82-01251 5D

AGRICULTURAL RESEARCH AND EDUCATION CENTER, LAKE ALFRED, FL.
Hydraulic Conductivity of Four Commercial Citrus Rootstocks,
W82-01546 2I

AGRICULTURAL RESEARCH AND EDUCATION CENTER, SANFORD, FL.
Nitrate Reduction in an Organic Soil-Water System,
W82-01129 5B

AGRICULTURAL UNIV., WAGENINGEN (NETHERLANDS). DEPT. OF WATER POLLUTION CONTROL.
Effect of Copper on Nitrification in Activated Sludge,
W82-01497 5C

AIR FORCE GEOPHYSICS LAB., HANSCOM AFB, MA.
An Improved Method for Obtaining the Water Content Values of Ice Hydrometeors from Aircraft and Radar Data,
W82-01523 7B

ALBERTA UNIV., EDMONTON.
Water Reclamation and Reuse,
W82-01252 3C

ALBERTA UNIV., EDMONTON. DEPT. OF MECHANICAL ENGINEERING.
Wave Formation and Heat Transfer at an Ice-Water Interface in the Presence of a Turbulent Flow,
W82-01128 2C

ALIGARH MUSLIM UNIV. (INDIA). ENVIRONMENTAL RESEARCH LAB.
Atomic Absorption Spectrophotometric Studies of Cadmium and Zinc in Commercial Fertilisers, Soils and River Waters,
W82-01388 5B

ALL-INDIA CO-ORDINATED RICE IMPROVEMENT PROJECT, HYDERABAD (INDIA).
Note on Probability Approach to Study the Occurrence of Rainfall at Hyderabad,
W82-01380 2B

AMERICAN WATER WORKS SERVICE CO., INC., HADDON HEIGHTS, NJ.
Investigation of Volatile Organics Removal,
W82-01490 5F

AMSTERDAM UNIV. (NETHERLANDS). LAB. OF CHEMICAL TECHNOLOGY.
Purification of Municipal Wastewater by Subsequent Reverse Osmosis and Anaerobic Digestion,
W82-01468 5D

ANDERSON-NICHOLS AND CO., INC., BOSTON, MA
Evaluation of Remedial Treatment, Detoxification and Stabilization Alternatives,
W82-01434 5D

ARGONNE NATIONAL LAB., IL.
Effects of Atmospheric Precipitation Additions on Phytoplankton Photosynthesis in Lake Michigan Water Samples,
W82-01196 2H

Synthetic Fuel Effluents,
W82-01263 5B

ARIZONA STATE UNIV., TEMPE. DEPT. OF GEOGRAPHY.
Channel Instability in a Braided, Sand Bed River,
W82-01316 2J

ARIZONA UNIV., TUCSON. DEPT. OF SOILS, WATER AND ENGINEERING.
Reclamation of Wastewater with a Soil-Turf Filter: I: Removal of Nitrogen,
W82-01101 5D

Reclamation of Wastewater with a Soil-Turf Filter: II: Removal of Phosphorus, Boron, Sodium and Chlorine,
W82-01102 5D

The Movement of Salts from Soils Following Heavy Application of Feedlot Wastes,
W82-01132 5B

ARMY CONSTRUCTION ENGINEERING RESEARCH LAB. (ARMY), CHAMPAIGN, IL.
Water Characteristics,
W82-01305 5B

ARMY ENGINEER WATERWAYS EXPERIMENT STATION, VICKSBURG, MS.
Stabilization/Solidification of Waste from Uncontrolled Disposal Sites,
W82-01432 5E

ARMY ENVIRONMENTAL HYGIENE AGENCY, ABERDEEN PROVING GROUND, MD.
Operational Problems with Rotating Biological Contactors,
W82-01549 5D

ATHENS UNIV. (GREECE) INST. OF SYSTEMATIC BOTANY.
Periphyton Analysis for the Evaluation of Water Quality in Running Waters of Greece,
W82-01358 5A

ATMOSPHERIC ENVIRONMENT SERVICE, DOWNSVIEW (ONTARIO).
Compatibility of Canadian Snowfall and Snow Cover Data,
W82-01466 2C

AUBURN UNIV., AL.
Textile Wastes,
W82-01259 5D

AUBURN UNIV., AL. DEPT. OF CIVIL ENGINEERING.
Thermal Energy Storage in a Confined Aquifer: Second Cycle,
W82-01473 4B

AUSTRALIAN ATOMIC ENERGY COMMISSION RESEARCH ESTABLISHMENT, LUCAS HEIGHTS.
Deuterium/Hydrogen Ratios in Australian Rainfall,
W82-01325 2B

Mining Pollution and the Diet of the Purple-Striped Gudgeon Mogurnda Mogurnda Richardson (Eleotridae) in the Finniss River, Northern Territory, Australia,
W82-01366 5C

BAGHDAD UNIV. (IRAQ). DEPT. OF BIOLOGY.
A Hydrobiological Survey of a Polluted Canal,
W82-01356 5C

BAJARD (Y.) ASSOCIATES LTD., VANCOUVER (BRITISH COLUMBIA).
Rural Water Supply and Related Services in Developing Countries-Comparative Analysis of Several Approaches,
W82-01330 6A

BATTELLE-COLUMBUS LAB., COLUMBUS, OH.
Meat-, Fish-, and Poultry-Processing Wastes,
W82-01256 5D

BEN GURION UNIV. OF THE NEGEV, BEERSHEBA (ISRAEL). INST. FOR DESERT RESEARCH.
Estimating Evapotranspiration from the Sonoita Creek Watershed near Patagonia, Arizona,
W82-01306 2D

BIOCHIMIE MARINE, VILLEFRANCHE-SUR-MER (FRANCE). STATION ZOOLOGIQUE.
Immediate Detection of Heterogeneities in Continuous Multivariate, Oceanographic Recordings. Application to Time Series Analysis of Changes in the Bay of Villefranche sur Mer,
W82-01393 7A

BRADLEY UNIV., PEORIA, IL. DEPT. OF BIOLOGY.
Sediment Oxygen Demand and Its Effect on Dissolved Oxygen in a Cutoff Meander of the Kaskaskia River,
W82-01448 4A

BRIGHAM YOUNG UNIV., PROVO, UT.
Biological Filters,
W82-01242 5D

BRIGHAM YOUNG UNIV., PROVO, UT. DEPT. OF BOTANY AND RANGE SCIENCE.
The Effects of a New Reservoir on the Attached Diatom Communities in Huntington Creek, Utah, U.S.A.,
W82-01521 2H

BRIGHAM YOUNG UNIV., PROVO, UT. DEPT. OF ZOOLOGY.
Postspawning Mortality of Rainbow Smelt in Western Lake Superior,
W82-01189 5C

BROOKHAVEN NATIONAL LAB., UPTON, NY. DEPT. OF ENERGY AND ENVIRONMENT.
Oxidation of SO2 in Aqueous Droplets: Mass Transport Limitation in Laboratory Studies and the Ambient Atmosphere,
W82-01470 2K

BROWNE (F. X.) ASSOCIATES, INC., LANSDALE, PA.
Non-Point Sources,
W82-01270 5B

BURBANK, CA.
Treatment of Sewage Plant Effluent for Use as Makeup Water,
W82-01585 3C

BUREAU OF RECLAMATION, DENVER, CO. ENGINEERING AND RESEARCH CENTER.
Hydraulic Model Study of Daule-Peripa Spillway and Outlet Works,
W82-01446 8A

CALIFORNIA DEPT. OF HEALTH SERVICES, BERKELY. HAZARDOUS MATERIALS LAB.
The Stringfellow Industrial Waste Disposal Site: A Technical Assessment of Environmental Impact,
W82-01415 5B

CALIFORNIA STATE UNIV., LONG BEACH.
Marine and Estuarine Pollution,
W82-01274 5C

CALIFORNIA UNIV., BERKELEY. DEPT. OF FORESTRY AND CONSERVATION.
Effects of Logging on Macroinvertebrates in Streams with and Without Buffer Strips,
W82-01227 5C

CALIFORNIA UNIV., BERKELEY, DEPT. OF PLANT AND SOIL BIOLOGY.
Studies on Unsaturated Zone Hydrology and Radionuclide Migration at a Shallow-Land Burial Site,
W82-01172 5B

CALIFORNIA UNIV., BERKELEY. LAWRENCE BERKELEY LAB.
A Study of Regional Temperature and Thermo-hydrologic Effects of an Underground Repository for Nuclear Wastes in Hard Rock,
W82-01347 5E

CALIFORNIA UNIV., BERKELEY, SANITARY ENGINEERING RESEARCH LAB.
Fixed Endpoint Alkalinity Determination,
W82-01187 7B

CALIFORNIA UNIV., DAVIS. DEPT. OF CIVIL ENGINEERING.
Stability of Activated Sludge Processes Based on Statistical Measures,
W82-01489 5D

CALIFORNIA UNIV., DAVIS. DEPT. OF LAND, AIR AND WATER RESOURCES.
Irrigation Management of Colorado River Water with Increase in Salinity,
W82-01226 3C

River Basin Hydrosalinity Modeling,
W82-01469 2K

CALIFORNIA UNIV., LOS ANGELES. DEPT. OF GEOGRAPHY.
A Parametric Crop Water Use Model,
W82-01310 2I

Changes in Sediment Storage in the Coon Creek Basin, Driftless Area, Wisconsin, 1853 to 1975,
W82-01563 2J

CALIFORNIA UNIV., RIVERSIDE. DEPT. OF SOIL AND ENVIRONMENTAL SCIENCE.
Nitrogen Balances for an Effluent Irrigation Area,
W82-01478 3C

CALIFORNIA UNIV., SANTA BARBARA. DEPT. OF GEOGRAPHY.
Effect of Grain Size and Snowpack Water Equivalence on Visible and Near-Infrared Satellite Observations of Snow,
W82-01311 7B

CAMBRIDGE UNIV. (ENGLAND). DEPT. OF APPLIED MATHEMATICS AND THEORETICAL PHYSICS.
Ice Blocks Melting Into a Salinity Gradient,
W82-01530 2C

CAMP, DRESSER AND MCKEE, INC., MILWAUKEE, WI. ENVIRONMENTAL SCIENCES DIV.
An All-Teflon Bailer and an Air-Driven Pump for Evacuating Small-Diameter Ground-Water Wells,
W82-01333 7B

CANADA CENTRE FOR INLAND WATERS, BURLINGTON, (ONTARIO).
Interactive Effects of Metals in Mixtures on Biomass Production Kinetics of Freshwater Copepods,
W82-01125 5C

A Survey of ATP Concentrations in Lake Ontario, 1975-1976,
W82-01144 2H

Modelling Effects of Remedial Programs to Aid Great Lakes Environmental Management,
W82-01146 5G

Regionalization of the Upper Great Lakes with Respect to Surveillance Eutrophication Data,
W82-01150 7A

Some Factors Affecting the Determination of Particulate Carbon and Nitrogen in River Water,
W82-01532 5A

Parameterization of Contaminant Transport Through an Anisotropic Unconfined Aquifer,
W82-01570 5B

CANADA CENTRE FOR INLAND WATERS, BURLINGTON (ONTARIO); AND NATIONAL WATER RESEARCH INST., BURLINGTON (ONTARIO).
Hypolimnion Flow Between the Central and Eastern Basins of Lake Erie During 1977 (Interbasin Hypolimnion Flows)
W82-01153 2H

CANADA CENTRE FOR INLAND WATERS, BURLINGTON (ONTARIO); AND NATIONAL WATER RESEARCH INST., BURLINGTON (ONTARIO). AQUATIC PHYSICS AND SYSTEMS DIV.
Changes in Lake Ontario Total Phosphorus Concentrations, 1976-1978,
W82-01126 2H

CAPITAL CONSULTANTS, INC., LANSING, MI. INDUSTRIAL AND ENVIRONMENTAL DIV.
Advanced Wastewater Plant is Energy Saver,
W82-01177 5D

CARNEGIE-MELLON UNIV., PITTSBURGH, PA. DEPT. OF CIVIL ENGINEERING.
Chemical Equilibria in Split-Treatment Softening of Water,
W82-01165 5F

CASE WESTERN RESERVE UNIV., CLEVELAND, OH. DEPT. OF GEOLOGICAL SCIENCES.
Trace Metal Mineral Equilibria in Lake Erie Sediments,
W82-01191 2H

CENTRAL ARID ZONE RESEARCH INST., JODHPUR (INDIA).
Effect of Water, Nitrogen and Row Spacing on the Yield and Oil Content of Safflower,
W82-01112 2I

CENTRAL FLORIDA UNIV., ORLANDO. DEPT. OF BIOLOGICAL SCIENCES.
Zooplankton Abundance and Diversity in Central Florida Grass Carp Ponds,
W82-01520 2H

CENTRAL INLAND FISHERIES RESEARCH INST., BARRACKPORE (INDIA).
Effect of Different Levels of Water Salinity on the Decomposition of Organic Manures in a Brackish Water Fish Pond Soil,
W82-01363 3C

CENTRO TEORIA DEI SISTEMI, MILANO (ITALY).
Supply-Demand Coordination in Water Resources Management,
W82-01299 6C

CHINA FEATURES, BEIJING (CHINA).
Bacteria: Man's Allies in Water Pollution Control,
W82-01158 5D

CLARKSON COLL. OF TECHNOLOGY, POTSDAM, NY.
Aquatic Sediments,
W82-01279 5B

CLEMSON UNIV., SC.
Economics,
W82-01304 5G

COAST GUARD, HAMILTON AFB, CA. PACIFIC STRIKE TEAM.
Use of the Contingency Fund at Stringfellow Hazardous Waste Disposal Site,
W82-01416 5G

COASTAL ENGINEERING RESEARCH CENTER, FORT BELVOIR, VA.
Linearized Solution to Inlet Equation with Inertia,
W82-01183 2L

COLD REGIONS RESEARCH AND ENGINEERING LABORATORY, HANOVER, NH.
Vegetation Selection and Management for Overland Flow Systems,
W82-01500 5E

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF CIVIL ENGINEERING.
Potential Use of a Stream-Aquifer Model for Management of a River Basin: Case of the South Platte River in Colorado,
W82-01301 6A

COLORADO STATE UNIV., FORT COLLINS. ENGINEERING RESEARCH CENTER.
Design and Merit of a River-Aquifer Model for Optimal Use of Agricultural Water,
W82-01193 6A

COLORADO STATE UNIV., FORT COLLINS. NATURAL RESOURCE ECOLOGY LAB.
Impact of Management Practices on the Tallgrass Prairie,
W82-01580 4A

COLORADO UNIV. AT BOULDER.
Eutrophication,
W82-01271 2H

COLUMBIA NATIONAL FISHERIES RESEARCH LAB., MD.
Laboratory Procedure for Estimating Residue Dynamics of Xenobiotic Contaminants in a Freshwater Food Chain,
W82-01443 5B

Abate: Effects of the Organophosphate Insecticide on Bluegills and Invertebrates in Ponds,
W82-01445 5C

COLUMBIA NATIONAL FISHERIES RESEARCH LAB., MO.
Cadmium, Lead, Mercury, Arsenic, and Selenium Concentrations in Freshwater Fish, 1976-77-National Pesticide Monitoring Program,
W82-01584 5B

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CANBERRA (AUSTRALIA). DIV. OF ENVIRONMENTAL MECHANICS.
Hydrodynamic Dispersion During Constant Rate Absorption of Water by Soil,
W82-01174 2G

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, WEMBLEY (AUSTRALIA). DIV. OF LAND RESOURCES MANAGEMENT.
A Study of a Method for Displacing Soil Solution by Centrifuging with an Immiscible Liquid.
W82-01131 5B

COMPLEXE SCIENTIFIQUE DES CEZEAUX, AUBIERE (FRANCE). LAB. ASSOCIE DE METEOROLOGIE PHYSIQUE.
The Use of the Equilibrium Temperature to Establish the Heat Balance of a Water Surface (Sur l'Utilization de la Temperature d'Equilibre pour l'Etablissement du Bilan Thermique d'Un Plan d'Eau),
W82-01353 2H

CONNECTICUT AGRICULTURAL EXPERIMENT STATION, NEW HAVEN.
Removal of Phosphorus from Waste Water by Soil Under Aerobic and Anaerobic Conditions, W82-01344 5D

CONNECTICUT UNIV., STORRS. DEPT. OF CIVIL ENGINEERING.
Denitrification of Blackwater with Greywater, W82-01225 5D

CORNELL UNIV., ITHACA, NY.
Systems Analysis, W82-01303 6A

CORNELL UNIV., ITHACA, NY. DEPT. OF AGRICULTURAL ECONOMICS.
Economic Impacts of Erosion and Sedimentation Control Plans: Case Studies of Pennsylvania Dairy Farms, W82-01134 4D

CORNELL UNIV., ITHACA, NY. DEPT. OF AGRONOMY.
Phosphorus Concentration-Water Flow Interactions in Tile Effluent from Manured Land, W82-01340 5B

Formation of N-Nitrosodimethylamine During Treatment of Municipal Waste Water by Simulated Land Application, W82-01343 5D

Effects of Dairy Manure on Phosphorus Concentrations and Losses in Tile Effluent, W82-01479 5B

CORNELL UNIV., ITHACA, NY. DEPT. OF PLANT PATHOLOGY.
Simulation of Daily Weather Data Using Theoretical Probability Distributions, W82-01526 2B

CORNELL UNIVERSITY, ITHACA, NY. SECTION OF ECOLOGY AND SYSTEMATICS.
Recent Acidification of Precipitation in North America, W82-01514 5B

CORVALLIS ENVIRONMENTAL RESEARCH LAB., OR.
Stream Nutrient Levels and Proximity of Agricultural and Forest Land to Streams: Some Relationships, W82-01554 5B

DAMES AND MOORE, ATLANTA, GA.
Surface Water Management at Hazardous Waste Sites, W82-01429 5G

DEDHAM WATER CO., MA.
Organic Contamination of Ground Water: Tell it All, W82-01474 5C

DELAWARE UNIV., NEWARK. COLL. OF MARINE STUDIES.
Sites of River-Derived Sedimentation in the Ocean, W82-01332 7B

DELAWARE UNIV., NEWARK. DEPT. OF GEOGRAPHY.
Using Computed Stream Flow in Watershed Analysis, W82-01538 2A

DELTA INST. FOR HYDROBIOLOGICAL RESEARCH, YERSEKE (NETHERLANDS).
Chemical Control of Mussel Settlement in a Cooling Water System Using Acrolein, W82-01501 5F

DENVER UNIV., CO. DEPT. OF CHEMISTRY.
Preconcentration for Trace Element Determination in Aqueous Samples, W82-01574 5A

DENVER UNIV., CO. DEPT., OF GEOGRAPHY.
Debris Flows in Small Mountain Stream Channels of Colorado and Their Hydrologic Implications, W82-01597 2E

DEPARTMENT OF AGRICULTURE, CHARLOTTETOWN (PRINCE EDWARD ISLAND). RESEARCH STATION.
Comparison of Tests Characterizing Varieties of Barley and Wheat for Moisture Stress Resistance, W82-01114 2I

DEPARTMENT OF AGRICULTURE, HARROW (ONTARIO). RESEARCH STATION.
Climatic Factors Contributing to Year-To-Year Variation in Grain Yield of Corn on Brookston Clay, W82-01115 2I

Estimating Evapotranspiration from Irrigated Crops in Southwestern Ontario, W82-01116 2D

DEPARTMENT OF AGRICULTURE, LETHBRIDGE (ALBERTA). RESEARCH STATION.
Water and Salt Movement in a Saline-Sodic Soil in Southern Alberta, W82-01119 2G

Prediction of Diffusion Coefficients from the Electrical Conductance of Soil, W82-01224 2G

DEPARTMENT OF AGRICULTURE, SUMMERLAND (BRITISH COLUMBIA).
Nonpoint N Runoff from Agricultural Watersheds into the Great Lakes, W82-01148 5B

DEPARTMENT OF AGRICULTURE, SWIFT CURRENT (SASKATCHEWAN). EXPERIMENTAL FARM.
The Effect of Snow Trapping and Cropping Sequence on Moisture Conservation and Utilization in West-Central Saskatchewan, W82-01117 3F

DEPARTMENT OF AGRICULTURE, SWIFT CURRENT (SASKATCHEWAN). RESEARCH STATION.
Yield and Phenotypic Traits of Semidwarf and Normal-Statured Barley (Hordeum Vulgare L.) Genotypes Grown Under Differing Levels of Moisture Stress, W82-01121 2I

DEPARTMENT OF ENERGY, PITTSBURGH, PA. PITTSBURGH ENERGY TECHNOLOGY CENTER.
Nearshore Spatial Distribution of Fishes in Gill Net Samples, Cayuga Lake, New York, W82-01195 7A

DEPARTMENT OF SCIENFITIC AND INDUSTRIAL RESEARCH, LOWER HUTT (NEW ZEALAND). PHYSICS AND ENGINEERING LAB.
On Identification and Validation of Some Geothermal Models, W82-01467 6A

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, LOWER HUTT (NEW ZEALAND). PHYSICS AND ENGINEERING LAB.
Identification of the Wairakei Geothermal System, W82-01312 2F

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, WELLINGTON (NEW ZEALAND). INDUSTRIAL PROCESSING DIV.
U.V.-DOC Characterization of Pulp and Paper Bleach Effluents, W82-01495 5A

DEPARTMENT OF THE ENVIRONMENT, EDMONTON. DIV. OF DESIGN AND CONSTRUCTION.
An Example of the Application of Statistical Techniques to Predict Lake Level Elevations, W82-01111 6A

DEPARTMENT OF THE ENVIRONMENT, LONDON (ENGLAND).
Thoughts on the Need to Control Discharges to Estuarial and Coastal Waters, W82-01384 6E

DETROIT WATER AND SEWERAGE DEPT., MI.
Detroit - Fresh Clean Water, W82-01506 5D

DONOHUE AND ASSOCIATES, INC., SHEBOYGAN, WI. ENVIRONMENTAL DIV.
A Successful Low Technology Wastewater Process, W82-01178 5D

DREXEL UNIV., PHILADELPHIA, PA.
Microbiology of Wastewater Treatment, W82-01291 5D

DUKE UNIV., DURHAM, NC.
Sludge Treatment, Utilization, and Disposal, W82-01247 5E

DURHAM UNIV. (ENGLAND). DEPT. OF BOTANY.
Phytoplankton of Four Rivers, the Tyne, Wear, Tees and Swale, W82-01376 2E

ECOLE NORMALE SUPERIEURE, ABIDJAN (IVORY COAST).
Data on the Stagnant Ponds of the Savannah of Lamto (Ivory Coast) (Donnees sur les Milieux Limniques Stagnants des Savanes de Lamto (Cote d'Ivoire)), W82-01357 2H

ECOLOGICAL ANALYSTS, INC., SPARKS, MD.
Bioassays - Procedures and Results, W82-01277 5A

ECONOMICS AND STATISTICS SERVICE, WASHINGTON, DC. NATURAL RESOURCE ECONOMICS DIV.
Managing Land to Meet Water Quality Goals, W82-01557 4D

ELECTRIC POWER RESEARCH INST., PALO ALTO, CA.
Entrainment and Impingement in Power Plant Cooling Systems, W82-01276 6G

ENGINEERED CONSTRUCTION INTERNATIONAL, INC., PITTSBURG, PA.
Soil-Bentonite Supply Trench Cutoffs, W82-01599 8D

ENVIRODYNE ENGINEERS, KNOXVILLE, TN.
Solid Wastes and Water Quality, W82-01269 5B

ENVIRONMENTAL PROTECTION AGENCY, CINCINNATI, OH.
Health Effects Associated with Wastewater Treatment and Disposal, W82-01255 5C

ENVIRONMENTAL PROTECTION AGENCY, CINCINNATI, OH.

Microbiology of Water,
W82-01284 5B

Microbiology: Methodology and Quality Assurance,
W82-01285 5A

Microbiology: Detection of Bacterial Pathogens and Their Occurrence,
W82-01288 5B

ENVIRONMENTAL PROTECTION AGENCY, DALLAS, TX. REGION VI.
Microbiology of Ground Water,
W82-01286 5B

Microbiology of Potable Water,
W82-01287 5F

ENVIRONMENTAL PROTECTION AGENCY, DULUTH, MN.
Toxicity and Bioaccumulation of Endrin and Methoxychlor in Aquatic Invertebrates and Fish,
W82-01160 5C

The Effects of Pollution on Freshwater Fish,
W82-01282 5C

ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, DC.
The National Assessment of the Ground-Water Contamination Potential of Wastewater Impoundments,
W82-01419 5G

ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, DC. OFFICE OF ANALYSIS AND EVALUATION.
Background Document for Modification of pH Effluent Limitations Guidelines and Standards for Point Sources Required by NPDES Permit to Monitor Continuously Effluent pH.
W82-01438 5D

ENVIRONMENTAL PROTECTION SERVICE, BURLINGTON (ONTARIO). WASTE WATER TECHNOLOGY CENTRE.
Data Base Development for the Design of a Radium-226 Removal Process,
W82-01188 5D

Steel Industry Wastes,
W82-01264 5D

ENVIRONMENTAL RESEARCH LAB.-DULUTH, MN.
Polychlorinated Biphenyls and Other Organic Chemical Residues in Fish from Major United States Watersheds Near the Great Lakes, 1978,
W82-01583 5A

ERTEC WESTERN INC., LONG BEACH, CA.
Cyclic Strengths Compared for Two Sampling Techniques,
W82-01170 8D

FEDERAL ENERGY REGULATORY COMMISSION, WASHINGTON, DC.
Application of Aerial Photographs and Surficial Geologic Maps to the Determination of Suitability of Land for Septic Tank Systems,
W82-01569 7B

FEDERAL ENERGY REGULATORY COMMISSION, WASHINGTON, DC. OFFICE OF ELECTRIC POWER REGULATION.
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W82-01352 5D

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Influence of PCBs in Water on Uptake and Elimination of DDT and DDE by Lake Trout,
W82-01342 5C

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, ANN ARBOR, MI. GREAT LAKES ENVIRONMENTAL RESEARCH LAB.
Comparison of First-Order Error Analysis and Monte Carlo Simulation in Time-Dependent Lake Eutrophication Models,
W82-01460 2H

Nepheloid and Suspended Particulate Matter in South-Eastern Lake Michigan,
W82-01499 2H

Release of Phosphorus by Certain Benthic Invertebrates,
W82-01502 2H

NATIONAL PHYSICAL RESEARCH LAB., PRETORIA (SOUTH AFRICA).
Gaseous Nitrogen as Evidence for Denitrification in Groundwater,
W82-01485 2K

NATIONAL POWER PLANT TEAM, ANN ARBOR, MI.
An Empirical Methodology for Estimating Entrainment Losses at Power Plants Sited on Estuaries,
W82-01173 6G

Cooling Water Intake Screening Devices Used to Reduce Entrainment and Impingement,
W82-01442 8I

NATIONAL WATER PLAN COMMISSION, MEXICO CITY.
Hydroelectrical Model for Optimal Operation of a Single Multipurpose Reservoir,
W82-01329 6A

NATIONAL WATER RESEARCH INST., BURLINGTON (ONTARIO). ENVIRONMENTAL CONTAMINANTS DIV.
Biogeochemical Investigation of Big Creek Marsh, Lake Erie, Ontario,
W82-01163 2H

NATIONAL WATER RESEARCH INSTITUTE, WINNIPEG (MANITOBA). FRESHWATER INST.
Historical Changes and Relationship to Internal Loading of Sediment Phosphorus Forms in Hypertrophic Prairie Lakes,
W82-01516 2H

NEBRASKA UNIV., LINCOLN. DEPT. OF AGRICULTURAL ENGINEERING.
Effects of Water and Nitrogen Management on Nitrate Leaching Loss from Sands,
W82-01581 5B

NEVADA UNIV. SYSTEM, RENO. DEPT. OF CIVIL ENGINEERING.
Optimal Risk-Based Design of Flood Levee Systems,
W82-01313 8B

NEVADA UNIV. SYSTEM, RENO. DESERT RESEARCH INST.
Experimental Verification of the Linear Relationship Between IR Extinction and Liquid Water Content of Clouds,
W82-01525 7B

Lidar Determinations of Atmospheric Ice Crystal Layers at South Pole During Clear-Sky Precipitation,
W82-01529 2C

NEVADA UNIV. SYSTEMS, RENO. DEPT. OF CIVIL ENGINEERING.
Risk Models for Flood Levee Design,
W82-01307 8A

NEW BRUNSWICK UNIV., FREDERICTON. DEPT. OF CIVIL ENGINEERING.
Evaluation of Effective Boundary Roughness for Gravel-Bed Rivers,
W82-01161 8B

NEW MEXICO AGRICULTURAL EXPERIMENTAL STATION, LAS CRUCES.
Spatial Variability of Steady-State Infiltration Rates as a Stochastic Process,
W82-01560 2G

NEW ORLEANS UNIV., LA. DEPT. OF CHEMISTRY.
Determination of Nanogram Quantities of Mercury in Water with a Gold-Plated Piezoelectric Crystal Detector,
W82-01509 5A

NEW YORK STATE DEPT. OF ENVIRONMENTAL CONSERVATION, ALBANY.
Preliminary Report of Stream Sampling for Acidification Studies 1980,
W82-01453 5A

NEW YORK STATE DEPT. OF HEALTH, ALBANY. DIV. OF LABS. AND RESEARCH.
Love Canal: Chemical Contamination and Migration,
W82-01436 5B

NEWCASTLE UNIV., NEW SOUTH WALES (AUSTRALIA). DEPT. OF CIVIL ENGINEERING.
Expansion of Effluent Constrained Treatment Plants,
W82-01355 5D

NIELSON, MAXWELL AND WANGSGARD, SALT LAKE CITY, UT.
Land Application of Municipal Wastewater,
W82-01253 5D

NORTH CAROLINA STATE UNIV. AT RALEIGH.
Acid Precipitation: Basic Principles and Ecological Consequences,
W82-01586 5C

NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF BIOLOGICAL AND AGRICULTURAL ENGINEERING.
Combination Surface-Subsurface Drainage Systems for Humid Regions,
W82-01228 4A

Water Management Model Evaluation for North Central Ohio,
W82-01536 4A

NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF PULP AND PAPER SCIENCE.
O2 Bleaching Shows Potential for Reducing Costs and Effluent Problems,
W82-01578 5D

NORTHUMBRIAN WATER AUTHORITY, GOSFORTH (ENGLAND).
A Catchment Approach to Flood Estimation,
W82-01397 2E

NOTRE DAME UNIV., IN.
Fermentation Industry,
W82-01257 5D

O'BRIEN AND GERE ENGINEERS, INC., SYRACUSE, NY.
Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements,
W82-01278 5C

OAK RIDGE NATIONAL LAB., ENVIRONMENTAL SCIENCES DIV.
Hydraulic Properties of Fullerton Cherty Silt Loam,
W82-01561 2G

OAK RIDGE NATIONAL LAB., TN.
Continuous Monitoring, Automated Analysis, and Sampling Procedures,
W82-01240 5A

Radioactive Wastes,
W82-01268 5D

A Dendroclimatic Reconstruction of Annual Precipitation Amounts in Iowa Since 1680,
W82-01314 2B

Concentrating Organics in Water for Biological Testing,
W82-01591 5A

OAK RIDGE NATIONAL LAB., TN. CHEMICAL TECHNOLOGY DIV.
Open-Pore Polyurethane as a Medium for Coal Conversion Process Aqueous Effluent Cleanup,
W82-01577 5D

OAK RIDGE NATIONAL LAB., TN. ENGINEERING TECHNOLOGY DIV.
Weather Modification from Cooling Towers. A Test Based on the Distributional Properties of Rainfall,
W82-01527 2B

OAK RIDGE NATIONAL LAB., TN. ENVIRONMENTAL SCIENCES DIV.
The Role of Atmospheric Deposition in an Eastern U.S. Deciduous Forest,
W82-01491 5B

OHIO STATE UNIV., COLUMBUS. DEPT. OF MICROBIOLOGY.
Sediment Distribution of Methanogenic Bacteria in Lake Erie and Cleveland Harbor,
W82-01233 2H

OHIO STATE UNIV., PUT-IN-BAY. CENTER FOR LAKE ERIE AREA RESEARCH.
Limnetic Larval Fish of the Maumee and Sandusky River Estuaries,
W82-01197 7A

OKLAHOMA STATE UNIV., STILLWATER.
Petroleum Processing Wastes,
W82-01262 5D

OKLAHOMA STATE UNIV., STILLWATER. DEPT. OF AGRONOMY.
Super Slurper Effects on Crust Strength, Water Retention, and Water Infiltration of Soils,
W82-01562 2G

ONTARIO MINISTRY OF AGRICULTURE AND FOOD, GUELPH (ONTARIO). PESTICIDE RESIDUE LAB.
PCB Residues in Bottom Sediments Collected From the Bay of Quinte, Lake Ontario 1972-1973,
W82-01155 5B

ONTARIO MINISTRY OF AGRICULTURE AND FOOD, GUELPH. PESTICIDE RESIDUE LAB.
Organochlorine Insecticides and PCB in Surficial Sediments of Lake Michigan (1975),
W82-01190 5A

ONTARIO MINISTRY OF THE ENVIRONMENT, REXDALE.
Comparison of Selective Media for the Enumeration and Identification of Fecal Streptococci from Natural Sources,
W82-01564 5A

ONTARIO MINISTRY OF THE ENVIRONMENT, TORONTO.
An Analysis of Acidic Precipitation in South-Central Ontario Using Air Parcel Trajectories,
W82-01513 5B

OREGON STATE UNIV., CORVALLIS. DEPT. OF CIVIL ENGINEERING.
Factors Affecting the Fate of Heavy Metals in the Activated Sludge Process,
W82-01547 5D

OTTAWA UNIV. (ONTARIO). DEPT. OF BIOLOGY.
Strategies of Response to Copper, Cadmium, and Lead by a Blue-Green and a Green Alga,
W82-01598 5C

PACIFIC SOUTHWEST FOREST AND RANGE EXPERIMENT STATION, ARCATA, CA.
Storm Flow Response to Road Building and Partial Cutting in Small Streams of Northern California,
W82-01295 4C

PACIFIC SOUTHWEST FOREST AND RANGE EXPERIMENT STATION, BERKELEY, CA.
Suspended Sediment Production from Forested Watersheds on Oahu, Hawaii,
W82-01531 2J

PARIS UNIV. (FRANCE).
Use of Excised Root Cultures as Bioindicators of Water Pollution (Utilisation Des Cultures de Racines Isolees Comme Test Biologique de Pollution des Eaux),
W82-01133 5A

PENN ENVIRONMENTAL CONSULTANTS, INC., PITTSBURGH, PA.
Remedial Options for Ground Water Protection at Abandoned Solid Waste Disposal Facilities,
W82-01426 5G

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK. DEPT. OF LANDSCAPE ARCHITECTURE.
Erosion and Sedimentation Control in Regional and Site Planning,
W82-01552 4D

PENNSYLVANIA UNIV., PHILADELPHIA.
Aluminum in Precipitation, Streams, and Shallow Groundwater in the New Jersey Pine Barrens,
W82-01297 5B

PENWALT CORP., KING OF PRUSSIA, PA. TECHNOLOGICAL CENTER.
High Temperature Ultrafiltration with Kynar Poly(Vinylidene Fluoride) Membranes,
W82-01566 5D

PERTH PUBLIC WORKS DEPT. (AUSTRALIA).
Predicting Stream Salinity Changes in South-Western Australia,
W82-01350 6A

Land and Stream Salinity in Western Australia,
W82-01374 5B

PHYSICAL RESEARCH LAB., AHMEDABAD (INDIA).
An Approach to Determining Pathways and Residence Time of Groundwaters: Dual Radiotracer Dating,
W82-01348 2F

PISA UNIV. (ITALY).
Mercury and Lead Concentrations in Some Species of Fish From the Tuscan Coasts (Italy),
W82-01368 5B

PLYMOUTH POLYTECHNIC (ENGLAND). DEPT. OF MARINE SCIENCE.
The Distribution of Mercury in the Sediments of the Plym Estuary,
W82-01390 5B

POPE SCIENTIFIC, INC., MENOMONEE FALLS, NI.
Inorganics,
W82-01238 5A

PORTLAND STATE UNIV., OR.
An Index of Arizona Summer Rainfall Developed Through Eigenvector Analysis,
W82-01528 2B

PRINCETON UNIV., NJ. DEPT. OF CIVIL ENGINEERING.
Regional Flood Frequency Estimation and Network Design,
W82-01294 2E

Dynamic Nutrient Cycle Model for Waste Stabilization Ponds,
W82-01541 5D

PUNJAB AGRICULTURAL UNIV., LUDHIANA (INDIA).
Irrigation Needs and Yield of Rice on a Sandy-Loam Soil as Affected by Continuous and Intermittent Submergence,
W82-01382 3F

PURDUE UNIV., LAFATETTE IN. SCHOOL OF CIVIL ENGINEERING.
Performance Evaluation of a Stochastic Optimization Model for Reservoir Design and Management with Explicit Reliability Criteria,
W82-01462 8A

QUEBEC UNIV., MONTREAL. DEPT. OF EARTH SCIENCES.
018 Modelling of Freshwater Inputs in Baffin Bay and Canadian Arctic Coastal Waters,
W82-01590 2C

RAIN BIRD WESTERN SALES CORP., GLENDORA, CA.
Characterizing Sprinkler Distribution Patterns with a Clustering Algorithm,
W82-01575 3F

Significant Features of Emitter Flushing Mode Characteristics,
W82-01576 3F

RAND CORP., SANTA MONICA, CA.
Anomalous Snowfall Caused by Natural-Draft Cooling Towers,
W82-01512 2B

RAVENSHAW COLL., CUTTACK (INDIA). DEPT. OF ZOOLOGY.
Observations on the Hydrography and Inshore Plankton of the Bay of Bengal off Balasore,
W82-01362 2A

REGINA RESEARCH STATION (SASKATCHEWAN).
A Comparison of Chemical and Cultural Control of Weeds in Irrigation Ditchbanks,
W82-01120 4A

RESOURCES FOR THE FUTURE, INC., WASHINGTON, DC.
Analysis of National Water Pollution Control Policies 1. A National Network Model,
W82-01292 6A

Analysis of National Water Pollution Control Policies 2. Agricultural Sediment Control,
W82-01293 6A

RESOURCES MANAGEMENT ASSOCIATES, LAFAYETTE, CA.
Mapping Contaminated Soil Plumes by Kriging,
W82-01423 5G

REXNORD INC., MILWAUKEE, WI.
Thermal Effects,
W82-01275 5C

RICE UNIV., HOUSTON, TX. DEPT. OF ENVIRONMENTAL SCIENCE AND ENGINEERING.
Groundwater Contamination by Trace Level Organics from a Rapid Infiltration Site,
W82-01496 5B

RIJKSINSTITUUT VOOR DE VOLKSGEZONDHEID, BILTHOVEN (NETHERLANDS).
Methyl Bromide and Bromide-Ion in Drainage Water After Leaching of Glasshouse Soils,
W82-01492 5B

ROTHAMSTED EXPERIMENTAL STATION, HARPENDEN (ENGLAND). DEPT. OF PHYSICS.
Scaling of Infiltration Behavior in Dissimilar Porous Materials,
W82-01105 2G

SASKATCHEWAN UNIV., SASKATOON. DEPT. OF GEOGRAPHY.
Snowmelt Prediction in a Subarctic Drainage Area,
W82-01571 2C

SCIENCE AND EDUCATION ADMINISTRATION, BELTSVILLE, MD.
Residue and Tillage Effects on SCS Runoff Curve Numbers,
W82-01404 4D

SCIENCE AND EDUCATION ADMINISTRATION, BOISE, ID. NORTHWEST WATERSHED RESEARCH CENTER.
Automatic Class-A Pan-Filling System,
W82-01326 7B

SCIENCE AND EDUCATION ADMINISTRATION, COLUMBIA, MO.
Time Distribution of Clock Hour Rainfall,
W82-01402 2A

Gully Erosion,
W82-01407 2J

SCIENCE AND EDUCATION ADMINISTRATION, DURANT, OK. SOUTHERN PLAINS WATERSHED AND WATER QUALITY LAB.
The Depth of Rainfall-Runoff-Soil Interaction as Determined by P32,
W82-01318 5B

SCIENCE AND EDUCATION ADMINISTRATION, DURANT, OK. SOUTHERN PLAINS WATERSHED AND WATER QUALITY MANAGEMENT LAB.
Nitrate Production, Uptake, and Leaching,
W82-01411 5B

SCIENCE AND EDUCATION ADMINISTRATION, DURANT, OK. WATER QUALITY MANAGEMENT LAB.
Enrichment Ratios for Water Quality Modeling,
W82-01410 2J

SCIENCE AND EDUCATION ADMINISTRATION, KIMBERLEY, ID. SNAKE RIVER RESEARCH CENTER.
A Combined Salt Transport-Chemical Equilibrium Model for Calcareous and Cypsiferous Soils,
W82-01230 5B

SCIENCE AND EDUCATION ADMINISTRATION, LAFAYETTE, IN.
Sediment Transport Capacity of Overland Flow,
W82-01408 2J

SCIENCE AND EDUCATION ADMINISTRATION, LINCOLN, NE.
Chemical and Bacteriological Quality of Pasture Runoff,
W82-01555 5B

SCIENCE AND EDUCATION ADMINISTRATION, MORGANTOWN, WV.
Effects of Sanitary Landfill Leachage on Some Soil Chemical Properties,
W82-01480 5E

SCIENCE AND EDUCATION ADMINISTRATION, MORRIS, MN. NORTH CENTRAL SOIL CONSERVATION RESEARCH LAB.
Soluble N and P Concentrations in Surface Runoff Water,
W82-01413 5B

SCIENCE AND EDUCATION ADMINISTRATION, OXFORD, MS. SEDIMENTATION LAB.
Selecting a Formula to Estimate Sediment Transport Capacity in Nonvegetated Channels,
W82-01405 2J

Modeling Erosion and Sediment Yield from Flatland Watersheds,
W82-01406 2J

Estimating Soluble (PO4-P) and Labile Phosphorus in Runoff from Croplands,
W82-01412 5B

SCIENCE AND EDUCATION ADMINISTRATION, PHOENIX, AZ. WATER CONSERVATION LAB.
Canopy Temperature as a Crop Water Stress Indicator,
W82-01106 2I

Erosivity 'R' for Individual Design Storms,
W82-01403 2J

SCIENCE AND EDUCATION ADMINISTRATION, STONEVILLE, MS. DELTA STATES AGRICULTURAL RESEARCH CENTER.
Pesticide Concentrations in Agricultural Runoff: Available Data and an Approximation Formula,
W82-01414 5B

SCIENCE AND EDUCATION ADMINISTRATION, TUCSON, AZ. SOUTHWEST RANGELAND WATERSHED RESEARCH CENTER.
Concentrated Flow Relationships,
W82-01409 2J

SCIENCE AND EDUCATION ADMINISTRATION, WASHINGTON, DC.
CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems.
W82-01401 5B

SCIENTIFIC AND EDUCATION ADMINISTRATION, COLUMBIA, MO. WATERSHED RESEARCH UNIT.
Sediment and Nutrient Trap Efficiency of a Small Flood-Detention Reservoir,
W82-01471 4A

SCIENTIFIC AND EDUCATION ADMINISTRATION, MORRIS, MN. NORTH CENTRAL SOIL CONSERVATION RESEARCH LAB.
Nitrogen Leaching as Influenced by Nitrogen Management and Supplement Irrigation Level,
W82-01472 5B

SCIENTIFIC AND EDUCATIONAL ADMINISTRATION, DURANT, OK. SOUTHERN PLAINS WATERSHED AND WATER QUALITY LAB.
The Release of Soil Phosphorous to Runoff in Relation to the Kinetics of Desorption,
W82-01477 5B

SERVICOS DE ENGENHARIA EMILIO BAUMGART LTD., BELO HORIZONTE (BRAZIL).
Interpreting Laboratory Results for the Design of Rapid Mixing and Flocculation Systems,
W82-01166 5F

SEVERN-TRENT WATER AUTHORITY, BIRMINGHAM (ENGLAND).
Development of Upton Intake Works, River Severn Supply Scheme, With the Aid of a Model,
W82-01395 8B

SEVERN-TRENT WATER AUTHORITY, BURMINGHAM (ENGLAND).
An Investigation Into the Effects of Thermal Movement in the Walls of Service Reservoirs,
W82-01396 8F

SHELL INTERNATIONALE RESEARCH MAATSHCAPPIJ N.V., THE HAGUE (NETHERLANDS). GROUP TOXICOLOGY DIV.
Holland's Eastern Scheldt Estuary Barrier Scheme: Some Ecological Considerations,
W82-01375 2L

SIMON FRASER UNIV., BURNABY (BRITISH COLUMBIA). DEPT. OF GEOGRAPHY.
Variations of pH with Annual Cumulative Precipitation in Acid Forest Soils,
W82-01118 2G

SMC-MARTIN, KING OF PRUSSIA, PA.
Top-Sealing to Minimize Leachate Generation, Case Study of the Windham, Connecticut, Landfill,
W82-01427 5G

SOIL SURVEY INST., WAGENINGEN (NETHERLANDS).
Measuring the Hydraulic Conductivity of Soil Adjacent to Tile Drains in a Heavy Clay Soil in the Netherlands,
W82-01323 2G

SOIL TESTING SERVICES OF WISCONSIN, INC., GREEN BAY.
Remedial Action Controls Groundwater Contamination at a Paper Mill Sludge Disposal Site,
W82-01582 5G

SONOMA STATE UNIV., ROHNERT PARK, CA. DEPT. OF CHEMISTRY.
Infrared Spectroscopic Study of the Water-Soluble Fraction of Sewage Sludge-Soil Mixtures During Incubation,
W82-01130 5E

SOUTHERN CALIFORNIA UNIV., LOS ANGELES. DEPT. OF GEOLOGICAL SCIENCES.
Some Recent Studies on Groundwater Radon Content as an Earthquake Precursor,
W82-01127 2F

SRI PRATAP COLL., SRINAGAR (INDIA). HYDROBIOLOGY LAB.
Comparative Limnology of Nine Lakes of Jammu and Kashmir Himalayas,
W82-01361 2H

STANFORD UNIV., CA. DEPT. OF ENVIRONMENTAL ENGINEERING.
Organics in Water - An Engineering Challenge,
W82-01540 5F

STATE OCEANOGRAPHIC INST., MOSCOW (USSR).
Balance of Biogenic Elements in the Aral Sea Upon a Drop of Its Level,
W82-01370 2H

STATE UNIV. OF NEW YORK AT BINGHAMTON. LAB. FOR TRACE METHODS AND ENVIRONMENTAL ANALYSIS.
Determination of Labilities of Soluble Trace Metal Species in Aqueous Environmental Samples by Anodic Stripping Voltammetry and Chelex Column and Batch Methods,
W82-01229 5A

STATE UNIV. OF NEW YORK AT BUFFALO. DEPT. OF GEOGRAPHY.
Drainage Network Structure and the Diameter-Magnitude Relation,
W82-01308 2A

STATE UNIV. OF NEW YORK COLL. AT OSWEGO.
Case Studies on the Migration of Pollutants in Ground Water,
W82-01424 5B

STONE AND WEBSTER ENGINEERING CORP., BOSTON, MA.
Northfield Mountain Pumped Storage Project: Performance,
W82-01517 8A

STRATHCLYDE REGIONAL COUNCIL (SCOTLAND).
Design and Construction of Shieldhall Sewage-Treatment Works, Glasgow,
W82-01385 5D

SYEARNS AND WHEELER, CAZENOVIA, NY.
Urban Runoff and Combined Sewer Overflow,
W82-01254 5B

TECHNION-ISRAEL INST. OF TECH., HAIFA.
A Numerical Solution for the Movement of an Interface in a Layered Coastal Aquifer,
W82-01327 2F

TECHNOS INC., MIAMI, FLORIDA.
Site Assessment: Improving Confidence Levels with Surface Remote Sensing,
W82-01422 5G

TEL AVIV UNIV. (ISRAEL). DEPT. OF GEOPHYSICS AND PLANETARY SCIENCES.
Uranium Isotopes as a Natural Tracer in the Waters of the Bet Shean-Harod Valleys, Israel,
W82-01328 2F

TENNESSEE UNIV., KNOXVILLE. DEPT. OF MICROBIOLOGY.
Phenanthrene Biodegradation in Freshwater Environments,
W82-01234 5B

Tenax-GC Extraction Technique for Residual Polychlorinated Biphenyl and Polyaromatic Hydrocarbon Analysis in Biodegradation Assays,
W82-01235 5A

TENNESSEE VALLEY AUTHORITY, CHATTANOOGA.
Coal and Coal Mine Drainage,
W82-01261 5G

LIBRARY U. S. L., URBANA-CHAMPAIGN

Dissolved Oxygen in Streams and Reservoirs,
W82-01272 5G

TENNESSEE VALLEY AUTHORITY, NORRIS.
Power Industry Wastes,
W82-01265 5B

TEXAS UNIVERSITY AT DALLAS, RICHARDSON.
Substrate Associated Microfauna,
W82-01283 5C

TORONTO UNIV. (ONTARIO). DEPT. OF GEOGRAPHY.
Public Concerns and PLUARG: Selected findings and Discussion,
W82-01137 5G

TORONTO UNIV. (ONTARIO). DEPT. OF MICROBIOLOGY AND PARASITOLOGY.
Persistence of Pseudomonas Aeruginosa in Chlorinated Swimming Pools,
W82-01124 5A

TOUHILL, SHUCKROW AND ASSOCIATES, INC., PITTSBURGH, PA.
Bench Scale Assessment of Technologies for Contaminated Ground Water Treatment,
W82-01433 5G

TOWER SYSTEMS INC., TACOMA, WA.
Optimum Recycle and Reuse Cooling System Designs Using the BCT Process,
W82-01503 3E

TRC ENVIRONMENTAL CONSULTANTS, INC., WETHERSFIELD, CT.
Preliminary Risk Evaluation for Suspected Hazardous Waste Disposal Sites in Connecticut,
W82-01417 5G

TRW ENVIRONMENT ENGINEERING DIV., REDONDO BEACH, CA.
Comparative Evaluation of Processes for the Treatment of Concentrated Wastewaters at Uncontrolled Hazardous Waste Sites,
W82-01430 5D

UNDERWOOD MCLELLAND AND ASSOCIATES LTD., WINNIPEG (MANITOBA).
Modeling Hydrologic Time Series from the Arctic,
W82-01198 2A

UNION CARBIDE CORP., SOUTH CHARLESTON, WV.
Chemicals and Allied Products,
W82-01267 5D

UNION CARBIDE CORP., SOUTH CHARLESTON, WV. CHEMICALS AND PLASTICS.
High-Solubility Gas Flotation,
W82-01184 5D

UNITED NATIONS ENVIRONMENT PROGRAM, GENEVA (SWITZERLAND). REGIONAL SEAS PROGRAMME ACTIVITY CENTER.
Water-Quality Monitoring: A Global Approach,
W82-01339 7A

UNIVERSITY COLL. OF SWANSEA (WALES). DEPT. OF BOTANY AND MICROBIOLOGY.
The Escherichia Coli Content of Mytilus Edulis from Analysis of Whole Tissue or Digestive Tract,
W82-01508 5A

UNIVERSITY OF WALES INST. OF SCIENCE AND TECHNOLOGY, CARDIFF. DEPT. OF APPLIED BIOLOGY.
The Effect of Pollutants from the Coal Industry on the Fish Fauna of a Small River in the South Wales Coalfield,
W82-01389 5C

UNIVERSITY OF WEST FLORIDA, PENSACOLA. DEPT. OF BIOLOGY.
The Effects of Organophosphorus Pesticides on Estuarine Ammonium Oxidizers,
W82-01567 5C

UNIVERSITY OF WESTERN ONTARIO (LONDON). DEPT. OF GEOLOGY.
Ferromanganese Nodules from Lake Ontario (Bay of Quinte): Minor Element Geochemistry,
W82-01143 2H

UNIVERSITY OF WESTERN ONTARIO (LONDON). DEPT. OF PLANT SCIENCES.
A Quantitative Study of Shoreline Marsh Communities Along Lake Huron in Ontario,
W82-01122 2H

UTAH STATE UNIV., LOGAN.
Lagoons and Oxidation Ponds,
W82-01244 5D

UTAH STATE UNIV., LOGAN. COLL. OF ENGINEERING.
Energy Requirement for Small Wastewater Treatment Systems,
W82-01185 5D

UTAH WATER RESEARCH LAB., LOGAN.
A Balloonborne Instrument for the Measurement of Vertical Profiles of Supercooled Liquid Water Concentration,
W82-01524 7B

VALLEY SANITARY DISTRICT, CA.
O & M Wastewater Collection and Treatment Facilities,
W82-01249 5D

VICTORIA UNIV. (BRITISH COLUMBIA).
Environmental Recovery in a Marine Ecosystem Impacted by a Sulfite Process Pulp Mill,
W82-01548 5B

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG.
Activated Sludge,
W82-01243 5D

Electroplating and Cyanide Wastes,
W82-01266 5D

Effects of Pollution on Freshwater Invertebrates,
W82-01280 5C

Law,
W82-01302 6E

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF BIOLOGY.
Evaluation of Ultraviolet Spectrophotometric Determination of Nitrate-Nitrogen in Glacial Snow, Firn and Ice,
W82-01572 5A

VIRGINIA UNIV., CHARLOTTESVILLE. DEPT. OF ENVIRONMENTAL SCIENCES.
Geomorphology of the Colorado River in the Grand Canyon,
W82-01338 2J

VOLCANI INST. OF AGRICULTURAL RESEARCH, BET-DAGAN (ISRAEL). DIV. OF SOIL PHYSICS.
Determination of Solution Electrical Conductivity from Bulk Soil Electrical Conductivity Measurements by the Four-Electrode Method,
W82-01458 2G

VOLCANI INST. OF AGRICULTURAL RESEARCH, BET-DAGEN (ISRAEL).
Utilization Efficiency of Nitrogen from Sewage Effluent and Fertilizer Applied to Corn Plants Growing in a Clay Soil,
W82-01515 3C

WASHINGTON STATE UNIV., PULLMAN. DEPT. OF ENVIRONMENTAL SCIENCE.
Hydropower Losses from Navigation in the Snake-Columbia Rivers: 1978-79,
W82-01139 6D

WASHINGTON UNIV., SEATTLE.
Organics,
W82-01239 5A

WATER AND POWER RESOURCES SERVICE, SACRAMENTO, CA.
Discussion-Engineering Geology of Arid Areas,
W82-01568 4B

WATER POLLUTION RESEARCH LAB., STEVENAGE (ENGLAND).
New Approaches to Anaerobic Sludge Digestion,
W82-01398 5D

WATER RESEARCH CENTRE, MARLOW (ENGLAND).
Mass Transport of Solutes in Dual-Porosity Media,
W82-01104 5B

Artificial Groundwater Recharge,
W82-01110 4B

WATER RESEARCH CENTRE, STEVENAGE (ENGLAND).
Developments in Sedimentation and Flotation,
W82-01391 5F

Groundwater Investigations in the Vale of Stathmore,
W82-01400 2F

The Application of Mutagenicity Testing to Drinking Water,
W82-01487 5A

WATERLOO UNIV. (ONTARIO). DEPT. OF BIOLOGY.
Some Effects of Agricultural Land Use on Stream Insect Communities,
W82-01159 5C

WATERLOO UNIV. (ONTARIO). DEPT. OF EARTH SCIENCES.
Origin, Age and Movement of Pore Water in Agrillaceous Quaternary Deposits at Four Sites in Southwestern Ontario,
W82-01321 2F

Carbon 14 Dating of Groundwater in Confined Aquifers: Implications of Aquitard Diffusion,
W82-01464 2F

WAYNE COUNTY BOARD OF PUBLIC WORKS, MI.
The Wayne County, Michigan, Wastewater Collection and Treatment System,
W82-01505 5D

WESTERN AUSTRALIA UNIV., NEDLANDS. DEPT. OF MICROBIOLOGY.
A Note on the Use of Membrane Faecal Coliform Medium for Enhancing Resolution and Accuracy When Enumerating a Small Plaquing Coliphage,
W82-01507 5A

WISCONSIN-MILWAUKEE UNIV. DEPT. OF GEOLOGICAL SCIENCES.
Monitoring Ground-Water Contamination at a Fly Ash Disposal Site Using Surface Electrical Resistivity Methods,
W82-01218 5B

Monitoring Leachate in Ground Water by Corrected Resistivity Methods,
W82-01219 5A

WISCONSIN UNIV.-MADISON.
Onsite Alternatives for Treatment and Disposal,
W82-01248 5D

WISCONSIN UNIV.-MADISON. DEPT. OF GEOLOGY AND GEOPHYSICS.
Seasonal Reversals of Groundwater Flow Around Lakes and the Relevance to Stagnation Points and Lake Budgets,
W82-01103 2F

WISCONSIN UNIV. MADISON. DEPT. OF PREVENTIVE MEDICINE.
Chrysotile Asbestos Fibers in Drinking Water from Asbestos-Cement Pipe,
W82-01592 5B

WISCONSIN UNIV.-MILWAUKEE. DEPT. OF GEOLOGICAL SCIENCES.
The Effect of Flyash Disposal on a Shallow Ground-Water System,
W82-01220 5B

WOODS HOLE OCEANOGRAPHIC INSTITUTION, MA.
Volatile C1-C7 Organic Compounds in Surface Sediments from Walvis Bay,
W82-01367 5B

WOODWARD-CLYDE CONSULTANTS, SAN FRANCISCO, CA.
Extraction Timing and Economic Incentives for Geothermal Reservoir Management,
W82-01504 4B

WORLDWATCH INST., WASHINGTON, DC.
Hydropower--An Old Technology for a New Era,
W82-01593 4A

YORKSHIRE WATER AUTHORITY (ENGLAND).
The River Ouse Water Supply Scheme,
W82-01371 5F

UNIVERSITY OF ILLINOIS-CHAMPAIGN

ACCESSION NUMBER INDEX

W82-01101 5D
W82-01102 5D
W82-01103 2F
W82-01104 5B
W82-01105 2G
W82-01106 2I
W82-01107 2G
W82-01108 5C
W82-01109 5B
W82-01110 4B
W82-01111 6A
W82-01112 2I
W82-01113 4B
W82-01114 2I
W82-01115 2I
W82-01116 2D
W82-01117 3F
W82-01118 2G
W82-01119 2G
W82-01120 4A
W82-01121 2I
W82-01122 2H
W82-01123 5A
W82-01124 5A
W82-01125 5C
W82-01126 2H
W82-01127 2F
W82-01128 2C
W82-01129 5B
W82-01130 5E
W82-01131 5B
W82-01132 5B
W82-01133 5A
W82-01134 4D
W82-01135 2G
W82-01136 5B
W82-01137 5G
W82-01138 6A
W82-01139 6D
W82-01140 4C
W82-01141 5A
W82-01142 5F
W82-01143 2H
W82-01144 2H
W82-01145 5B
W82-01146 5G
W82-01147 2H
W82-01148 5B
W82-01149 5C
W82-01150 7A
W82-01151 5B
W82-01152 5B
W82-01153 2H
W82-01154 2H
W82-01155 5B
W82-01156 2J
W82-01157 2H
W82-01158 5D
W82-01159 5C
W82-01160 5C
W82-01161 8B
W82-01162 5A
W82-01163 2H
W82-01164 2H
W82-01165 5F
W82-01166 5F
W82-01167 5D
W82-01168 6A
W82-01169 8D
W82-01170 8D
W82-01171 8B
W82-01172 5B
W82-01173 6G
W82-01174 2G
W82-01175 6C
W82-01176 2J
W82-01177 5D
W82-01178 5D
W82-01179 2F
W82-01180 5D
W82-01181 6D
W82-01182 5B
W82-01183 2L
W82-01184 5D
W82-01185 5D
W82-01186 5A
W82-01187 7B
W82-01188 5D
W82-01189 5C
W82-01190 5A
W82-01191 2H
W82-01192 2H
W82-01193 6A
W82-01194 8I
W82-01195 7A
W82-01196 2H
W82-01197 7A
W82-01198 2A
W82-01199 4B
W82-01200 5G
W82-01201 7C
W82-01202 7C
W82-01203 7C
W82-01204 7C
W82-01205 7C
W82-01206 7C
W82-01207 7C
W82-01208 7C
W82-01209 7C
W82-01210 2E
W82-01211 7C
W82-01212 7C
W82-01213 7C
W82-01214 7C
W82-01215 7C
W82-01216 7C
W82-01217 7C
W82-01218 5B
W82-01219 5A
W82-01220 5B
W82-01221 5B
W82-01222 2F
W82-01223 5B
W82-01224 2G
W82-01225 5D
W82-01226 3C
W82-01227 5C
W82-01228 4A
W82-01229 5A
W82-01230 5B
W82-01231 5C
W82-01232 5C
W82-01233 2H
W82-01234 5B
W82-01235 5A
W82-01236 6E
W82-01237 8G
W82-01238 5A
W82-01239 5A
W82-01240 5A
W82-01241 5D
W82-01242 5D
W82-01243 5D
W82-01244 5D
W82-01245 5D
W82-01246 5D
W82-01247 5E
W82-01248 5D
W82-01249 5D
W82-01250 5D
W82-01251 5D
W82-01252 3C
W82-01253 5D
W82-01254 5B
W82-01255 5C
W82-01256 5D
W82-01257 5D
W82-01258 5D
W82-01259 5D
W82-01260 5D
W82-01261 5G
W82-01262 5D
W82-01263 5B
W82-01264 5D
W82-01265 5B
W82-01266 5D
W82-01267 5D
W82-01268 5D
W82-01269 5B
W82-01270 5B
W82-01271 2H
W82-01272 5G
W82-01273 2F
W82-01274 5C
W82-01275 5C
W82-01276 6G
W82-01277 5A
W82-01278 5C
W82-01279 5B
W82-01280 5C
W82-01281 5C
W82-01282 5C
W82-01283 5C
W82-01284 5B
W82-01285 5A
W82-01286 5B
W82-01287 5F
W82-01288 5B
W82-01289 5C
W82-01290 5A
W82-01291 5D
W82-01292 6A
W82-01293 6A
W82-01294 2E
W82-01295 4C
W82-01296 6A
W82-01297 5B
W82-01298 2G
W82-01299 6C
W82-01300 5A
W82-01301 6A
W82-01302 6E
W82-01303 6A
W82-01304 5G
W82-01305 5B
W82-01306 2D
W82-01307 8A
W82-01308 2A
W82-01309 6A
W82-01310 2I
W82-01311 7B
W82-01312 2F
W82-01313 8B
W82-01314 2B
W82-01315 2F
W82-01316 2J
W82-01317 2E
W82-01318 5B
W82-01319 2F
W82-01320 6A
W82-01321 2F
W82-01322 2K
W82-01323 2G
W82-01324 2A
W82-01325 2B
W82-01326 7B
W82-01327 2F
W82-01328 2F
W82-01329 6A
W82-01330 6A
W82-01331 6B
W82-01332 7B
W82-01333 7B
W82-01334 2F
W82-01335 2F
W82-01336 2F
W82-01337 6E
W82-01338 2J
W82-01339 7A
W82-01340 5B
W82-01341 3A
W82-01342 5C
W82-01343 5D
W82-01344 5D
W82-01345 7B
W82-01346 2C
W82-01347 5E
W82-01348 2F
W82-01349 3B
W82-01350 6A
W82-01351 6F
W82-01352 5D
W82-01353 2H
W82-01354 2A
W82-01355 5D
W82-01356 5C
W82-01357 2H
W82-01358 5A
W82-01359 2H
W82-01360 2H
W82-01361 2H
W82-01362 2A
W82-01363 3C
W82-01364 2H
W82-01365 5F
W82-01366 5C
W82-01367 5B
W82-01368 5B
W82-01369 2I
W82-01370 2H
W82-01371 5F
W82-01372 2H
W82-01373 5A
W82-01374 5B
W82-01375 2L
W82-01376 2E
W82-01377 5C
W82-01378 2H
W82-01379 2H
W82-01380 2B
W82-01381 2H
W82-01382 3F
W82-01383 6E
W82-01384 6E
W82-01385 5D
W82-01386 5D
W82-01387 5E
W82-01388 5B
W82-01389 5C
W82-01390 5B
W82-01391 5F
W82-01392 5D
W82-01393 7A
W82-01394 8A
W82-01395 8B
W82-01396 8F
W82-01397 2E
W82-01398 5D
W82-01399 2A
W82-01400 2F
W82-01401 5B
W82-01402 2A
W82-01403 2J
W82-01404 4D
W82-01405 2J
W82-01406 2J
W82-01407 2J
W82-01408 2J
W82-01409 2J
W82-01410 2J
W82-01411 5B
W82-01412 5B
W82-01413 5B
W82-01414 5B
W82-01415 5B
W82-01416 5G
W82-01417 5G
W82-01418 5G
W82-01419 5G
W82-01420 5G
W82-01421 5G
W82-01422 5G
W82-01423 5G
W82-01424 5B
W82-01425 5B
W82-01426 5G
W82-01427 5G
W82-01428 5G
W82-01429 5G
W82-01430 5D
W82-01431 5A
W82-01432 5E
W82-01433 5G
W82-01434 5D
W82-01435 5G
W82-01436 5B

W82-01437 5E
W82-01438 5D
W82-01439 6D
W82-01440 6D
W82-01441 6D
W82-01442 8I
W82-01443 5B
W82-01444 6G
W82-01445 5C
W82-01446 8A
W82-01447 1B
W82-01448 4A
W82-01449 6A
W82-01450 6A
W82-01451 5D
W82-01452 7A
W82-01453 5A
W82-01454 5D
W82-01455 6E
W82-01456 6E
W82-01457 5C
W82-01458 2G
W82-01459 5B
W82-01460 2H
W82-01461 5B
W82-01462 8A
W82-01463 2J
W82-01464 2F
W82-01465 4C
W82-01466 2C
W82-01467 6A
W82-01468 5D
W82-01469 2K
W82-01470 2K
W82-01471 4A
W82-01472 5B
W82-01473 4B
W82-01474 5C
W82-01475 6A
W82-01476 6B
W82-01477 5B
W82-01478 3C
W82-01479 5B
W82-01480 5E
W82-01481 2F
W82-01482 5D
W82-01483 2H
W82-01484 5F
W82-01485 2K
W82-01486 2J
W82-01487 5A
W82-01488 2A
W82-01489 5D
W82-01490 5F
W82-01491 5B
W82-01492 5B
W82-01493 5A
W82-01494 5C
W82-01495 5A
W82-01496 5B
W82-01497 5C
W82-01498 5B
W82-01499 2H
W82-01500 5E
W82-01501 5F
W82-01502 2H
W82-01503 3E
W82-01504 4B
W82-01505 5D
W82-01506 5D
W82-01507 5A
W82-01508 5A
W82-01509 5A
W82-01510 2H
W82-01511 2C
W82-01512 2B
W82-01513 5B
W82-01514 5B
W82-01515 3C
W82-01516 2H
W82-01517 8A
W82-01518 5E
W82-01519 7B
W82-01520 2H
W82-01521 2H
W82-01522 7B
W82-01523 7B
W82-01524 7B
W82-01525 7B
W82-01526 2B
W82-01527 2B
W82-01528 2B
W82-01529 2C
W82-01530 2C
W82-01531 2J
W82-01532 5A
W82-01533 7B
W82-01534 6E
W82-01535 2B
W82-01536 4A
W82-01537 8C
W82-01538 2A
W82-01539 6A
W82-01540 5F
W82-01541 5D
W82-01542 5F
W82-01543 5D
W82-01544 5D
W82-01545 5D
W82-01546 2I
W82-01547 5D
W82-01548 5B
W82-01549 5D
W82-01550 5B
W82-01551 4D
W82-01552 4D
W82-01553 3D
W82-01554 5B
W82-01555 5B
W82-01556 4D
W82-01557 4D
W82-01558 2C
W82-01559 5G
W82-01560 2G
W82-01561 2G
W82-01562 2G
W82-01563 2J
W82-01564 5A
W82-01565 5A
W82-01566 5D
W82-01567 5C
W82-01568 4B
W82-01569 7B
W82-01570 5B
W82-01571 2C
W82-01572 5A
W82-01573 5A
W82-01574 5A
W82-01575 3F
W82-01576 3F
W82-01577 5D
W82-01578 5D
W82-01579 5D
W82-01580 4A
W82-01581 5B
W82-01582 5G
W82-01583 5A
W82-01584 5B
W82-01585 3C
W82-01586 5C
W82-01587 6E
W82-01588 8A
W82-01589 5D
W82-01590 2C
W82-01591 5A
W82-01592 5B
W82-01593 4A
W82-01594 5D
W82-01595 2H
W82-01596 5D
W82-01597 2E
W82-01598 5C
W82-01599 8D
W82-01600 6E

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- WATER QUALITY MANAGEMENT AND PROTECTION
- WATER RESOURCES PLANNING
- RESOURCES DATA
- ENGINEERING WORKS
- MANPOWER, GRANTS, AND FACILITIES
- SCIENTIFIC AND TECHNICAL INFORMATION

INDEXES

- SUBJECT INDEX
- AUTHOR INDEX
- ORGANIZATIONAL INDEX
- ACCESSSION NUMBER INDEX

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APRIL 1, 1982

W82-01601 -- W82-02100
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UNIVERSITY OF ILLINOIS
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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Office of Water Research and Technology,
U.S. Department of the Interior

VOLUME 15, NUMBER 4
APRIL 1, 1982

W82-01601 -- W82-02100

The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

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PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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THE OFFICE OF WATER RESEARCH AND TECHNOLOGY DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology
U.S. Department of the Interior
Washington, D.C. 20240

CONTENTS

SUBJECT FIELDS AND GROUPS

Please use the edge index on the back cover to locate Subject Fields and Indexes.

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

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SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

APPLICATIONS OF STRIPPING ANALYSIS TO METAL DETERMINATIONS IN NATURAL WATERS,
Colorado State Univ., Fort Collins. Dept. of Chemistry.
J. E. Bonelli.
PhD Dissertation, 1980. 187 p 4 Fig, 4 Tab, 182 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX80-28725.

Descriptors: *Metal *Analytical techniques, *Electrochemistry, Water, Freshwater, Zinc, Cadmium, Lead, Copper, Thallium, Water analysis, Stripping analysis.

Analytical methods for the simultaneous multielement determination of zinc, cadmium, lead, and copper, and for the determination of thallium in natural waters are presented. The methods were optimized for their specific intended applications, evaluated, and applied to ultratrace metals determinations in a variety of natural water samples. Interference effects due to intermetallic compound formation, variations in acidity, and unresolved oxidation processes were evaluated and minimized. A positive interference on copper determinations due to iron was identified and characterized. A simple, experimental compensation technique for this latter interference effect was devised and applied to copper determinations in a river water sample. Experimental results indicate that anodic stripping determinations can be performed in a thiocyanage supporting electrolyte medium. Although the gallium electrode was found to be of limited utility for trace analysis by anodic stripping voltammetry, its unique characteristics may lead to other electrochemical applications. (Sinha-OEIS)
W82-01670

NON-EQUILIBRIUM WATER/ROCK INTERACTIONS,
Stanford Univ., CA. Dept. of Geology.
W. E. Dibble, Jr.
PhD Dissertation, 1980. 179 p, 17 Fig, 9 Tab, 118 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-24643.

Descriptors: *Crystal growth, *Mass transfer, Interfaces, Silicates, Chemical reactions, *Mass transport, *Mineral water reactions.

The results of established crystal growth theory and silicate dissolution experiments are combined in developing a new model for mineral/water reactions controlled by surface processes. The overall reaction rate at steady-state is determined by coupling equations for the velocities of mass transport and interface detachment processes. Non-steady state processes can be successfully treated when interface reactions control the rate. For most sparingly soluble minerals, diffusion through the solution can be neglected as a rate-determining factor. Experimental rate data for quartz dissolution are used to define molecular activation mechanisms based on the kink-site detachment model. The quartz dissolution mechanism involves binding of ionic species to surface detachment sites. Surface binding reactions are controlled mainly by the sign and magnitude of the surface electrostatic potential. The dissolution of silicates is more complex than quartz dissolution because most silicates dissolve incongruently. To determine variations in interface composition as a result of incongruent dissolution, values of the chemical potentials of components in the bulk solid phase must be known. The results are used to predict chemical potential values for F- and Li-bearing components and for components in the exchange position of smectites. They show that small amounts of fluorine in a sheet silicate significantly affect the Gibbs energy of formation. (Sinha-OEIS)
W82-01684

1B. Aqueous Solutions and Suspensions

THE SPREADING OF THIN LIQUID FILMS ON A WATER-AIR INTERFACE,
McGill Univ., Montreal (Quebec). Dept. of Civil Engineering and Applied Mechanics.
M. Foda, and R. G. Cox.
Journal of Fluid Mechanics, Vol 101, No 1, p 33-51, November, 1980. 8 Fig, 1 Tab, 17 Ref.

Descriptors: *Films, *Oil-water interfaces, *Physical properties, Thin films, Monomolecular films, Water-air interfaces, Surface tension, Fate of pollutants, Oil pollution, Fluid mechanics.

The spreading of liquid layers on the surface of an immiscible supporting liquid (example, an oil slick on a water body) occurs according to three basic mechanisms: first, gravity opposed by inertia; then, gravity opposed by viscous drag; and finally, after a very long time, when the layer is almost molecularly thin, surface tension, replacing gravity. The paper produces a similarity solution for unidirectional spreading in the third stage, when surface tension is the driving force. The monolayer is considered to be spreading on a quiescent water surface, such as in a long channel. Assumptions are that: (1) the monolayer spreads in a positive direction so that the length is a function of time, (2) the monolayer thickness does not vary, and (3) oil must be continually supplied to the monolayer. The solution gives both the size of the film as a function of time and the velocity and thickness distribution along the spreading film. Experiments with spreading of silicone fluid on distilled water at rest in a channel (120 x 9 x 5 cm deep) produced good agreement with the theory. (Cassar-FRC)
W82-01955

THE CONTAINMENT OF AN OIL SLICK BY A BOOM PLACED ACROSS A UNIFORM STREAM,
McGill Univ., Montreal (Quebec). Dept. of Civil Engineering and Applied Mechanics.
N. D. Di Pietro, and R. G. Cox.
Journal of Fluid Mechanics, Vol 96, No 3, p 613-640, February, 1980. 9 Fig, 1 Tab, 25 Ref.

Descriptors: *Films, *Oil-water interfaces, *Surface tension, Physical properties, Fluid mechanics, Thin films, Monomolecular films, Water-air interfaces, Oil pollution.

In a spreading oil slick a surface tension region exists between the gravity-viscous and monolayer regions. Pressure differences across the oil-water and oil-air interfaces are important in this region, usually only a few mm wide. The surface tension region is important because it is necessary to connect the solution with the gravity-viscous and monolayer regions, and the slopes of the interfaces are largest here. This idea is used to find the theoretical thickness profile of an oil layer contained upstream of an oil boom placed across a channel in which water is flowing at a constant velocity. The total length of the spreading layer and its thickness at the barrier are found as functions of velocity and volume. It is assumed that: (1) the velocity difference across the oil layer is small compared with the water velocity, (2) the monolayer and bulk layer lengths are much larger than the capillary length scale, (3) the interfaces have small slopes, (4) inertia effects in oil and the pressure variations in substrate flow are neglected, (5) the boundary layer in the water is laminar, and (6) the monolayer is not depleted. General conditions for validity of results are discussed. Modifications are given for the case where the boundary layer in the substrate is turbulent. Experimental results from studies on unsteady spreading on quiescent water in a channel agreed well with theory. (Cassar-FRC)
W82-01956

2. WATER CYCLE

2A. General

CAN WE MODEL THE RAINFALL-RUNOFF PROCESS TODAY,
Eidgenoessische Technische Hochschule, Zurich (Switzerland), Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
F. Naef.
Hydrological Sciences Bulletin, Vol 26, No 3, p 281-289, September, 1981. 4 Fig, 4 Tab, 6 Ref.

Descriptors: *Model studies, *Rainfall-runoff relationships, Runoff, Rainfall, Mathematical studies, Simulation.

This paper attempts to illustrate how some of the widely used models for simulating rainfall-runoff processes in a basin are able to operate with data which can be collected with reasonable effort and expense. Models available for such tasks include simple ones such as the unit hydrograph, Nash cascade, runoff coefficient and linear regression; mathematical models which are models with a simple structure but which employ sophisticated methods for parameter or error estimation such as CLS; conceptual models such as Stanford and Sacramento; and physically based models which are based on the solution of differential equations for evapotranspiration, infiltration and runoff. Models of different complexity were calibrated to three small basins with dense networks of recording rain gauges and reliable stream gauges. Under average conditions it was found that the simulation and forecasting of discharge were not difficult tasks. They could be successfully solved using simple concepts. Furthermore, the selection of the model was not critical to the result. However, forecasts made under extraordinary conditions or extrapolations using the models tested appeared to be practically a matter of luck. None of them truly reflected the runoff process, and the data were not available in the required quality. (Baker-FRC)
W82-01609

KINEMATIC FLOW APPROXIMATION OF RUNOFF ON A PLANE: AN EXACT ANALYTICAL SOLUTION,
Griffith Univ., Brisbane, Queensland (Australia). School of Australian Environmental Studies.
J. Y. Parlange, C. W. Rose, and G. Sander.
Journal of Hydrology, Vol 52, No 1-2, p 171-176, June, 1981. 1 Fig, 8 Ref.

Descriptors: *Overland flow, *Model studies, *Rainfall-runoff relationships, *Excess rainfall, *Watershed management, Flow patterns, Mathematical equations, Mathematical studies, Storm runoff, Surface runoff, Laminar flow, Sheet erosion, Soil erosion, *Plane flow, Irrigation effects, Erosion control.

An analytical solution is offered for the estimation of kinematic flow for an excess rainfall runoff. The solution operates on any arbitrary function of time and generalizes a previously proposed model for situations of constant excess rainfalls over a finite period of time. The problem of overland flow was solved by the method of characteristics using a system of mathematical equations. The solution was applied successfully to calculate the runoff resulting from a variable rate of excess rainfall, and also to a problem in border irrigation. The model reproduces the results of an earlier qualitative solution which dealt with the rise and drop of the water level and the progressive reduction of the region where the sheet has a constant thickness. (Geiger-FRC)
W82-01617

PARAMETER ESTIMATION OF RAINFALL-RUNOFF MODELS WITH HETEROSCEDASTIC STREAMFLOW ERRORS--THE NONINFORMATIVE DATA CASE,
Case Western Reserve Univ., Cleveland, OH. Dept. of Systems Engineering.
S. Sorooshian.

Group 2A—General

Journal of Hydrology, Vol 52, No 1/2, p 127-138, June, 1981. 1 Fig, 1 Tab, 12 Ref. OWRT-C-90320-G(9442)(1).

Descriptors: *Rainfall-runoff relationships, *Model studies, Runoff, Precipitation, Stochastic hydrology, Hydrology, Streamflow.

Due to practical difficulties encountered in obtaining adequate weight estimates, the use of the weighted least-squares criterion for parameter estimation of rainfall-runoff models has been restricted. An estimation procedure is presented which is able to correct the effect of heteroscedastic (changing variance) streamflow errors. The noninformative data case is assumed, and for that a Bayesian formulation is used to automatically estimate the proper weights. Subsequently, the weights are used in the maximum likelihood estimator to evaluate the model parameters. A four-parameter model was used to test the new method, and comparisons were made with the simple least squares criterion and with the weighted objective function of the HEC-1 of the US Army Corps of Engineers, using synthetic data. The study indicated that the need for specifying subjective weighting functions or guessing the values of the weights was totally eliminated. Sensitivity analysis revealed that the resulting response surface of the MLE criterion where the search for model parameters takes place was smoother and more concentric. The improved concentricity of the parameter space helped the search algorithm and increased the chances for convergence to a parameter set which was closer to the true set. The study also suggested that special care is needed in selecting weighting functions. If the selected weighting rule does not explain to some degree the stochastic properties of the errors, then the resulting parameter estimates may produce wrong forecasts. The implementation of the new procedure was easy. (Baker-FRC)
W82-01657

A MODEL OF THE ANTARCTIC SINK FOR STRATOSPHERIC WATER VAPOR,
Iowa State Univ., Ames.
A. R. Douglass.
PhD Dissertation, 1980. 137 p, 24 Fig, 14 Tab, 65 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-06007.

Descriptors: *Water balance, *Water vapor, *Antarctic, Model studies, Exchange processes.

The main focus of the work is the development of a model through which the sink mechanism can be quantified and understood in the context of the rest of the annual water vapor budget. The classical description of the stratospheric water vapor distribution is discussed and other proposed sources of stratospheric water vapor and their implications for the annual budget are considered. Observational evidence that led to the proposal of the Antarctic sink mechanism is also presented. The upper limit of the amount of water vapor removed from the stratosphere in 1973 is slightly larger than the lower limit of estimates of the amount of water vapor added to the stratosphere by oxidation of methane. If no other sources are operational, and the methane source strength were shown to be the low estimate, the Antarctic sink would allow balance to be achieved in the annual budget. Even so, it would be difficult to explain the observed water vapor distribution if this high altitude source were to be balanced only by a south polar sink. At least in the northern hemisphere, where there is no winter stratospheric sink, the lack of a pronounced vertical and poleward gradient of water vapor mixing ratio remains a puzzle, especially if the methane source is at the upper limit of the estimates. Although any circulation proposed for the stratosphere must not contradict the observations of stratospheric water vapor, it is with caution that the water vapor may be used as a tracer of trophosphere to stratosphere exchange processes. (Sinha-OEIS)
W82-01686

ANALYSIS OF THE ORIGIN OF WATER WHICH FORMS LARGE AUFEIS FIELDS ON THE ARCTIC SLOPE OF ALASKA USING GROUND AND LANDSAT DATA,
Maryland Univ., College Park.
For primary bibliographic entry see Field 2C.
W82-01690

GEOCHEMISTRY AND HYDRODYNAMICS IN THE HUTT AND LEEMAN EVAPORITIC LAGOONS, WESTERN AUSTRALIA: A COMPARATIVE STUDY,
Uranerz Australia Party, Ltd., Subiaco.
For primary bibliographic entry see Field 2L.
W82-01746

HYDROLOGIC DATA FOR EXPERIMENTAL AGRICULTURAL WATERSHEDS IN THE UNITED STATES, 1972,
Science and Education Administration, Beltsville, MD. Water Data Lab.
Science and Education Administration, Miscellaneous Publication Number 1412, September 1981. 437 p, 98 Fig, 630 Tab, 75 Ref. J. B. Burford, J. L. Delashmutt, and R. T. Roberts, compilers.

Descriptors: *Agricultural watersheds, *Hydrologic data, *Precipitaion, Rainfall-runoff relationships, Experimental basins, Steamflow, Steam discharge.

Selected hydrologic data from 131 watersheds for 1972 are reported including data on monthly precipitation and runoff for all the watersheds; annual maximum discharge and maximum volumes of runoff for intervals of 1, 2, 6, and 12 hours and 1, 2, and 8 days for 117 watersheds; daily precipitation for 130 watersheds; mean daily discharge for 131 watersheds; daily maximum and minimum air temperature for 18 watersheds; and detailed information on one or more selected typical storm events for 98 watersheds. Information on selected storm events includes: tabular data for antecedent rainfall and runoff; data on rainfall intensity and runoff for the event and on accumulated depth of rainfall and runoff; description of watershed conditions at the time of the selected events; and plottings of runoff hydrograms and rainfall histograms. For newly established watersheds, descriptions of watershed physical characteristics, instrumentation, land management and recommended area of application of the results are given. There are 19 waterhseds installed in recent years and not previously reported. (Moore-SRC)
W82-01772

A MATHEMATICAL MODEL OF THE HYDROLOGIC REGIME OF THE UPPER NILE BASIN,
Snowy Mountains Engineering Corp., Cooma (Australia).
J. A. H. Brown, F. M. J. Ribeny, E. J. Wolanski, and G. P. Codner.
Journal of Hydrology, Vol 51, No 1-4, p 97-107, May, 1981. 4 Fig, 1 Tab, 4 Ref.

Descriptors: *Mathematical models, *Hydrological regime, *Nile Basin, Catchment basins, Basins, River basins, Africa, Channel flow, Lakes, Systems engineering, Computer programs.

The Upper Nile Basin Model was developed as part of the Hydrometeorological Survey of the Catchments of Lakes Victoria, Kyoga, and Mobutyu Sese Seko (Albert), sponsored by the United Nations Development Program. The hydrology of the basin is dominated by the role of the lakes, which cover about 20% of the total surface area. The model comprises three separate models combined into an overall system, which is the Upper Nile Basin Model. A catchment model enables the runoff of the catchments contributing to the three lakes to be estimated from rainfall and evapotranspiration data. A lake model computes outflows and changes in storage for various inflows and operational rules. A channel model is used to predict the movement of water in the main river channels between the lakes. The Upper Nile Basin Model includes a total of 36 programs and a master program which controls their selection. The 36 programs can be called up automatically in any predetermined sequence. Beginning with only rainfall and evaporation data, the model is capable of simulating the behavior of the whole basin and of computing the outflows from the system downstream of Lake Mobutu Sese Seko. Provisions for preselection of programs for a particular study, inclusion of new programs, and easy replacement or revision of individual existing programs contribute to the flexibility of the model. (Carroll-FRC)
W82-01857

AN AQUIFER SIMULATION PROGRAM FOR MICRO-BASED PROCESSORS,
Osmania Univ., Hyderabad (India). Centre of Exploration Geophysics.
For primary bibliographic entry see Field 2F.
W82-01879

DEVELOPMENT AND APPLICATIONS OF A RUNOFF MODEL FOR SNOWCOVERED AND GLACIERIZED BASINS,
Technical Univ. of Denmark, Lyngby. Inst. of Hydrodynamics and Hydraulic Engineering.
For primary bibliographic entry see Field 2C.
W82-01885

SPATIAL SIMULATION OF SNOW PROCESSES,
Danish Inst. of Applied Hydraulics, Hoersholm.
For primary bibliographic entry see Field 2C.
W82-01887

MODELING STORMWATER STORAGE/TREATMENT TRANSIENTS: THEORY,
Duke Univ., Durham, NC. Dept. of Civil Engineering.
M. A. Medina, Jr., W. C. Huber, and J. P. Heaney.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE4, p 781-797, August, 1981.

Descriptors: *Mathematical models, *Storm runoff, Storm water, Urban runoff, *Wastewater treatment, Simulation models, Water quality, Computers, Prediction, Water pollution, Storage requirements, Mathematical equations.

Preliminary planning and assessment of storm water storage and treatment needs and facilities is increasingly based on long-term characterization of the rainfall/runoff process rather than on selection of a particular design storm event. This characterization is achieved either by a deterministic approximation using continuous simulation models or through probabilistic analysis of storm event loads and storage/treatment device performance. This report discusses the development of a deterministic approach in which mathematical models are derived from the principle of conservation of mass to represent the movement, decay, storage, and treatment of storm water runoff pollutants and dry weather wastewater flows through natural and engineered transport systems. These mathematical models describe the transient response of storage/treatment systems to highly variable forcing functions of flow and concentration both for completely mixed systems of constant and variable volumes and for one-dimensional advective-dispersive systems. (Carroll-FRC)
W82-01980

2B. Precipitation

A STOCHASTIC CLUSTER MODEL OF DAILY RAINFALL SEQUENCES,
Purdue Univ., Lafayette, IN. School of Civil Engineering.
M. L. Kavvas, and J. W. Delleur.
Water Resources Research, Vol 17, No 4, p 1151-1160, August, 1981. 3 Fig, 3 Tab, 34 Ref. OWRT-B-036-IND(20).

Descriptors: *Rainfall, *Stochastic process, Model studies, Cluster models, Neyman-Scott model, Precipitation, *Indiana, Weather patterns.

The Neyman-Scott cluster process was applied to a two-level point stochastic model for rainfall

events at a given station in the time dimension. The primary level is rainfall-generating mechanisms; the secondary level, the rainfalls generated by the mechanisms. The cluster model assumes superposition of rainfalls (that the rainfall events occur in clusters and that the occurrence of rainfall events in a certain time interval is caused both by the given mechanism in the time interval and also by generating mechanisms which occurred before the interval). The model was tested with rainfall data from six stations in Indiana. Since the cluster model is time homogeneous, it may be of practical use only for stationary rainfall occurrences. (Cassar-FRC)
W82-01651

VARIOUS KINETIC ENERGY CHARACTERISTICS OF HAILPATTERNS IN THE GROSSVERSUCH IV EXPERIMENT,
Groupement National d'Etudes des Fleaux Atmospheriques, Grenoble (France).
J. F. Mezeix, and N. Doras.
Journal of Applied Meteorology, Vol 20, No 4, p 377-386, April, 1981. 10 Fig, 4 Tab, 21 Ref.

Descriptors: *Hail, *Kinetic energy, Kinetics, Precipitation, Sleet, Storms, Weather modification, Experimental data, Switzerland.

The Grossversuch hailpad network of hailfalls was used to record distinct hailpatterns and calculate their kinetic energy. Hailpad data was collected from 184 distinct non-seeded hailpatterns, so that possible characteristics of kinetic energy of hailpatterns might be grasped. It was noted from the four years of recorded data from 1975 through 1978 that the four year multi-annual distribution of global energy may be considered as lognormal, represented by a probability density function. The annual lognormal distributions, however, have statistically different means. Relations were established between global kinetic energy and several physical parameters of hailpatterns. Viewed from the kinetic energy aspect, the hail phenomenon seems to be organized. The regularity of the evolution of the physical characteristics of hailfalls may suggest an hypothesis of a hail production mechanism similar from one hailfall to another. Where kinetic energy is concerned, the result stays within the continuum for all the hailfalls. Some of the properties common to hailfalls will probably aid in the identification of physical effects in storm modification experiments. (Baker-FRC)
W82-01732

EVALUATION OF A PRECIPITATION MAP USING A SMOOTHED ELEVATION-PRECIPITATION RELATIONSHIP AND OPTIMAL ESTIMATES (KRIGING),
Service Hydrologique National, Bern (Switzerland).
F. A. deMontmollin, R. J. Olivier, R. G. Simard, and F. Zwahlen.
Nordic Hydrology, Vol 11, No 3/4, p 113-120, 1980. 4 Fig, 9 Ref.

Descriptors: *Precipitation, *Kriging, *Altitude, *Maps, *Switzerland, Mountains, Anomaly maps, Rain gages.

An annual average precipitation map for a mountainous 1600 sq km area between Neuchatel and Lausanne, Switzerland, was evaluated by the anomaly method, improved by using an optimal smoothed altitude index and universal kriging. Data from 45 rain gaging stations for the years 1974-76 were used. Altitude data was obtained from a data bank containing all the digitized altitudes for the western part of Switzerland on a 50-mile grid. A near optimal filtering window of 7 km was chosen. The average altitude over an area of optimized size was designated the index elevation. The precipitation range was 720-1200 mm, the higher amounts being found in the southern slope of the Jura Mountains and Jorat hills and the dry region in the center. (Cassar-FRC)
W82-01892

PHOTOMETRIC INVESTIGATIONS OF PRECIPITABLE WATER AND OPTICAL DEPTH WAVELENGTH EXPONENTS IN AN URBAN AREA,
Wyoming Univ., Laramie. Dept. of Atmospheric Science.
T. Yoksas.
Journal of Applied Meteorology, Vol 19, No 5, p 616-622, May, 1980. 4 Fig, 20 Ref.

Descriptors: *Aerosols, *Atmospheric water, *Water vapor, Urban areas, *Precipitation, Wavelengths, Data collections, Optical properties, *Photometry, St Louis, Missouri, METROMEX.

Aerosol loading and atmospheric precipitable water were monitored in the St. Louis urban area during Project METROMEX 1976. Data were collected with a six-channel Volz sunphotometer. A least-square fit of photometric observations to spatially and temporally proximate radiosonde measured precipitable water vapor produced the exponent (1/1.993) in the precipitable water equation. This indicates agreement with the square-root absorption law of band models. Wavelength exponents calculated from least-square fits of five water vapor transmission band optical depths to wavelengths were represented by a wavelength exponent of 1.71 + or - 0.54 using 70 observations. Modal values of the wavelength exponent were centered at 1.60 and 1.90. Trends in daily evolution of the wavelength exponent indicate the growth and decay of corresponding Junge-type power law aerosol size distributions similar to those measured in situ during previous studies in the same area. (Cassar-FRC)
W82-01966

OBSERVATIONS OF TWO COLORADO THUNDERSTORMS BY MEANS OF A ZENITH-POINTING DOPPLER RADAR,
Arizona Univ., Tucson. Inst. of Atmospheric Physics.
L. J. Battan.
Journal of Applied Meteorology, Vol 19, No 5, p 580-592, May, 1980. 7 Fig, 20 Ref.

Descriptors: *Thunderstorms, *Radar, Storms, Colorado, Arizona, Velocity, Wind velocity, Hail, Precipitation, Remote sensing.

A pulsed-Doppler radar, operated with its antenna pointed toward the zenith, was used to obtain data on the distributions of radar reflectivity, mean Doppler velocity, velocity, vertical air velocity, and Doppler-velocity variance in two thunderstorms over eastern Colorado. Data were collected at height intervals centered 152 meters apart. Previous studies have shown that many thunderstorms include a series of turbulent updraft cores spaced at distances of 1 to 3 kilometers, each of which is surrounded by sinking or slowly rising air. The cores are each composed of a current of rising air which includes a number of eddies having diameters of a few hundred meters to 1 or 2 kilometers. The two thunderstorms observed during the course of this study demonstrated some of the characteristics generally attributed to multicell thunderstorms, but the cell sizes were smaller and more frequent than previously reported. Hailstorms in southeastern Arizona also exhibited a series of turbulent updraft cores. On the basis of similarities between the thunderstorms observed in Colorado and those observed elsewhere, it is suggested that the variable nature of the radar reflectivities and updrafts may be a characteristic feature of most thunderstorms and that they may contribute significantly to the highly variable nature of hail. (Carroll-FRC)
W82-01967

WATER-ICE AND WATER-UPDRAFT RELATIONSHIPS NEAR -10 DEGREES C WITHIN POPULATIONS OF FLORIDA CUMULI,
National Hurricane and Experimental Meteorology Lab., Coral Gables, FL.
R. I. Sax, and V. W. Keller.
Journal of Applied Meteorology, Vol 19, No 5, p 505-514, May, 1980. 7 Fig, 1 Tab, 5 Ref.

Descriptors: *Cloud physics, *Crystallization, Rain, Clouds, Ice, Temperature effects, *Convective precipitation, *Florida.

During most late spring and summer afternoons, south Florida experiences a large population of cloud towers in various stages of development, with tops near the -10 C level. Penetration of several of these convective towers near their tops in the temperature range of -4 C to -12 C with aircraft specifically equipped to obtain cloud physics data resulted in the collection of an in-cloud microphysical data set which demonstrated a sequential development of cloud water, rainwater, graupel, and crytalline ice as the cloud ages. Repeat penetrations of some convection towers showed that some, but not all, experienced a very rapid onset of graupel. A separate data set showed a large scatter in the relationship between maximum value of cloud water and maximum value of vertical velocity, suggesting that measurements of cloud water, by themselves, can be misleading as an indication of cloud growth activity. The sequential pass data showing the evolution of ice and water are consistent with a rime-splintering, secondary ice production hypothesis. The variability in the decay of the cloud water mass observed from one cloud to another appears to be related to the detailed structure of the updraft and to the manner in which mixing of drier ambient air is occurring near the top of the cloud envelope. Three case studies are used to demonstrate the variabilities encountered in the evolutionary sequence of the four parameters. (Carroll-FRC)
W82-01968

ANOMALIES IN TEMPERATURE AND RAINFALL DURING WARM ARCTIC SEASONS AS A GUIDE TO THE FORMULATION OF CLIMATE SCENARIOS,
J. Williams.
Climatic Change, Vol 2, No 3, p 249-266, 1980. 9 Fig, 3 Tab, 16 Ref.

Descriptors: *Weather patterns, *Arctic, *Precipitation, Climatology, Atmospheric pressure, Air temperature, Seasonal variation, Air circulation.

Temperature, precipitation, and pressure anomalies in the northern hemisphere were investigated for the Arctic's 10 warmest winters (mean temperature -13.5 C) and 10 warmest summers (mean temperature 10.5 C) during the last 70 years. Means for the remaining years were -15.8 C in winter and 9.5 C in summer. This study was undertaken to secure information applicable to the problem of global warming from increased CO2 in the atmosphere. During warm periods in the Arctic, circulation changes produce anomalies elsewhere in the Northern Hemisphere, with some areas cooling and some warming. Warm winters produce larger amplitude anomalies than warm summers. In warm winters the sea level pressure field differs from the long-term mean in several regions, specifically Greenland-North Atlantic, while warm summers produce no such differences. Warm summers are associated with large coherent areas of increasing or decreasing mean precipitation in the Northern Hemisphere, as a result of circulation changes, while warm winters have no significant effect on precipitation. During warm Arctic summers, Alaska and the west coast of the U.S. are drier; the southern states and Florida, wetter. Positive differences in precipitation at several North American stations were as follows (in mm): Jacksonville, 103; Charleston, 103; New Orleans, 103; Yuma, 14; Sandusky, 54; Prince George, 57; Masset, 55. Negative differences (in mm) were found at: Topeka, -82; Peoria, -83; Des Moines, -74; Crete, -96; Lincoln, -106; Valentine, -47; Huron, -50; and Prince Albert, -42. (Cassar-FRC)
W82-01975

SIMPLIFIED METHOD FOR RAINFALL INTENSITIES,
Utah State Univ., Logan. Dept. of Agriculture and Irrigation Engineering.
G. H. Hargreaves.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR3, p 281-288, September, 1981. 1 Tab, 8 Ref.

Descriptors: *Precipitation, *Rainfall intensity, *Developing countries, Rainfall distribution, Weather data collections.

Several rainfall amount-intensity relationships were investigated with particular focus on providing rainfall intensity data for developing countries, where such data is inadequate for water resources development projects. Methods evaluated were regressions predicting maximum monthly rainfall from mean monthly rainfall, 10-year return period, 24-hour duration amounts from maximum monthly rainfall, and the full range of rainfall intensity-duration-frequencies from the 10-year 24-hour values. Data from Central America, the U.S., India, Australia, and, to a more limited extent, the world were used. Maximum monthly precipitation and outlying and evelope values can be reliably estimated from mean monthly rainfall. There is a fairly good relationship between 10-year, 24-hour rainfall and maximum monthly rainfall. For durations of 30 min to 4 days and return periods of 5 to 100 years, precipitation amounts vary approximately as the fourth root of the time and the sixth root of the return period. Errors may result from not compensating for anomalous storms, short records, inadequate station coverage, and nonrepresentative locations. Further statistical analysis of the equations in this paper is recommended to determine the extent of their application on a global scale. (Cassar-FRC)
W82-01978

NOTE ON RANDOM RAINDROPS AND SAMPLING ERROR,
Otago Univ. (New Zealand).
W. E. Bardsley.
Nordic Hydrology, Vol 11, No 1, p 1-6, 1980. 1 Tab, 4 Ref.

Descriptors: *Sampling, *Errors, *Rain gages, Mathematical studies, Precipitation, *Rainfall, Radar, Statistics.

Rain gage measurements and radar reflectivity of a given volume of air containing raindrops are among the variables of interest in precipitation studies which can be interpreted as series of random numbers of random variables. Some statistical results obtained by Robbins (1948) were used to obtain a general expression for the coefficient of variation of such variables when the number of terms per sum and the transformed variables follow any specified probability distribution. Some simple expressions are obtained for the special case of an exponential distribution of raindrop diameters. Some conclusions of Gertzman and Atlas (1977) were obtained as special cases of the general expression. (Cassar-FRC)
W82-02032

TOWARDS AN UNDERSTANDING OF THE EFFECTS OF OROGRAPHY ON THE DISTRIBUTION OF PRECIPITATION OVER THE CAPE PENINSULA,
Washington Univ., Seattle. Dept. of Atmospheric Sciences.
D. A. Erasmus.
South African Journal of Science, Vol 77, No 7, p 295-298, July, 1981. 5 Fig, 6 Ref.

Descriptors: *Orographic precipitation, *Precipitation intensity, *Cape Peninsula, Precipitation, Climates, Air circulation, Vortices, Flow, *South Africa.

The precipitation distribution in the vicinity of Table Mountain in the Cape Peninsula, South Africa, was investigated for five rainfall periods during the winter of 1977. For each of these periods, precipitation was associated with the passage of eastward moving baroclinic disturbances. An important factor was a strong flow of warm moist air at low levels to maintain the liquid water content of the feeder clouds. Seeding particles were generated at intermediate altitudes, which augmented rainfall and resulted in the downward displacement of the precipitation maximum. A vorticity was observed which may result in localized increases in rainfall. The vorticity may be the result of the confluence of fast moving air streams in the lee of the col between Table Mountain and Devil's Peak. A more comprehensive data network is needed to further understand precipitation in the area. (Small-FRC)
W82-02085

2C. Snow, Ice, and Frost

ANALYSIS OF THE ORIGIN OF WATER WHICH FORMS LARGE AUFEIS FIELDS ON THE ARCTIC SLOPE OF ALASKA USING GROUND AND LANDSAT DATA,
Maryland Univ., College Park.
D. K. Hall.
PhD Dissertation, 1980. 141 p, 18 Fig, 16 Tab, 53 Ref, Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-03882.

Descriptors: *Water sources, *Meteorological data, *Groundwater, Arctic, Melt water, *Alaska, Surface-groundwater relations, *Aufeis fields, River ice.

The origin of the water which forms large aufeis fields (overflow river ice) on the Arctic Slope of Alaska has been controversial. For this study, various hypotheses were tested using ground and satellite data to analyze the origin of the aufeis water. In addition, meteorological data from 1972 through 1979 were analyzed and graphically displayed with aufeis extent. It is concluded that aufeis extent in a given river channel on the Arctic Slope is controlled by discharge from reservoirs of groundwater. It seems probable that precipitation passes into limestone aquifers in the Brooks Range, through an interconnecting system of subterranean fracturs in calcareous rocks and ultimately discharges into alluvial sediments on the coastal plain to form aufeis. It is speculated that only small (perhaps beaded) aufeis patches are affected by local meteorological conditions of the months just prior to aufeis formation. (Sinha-OEIS)
W82-01690

ON THE VALUES AND VARIABILITY OF DEGREE-DAY MELTING FACTOR IN FINLAND,
Finnish Hydrological Office, Helsinki.
E. Kuusisto.
Nordic Hydrology, Vol 11, No 5, p 235-242, 1980. 4 Fig, 2 Tab, 4 Ref.

Descriptors: *Snowmelt, *Degree-day factor, *Heat transfer, Solar radiation, Forests, Precipitation, Seasonal variation, Snow depth, Snow density, *Finland.

The degree-day factor, widely used in snowmelt forecasting, was studied using data collected from 12 stake stations, each with 25 stakes in forest and 9 on open field. During 1959-1978 about 96,000 snow depth and 17,000 snow density measurements were obtained. The water equivalent of snow was calculated on the basis of the average of snow depth and density. The annual maximum water equivalent ranged between 80 and 180 mm at different stations in southern and central Finland, and between 120 and 250 mm in northern Finland. The seasonal averages of degree-day factor varied widely from station to station. For forest sites the mean was 2.42 mm per degree C per day (range 1.75-3.36 mm per degree C per day) and for open sites, 3.51 mm per degree C per day (range 2.82-4.94 mm per degree C per day). A 10% increase in canopy cover in forest sites decreased the degree-day factor by about 0.16 mm per degree C per day. On rainy pentades the average degree-day factors (in mm per degree C per day) were 2.16, 2.33, and 2.79 for forest and 3.21, 3.33, and 3.38 for open field in the precipitation classes 0-1, 1-10, and > 10 mm, respectively, contrary to expectations that greater solar radiation on clear days could lead to higher degree-day factors. The degree-day factor varied seasonally. In Finland in March it was 30-70% of the seasonal mean, which was reached during early April in the south and late April in the north. There was a greater increase in open field than in forest. (Cassar-FRC)
W82-01735

SUMMER ICE AND CARBON DIOXIDE,
Lamont-Doherty Geological Observatory, Palisades, NY.
G. Kukla, and J. Gavin.
Science, Vol 214, No 4520, p 497-503, October 30, 1981. 4 Fig, 3 Tab, 62 Ref.

Descriptors: *Ice, *Carbon dioxide, Temperature effects, Seasonal variation, Antarctic, Polar regions, Model studies.

Changes occurring in the surface air temperature of the earth and in the areas of snow and sea ice are reviewed. Data have been collected from satellite monitoring systems, from ship reports, from the Oceanographic Atlas of the Polar Seas, and from various published ice charts. The information gathered yielded several conclusions. The multiyear variability in the extent of the Antarctic sea ice is considerable and has a large potential impact on the energy budget of the middle and high southern latitudes. In the late spring and summer ice around Antarctica during the last few years has been less extensive than reported in atlases published prior to 1970. Pack ice in specific areas appears to have been more extensive from November through February in the 1930's than it is at present. The observations agree qualitatively with the expected effect of a carbon dioxide increase. The mean surface air temperatures along selected northern latitudes during spring and summer were higher in 1974 to 1978 than in 1934 to 1938. The positive anomalies appear to be associated with the seasonally shifting belt of melting snow. This finding is consistent with the temporal and spatial impact of increasing carbon dioxide predicted by the energy balance model. It is concluded that studies of highly variable components of the climate system such as snow and pack ice fields and associated surface air temperatures should be given priority in the search for early signs of a carbon dioxide effect. Conclusions about a relationship of the observed changes in snow and sea ice areas and surface air temperatures to carbon dioxide increases are only tentative. (Baker-FRC)
W82-01843

GLACIER SURVEYS IN ALBERTA - 1979,
National Water Research Inst., Burlington, (Ontario). Water Resources Branch.
I. A. Reid, and J. O. G. Charbonneau.
Report Series No 69, 1981. 18 p, 6 Fig, 20 Tab, 9 Ref.

Descriptors: *Glaciers, *Athabasca glacier, *Saskatchewan glacier, Surveys, Surface water, Runoff, Linear change, Volumetric change, Stereoscopic terrestrial photographs, *Alberta, *Melt water, Streamflow, *Glaciohydrology.

Glaciers act as natural regulators, storing water in winter and releasing it in summer. To gain some understanding of this phenomenon and the contribution which glaciers make to streamflow, the predecessors of the Water Survey of Canada began glacier surveys in 1945. The earlier surveys offered some clue to the role of the glacier, but the data collected were not sufficient to provide the overall picture. Following adoption of photogrammetric survey techniques, however, the glacier surveys have evolved to the extent that it is now feasible to produce a series of maps from which the linear, areal, directional and volumetric changes can be determined. The surveys have revealed that the glaciers, in general, are becoming smaller in size; hence the regulating effect on streamflow is diminishing. (WATDOC)
W82-01855

DEVELOPMENT AND APPLICATIONS OF A RUNOFF MODEL FOR SNOWCOVERED AND GLACIERIZED BASINS,
Technical Univ. of Denmark, Lyngby. Inst. of Hydrodynamics and Hydraulic Engineering.
L. Gottlieb.
Nordic Hydrology, Vol 11, No 5, p 255-272, 1980. 9 Fig, 2 Tab.

Descriptors: *Glaciers, *Snowmelt, *Runoff, Glaciohydrology, *Model studies, Ice cover, Peyto Glacier, Alberta, Johan Dahl Land Glacier, Greenland, *Runoff forecasting.

A model for prediction of daily runoff from snow-covered and glacial basins was developed and applied to two basins. The model divides the basin into an ice-free area and an ice-covered area, accounting for the large differences in heat balance,

runoff, meteorological conditions, and snow cover between the two types of areas. The heat exchage between atmosphere and snow or ice cover is calculated by a modified degree-day approach or, if the data are available, by the complete energy balance equation. The NAM model, a conceptual, lumped rainfall-runoff model, is used to calculate the amount of water routed to the stream each day. In the ice-covered area, runoff originates from the melting of seasonal snow cover and from melting of the permanent ice mass. The model treats the routing of melt water over the ice as a simple linear reservoir. The model was tested on the Peyto Glacier Basin, Alberta, for which 8 years of runoff data and meteorological observations were available. Overall agreement was quite good, but the model did not predict major peak flows accurately. The model was also used for the study of the Johan Dahl Land glacierized basin, Greenland, of interest in hydropower development. Here, 15 years of synthetic runoff were generated from 4 years of discharge data (1976-79). Estimates of average runoff were greatly improved; the standard deviation obtained using the 15 years generated data plus 4 years actual observations was half that of the standard deviation using only 4 years of observed runoff. (Cassar-FRC)
W82-01885

SPATIAL SIMULATION OF SNOW PROCESSES,
Danish Inst. of Applied Hydraulics, Hoersholm.
A. G. Thomsen.
Nordic Hydrology, Vol 11, No 5, p 273-284, 1980. 10 Fig, 1 Tab, 4 Ref.

Descriptors: *Snowmelt, *Snow accumulation, *Satellite technology, Simulation analysis, Model studies, Watersheds, Hydrographs, Streamflow, Forest management, Remote sensing.

A system of simulation models designed to efficiently use both traditional and remotely sensed data sources is presented. Watershed information on topography, vegetation, and soils in digital terrain models serve as a data base for watershed analysis, classification of snow in Landsat imagery, and automatic generation of parameter decks for operating distributed simulation models of snow cover dynamics and streamflow generation. The system is tested in the Williams Fork Watershed in the Central Rocky Mountains of Colorado, area 476 sq km, elevation 2380 to 4137 meters. The models can be used individually or in combination. EXTRACT automatically defines hydrologic response units and calculate their parameters from data in overlays. WATBAL is a snow process simulation model requiring daily extreme temperatures and precipitation as driving variables. LATFLOW simulates overland flow and baseflow contributions to the snowmelt hydrograph and the dominant lateral flow component. Using EXTRACT it is also possible to simulate watershed response to thinning or clear cutting timber stands. SNOWPCT is available for classifying the fractional snow covered area within Landsat pixels (ground resolution elements). (Cassar-FRC)
W82-01887

EVAPORATION FROM A SNOW COVER--REVIEW AND DISCUSSION OF MEASUREMENTS,
Lulea Univ. (Sweden). Div. of Water Resources Engineering.
For primary bibliographic entry see Field 2D.
W82-01888

LIMITATIONS IN HYDROLOGICAL INTERPRETATIONS OF THE SNOW COVERAGE,
Federal Inst. for Snow and Avalanche Research, Davos/Weissfluhjoch (Switzerland).
J. Martinec.
Nordic Hydrology, Vol 11, No 5, p 209-220, 1980. 10 Fig, 2 Tab, 7 Ref.

Descriptors: *Snow cover, *Runoff, *Snowmelt, Seasonal variation, Alpine regions, Dischma Basin, *Switzerland.

Although patterns of receding snow cover in a given area are similar from year to year, they cannot be used to reliably predict the volume of stored snow or water and seasonal runoff. The Dischma basin, Switzerland, had similar snow cover (about 40-45%) on July 5, 1974, and June 8, 1976, but the measured runoffs for 150 degree days from the starting date were 14.2 million cu meters and 6.4 million cu meters, respectively. Similar snow cover in June 21, 1972, and July 17, 1978, produced 9.6 million cu meters and 12.8 cu meters, respectively. The areal extent of the snow cover appears to be related to the ratio of the current water equivalent to its maximum value in the respective year. (Cassar-FRC)
W82-01889

2D. Evaporation and Transpiration

WATER REQUIREMENTS AND MAN-INDUCED CLIMATE CHANGE,
Utah State Univ., Logan. Dept. of Agriculture and Irrigation Engineering.
G. H. Hargreaves.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR3, p 247-255, September, 1981. 9 Ref.

Descriptors: Evapotranspiration, *Water requirements, *Climatology, *Agriculture, Research priorities, *Carbon dioxide, Water management, Temperature, Air temperature, Crop production, *Global climate change.

The global temperature rise expected over the next 50 years as a result of increased concentrations of CO2 in the atmosphere from fossil fuel burning will affect water requirements. Doubling of CO2 concentrations would increase temperatures by 2 C near the equator and 8 C at 83 degrees latitude. This temperature rise would shift crop zones 250-300 miles further north and increase photosynthesis. Total increases in water requirements, considering increases due to higher temperature and increases in length of growing season, are 16% at 30 degrees latitude, 27% at 40 degrees, 42% at 50 degrees, and 63% at 60 degrees. At the same time, rainfall in the 37-47 degree latitudes, where the major portion of U.S. corn and livestock is produced, is expected to decrease. However, potential benefits (increased crop production) may result from higher global temperatures if water is available in sufficient quantities at the required locations. (Cassar-FRC)
W82-01633

ENVIRONMENTAL AND PHYSIOLOGICAL CONTROL OF WATER FLUX THROUGH PINUS CONTORTA,
Colorado State Univ., Fort Collins. Dept. of Forest and Wood Sciences.
S. W. Running.
Canadian Journal of Forest Research, Vol 10, No 1, p 82-91, March, 1980. 8 Fig, 2 Tab, 31 Ref.

Descriptors: *Trees, *Stomatal transpiration, *Soil-water-plant relationships, Leaves, Water potential, Pine trees, Air temperature, Temperature, Humidity, Conductance, Evapotranspiration, Forests, Experimental forest, *Colorado.

Humidity responses studied in a stand of Pinus contorta Dougl. ex Loud lodgepole pine in the Fraser Experimental Forest, Colorado, were similar to those reported for other conifers. The following measurements were recorded during June-August 1978: leaf conductance, leaf water potential, temperature, humidity, and radiation. The daily range of leaf conductances decreased 10-fold from June (0.12-0.16 cm per sec) to August (0.01-0.03 cm per sec). There was a high correlation between predawn leaf water potential and morning maximum leaf conductance. There was not enough difference in stomatal response in needles of different ages to permit formal analysis. Generally, older needles appeared unable to close their stomata as tightly as new needles, and maximum leaf conductance was slightly lower and more erratic in the oldest needles. Low atmospheric humidity significantly decreased midday leaf conductance. Minimum leaf water potential threshold was -1.8 to -2.0 MPa. The seasonal change in total soil-water-plant resistance to water flux was nonlinearly correlated with changes in predawn leaf water potential, which is an indirect measure of soil water potential. (Cassar-FRC)
W82-01827

EVAPORATION FROM A SNOW COVER--REVIEW AND DISCUSSION OF MEASUREMENTS,
Lulea Univ. (Sweden). Div. of Water Resources Engineering.
L. Bengtsson.
Nordic Hydrology, Vol 11, No 5, p 221-234, 1980. 9 Fig, 1 Tab, 19 Ref.

Descriptors: *Snow cover, *Evaporation, Condensation, Heat transfer, Snowmelt, Seasonal variation, Air temperature, Lysimeters, *Sweden.

A review of the literature and lysimeter measurements in Sweden demonstrated that total evaporation from snow cover during the season was only 10-20 mm. The calculated net total evaporation, accounting for the energy supply, for a single day in April was 0.14 mm. Variation in evaporation over the day, April 6, 1978, at Lulea, was from -5 mm per hour to 10 mm per hour. During midwinter when air was dry, little evaporation occurred. In spring solar radiation was available but the vapor pressure difference was very small. In the beginning of May 1979 evaporation rates were 0.6-0.8 mm per day, decreasing to zero by May 14 and becoming negative (condensation) May 15-23. Total evaporation was 6 mm, but net evaporation only 3 mm. The aerodynamic formula is most frequently used for determining evaporation on a routine basis, but should be used together with energy balance computations, because evaporation rate is limited by available energy. The profile method, which compensates for the effect of density stratification in the air, can be used on a short-term basis. (Cassar-FRC)
W82-01888

WAYS OF SUCCESSIVE REFINEMENT OF METHODS OF CALCULATING THE DUTY OF WATER,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
A. I. Budagovskii, and L. Ya. Dzhogan.
Water Resources (English Translation), Vol 7, No 6, p 483-500, November-December, 1980. 4 Fig, 27 Ref. Translated from Vodnye Resursy, No 6, p 29-51, November-December, 1980.

Descriptors: *Irrigation efficiency, *Evaporation, *Consumptive use, Evapotranspiration, Water use efficiency, Soil water, Mathematical studies.

Methods for the calculation of the nonreturnable consumption of water for irrigation were refined. Existing methods for making this calculation are at least 20-25 years old. The new refinement replaces the biological curve of evaporation and considers soil evaporation as a function of its water content. The effect of precipitation on soil water evaporation is also considered. One of the most important steps is determining the extent of nonproductive evaporation. The heat-water balance method of calculating evaporation is also refined. The assumption of equality of the critical water content for transpiration and evaporation by bare soil was eliminated. (Small-FRC)
W82-02094

2E. Streamflow and Runoff

LOG PEARSON III DISTRIBUTION - EFFECT OF DEPENDENCE, DISTRIBUTION PARAMETERS AND SAMPLE SIZE ON PEAK ANNUAL FLOOD ESTIMATES,
Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
R. Srikanthan, and T. A. McMahon.
Journal of Hydrology, Vol 52, No 1-2, p 149-159, June, 1981. 5 Fig, 3 Tab, 8 Ref.

Descriptors: *Flood peak, *Mathematical studies, *Flood forecasting, Markov process, Statistical

methods, Analysis of variance, Correlation analysis, Flood plain management, Flood control, Flood profiles.

The effect of sample size, distribution parameters and dependence on peak annual flood estimates by the log Pearson III distribution was examined in 172 Australian streams. Overall results showed that positive skewness flood estimates were underestimated, while those for negative skewness were overestimated. The percentage difference (d) decreased with increasing sample size. However, in streams with great variability and skewness, errors of over 40% may be expected. Analyses of distribution parameters showed that the mean did not affect d. The difference was at a minimum when skewness was between -0.5 and 0. The lag-1 autocorrelation had little effect on d-values. Based on 30 years of data, the 100-year peak flood estimate for Australian streams is in error by about 10% using the log Pearson III distribution. For individual streams, errors as high as 50% could occur. (Geirger-FRC)
W82-01649

LOG PEARSON III DISTRIBUTION - AN EMPIRICALLY-DERIVED PLOTTING POSITION,
Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
R. Srikanthan, and T. A. McMahon.
Journal of Hydrology, Vol 52, No 1-2, p 161-163, June, 1981. 1 Tab, 5 Ref.

Descriptors: *Mathematical studies, *Monte Carlo method, *Flood frequency, Flood peak, Flood forecasting, Statistical methods, Flood control, Flood profiles, Graphical analysis, Graphical methods, Comparison studies.

The log Pearson Type III (LP-III) distribution has been adopted as the standard distribution for flood frequency analysis in several countries; however, no appropriate plotting position has been recommended for its use. A Monte Carlo analysis was undertaken to determine an appropriate value for alpha, the constant in the general plotting position formula used in the LP-III distribution. The optimum value of alpha was found to vary with the shape of the distribution or g, the coefficient of skewness of the logarithms of the peak annual discharges. The optimum value of alpha over all values of g was close to 0.4. This value was in agreement with previous studies on the optimum value of the constant used in the general plotting position formula of the LP-III distribution. (Geiger-FRC)
W82-01650

LEGAL CHALLENGE OF THE UNGAGED WATERSHED,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
D. F. Kibler, J. M. Hrubovack, and D. C. Froehlich.
Water Resources Bulletin, Vol 17, No 3, p 458-465, June, 1981. 1 Fig, 5 Tab, 17 Ref. OWRT-A-049-PA(4), 14-34-0001-8040.

Descriptors: *Flood peak, *Judicial decisions, *Culverts, Flood frequency, Watersheds, *Runoff forecasting, *Pennsylvania, Legal aspects, Gaging, Hydrographs, Flood plain zoning, Design floods, Hydrologic aspects.

Methods for estimating flood peak discharges in ungaged Pennsylvania watersheds were compared in connection with a court case in which the design of highway culverts carrying the Wissahickon Creek near Lansdale, Pennsylvania, was contested by a landowner in the basin. The Environmental Hearing Board ruled in favor of the defendants on August 25, 1976, and further appeals did not produce any change in the decision. Methods used by the plaintiff and the resulting 050 were as follows: Soil Conservation Service Composite Hydrograph, 2922 and 2120 cfs; and Regional Science Research Institute (Hammer, 1974) method, 1933 cfs. Methods used by the defendants and resulting Q50 were: Potter, 744 cfs; PSU III, 1366 cfs; Department of Environmental Resources B curve, 1390 cfs; Soil Conservation Service Flood Peak, 1140, 1440, and 1940 cfs. Six methods applicable to ungaged Pennsylvania watersheds were evaluated on 38 years' data from the Little Mahoning Creek and the Aquashicola Creek. Standard errors resulting from application of these methods to a total of 10 gaged stations were as follows: Federal Highway Administration method, 63.6%; United States Army of Engineers, 41.5%; Department of Environmental Resources, 26.5%; U. S. Geological Survey methods, 47.2%; Pennsylvania Department of Transportation Flood Peak Frequency Design Manual (PSU III) 38.9%; and Pennsylvania Flood Index Map, 31.5%. Those methods developed from a large number of stations within the study region performed better. Generally, methods that depend on mapping of point values, such as the C-index, were better than either regression models or iso-line contours. (Cassar-FRC)
W82-01664

PREDICTING STORM RUNOFF FROM SMALL GRASSLAND WATERSHEDS WITH THE USDAHL HYDROLOGIC MODEL,
Oklahoma State Univ., Stillwater.
R. L. Bengtson.
PhD Thesis, 1980. 187 p, 38 Fig, 68 Tab, 45 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-27163.

Descriptors: *Model studies, *Watersheds, *Storm runoff, Hydrologic data, Grasslands, Calibration, *Oklahoma, *Runoff forecasting, Comparison studies, Hydrologic models, Predictions.

A study of the capabilities of the USDAHL model was conducted on four grassland watersheds located in central Oklahoma. The objectives of this study were: (1) to calibrate the USDAHL model to find those hydrologic parameters which best simulate the observed runoff, (2) to test the transferability of the model by applying it to three watersheds using the preceding hydrologic parameters and comparing the observed runoff against the simulated runoff, and (3) to identify any components of the USDAHL model that require improvements. Based on the analysis and interpretation of the results of this study, the following conclusions were made: (1) The hydrologic parameters to be varied during calibration are the vegetative parameter (A), depression storage (VD), evapotranspiration (ET/EP), and deep groundwater recharge (GR); (2) The Type II calibration procedure proved to be the best procedure for calibrating the USDAHL model; (3) Subsurface flow can be ignored for small watersheds of the type studied with ephemeral runoff; and (4) The model overpredicted annual peak rates of flow when calibrated for runoff yield. (Sinha-OEIS)
W82-01672

INVESTIGATIONS INTO THE DYNAMICS OF WATER MOVEMENT ON A LOW RELIEF LANDSCAPE ON THE EASTERN SHORE OF MARYLAND,
Maryland Univ., College Park.
For primary bibliographic entry see Field 2F.
W82-01673

FLOOD CONTROL ON THE PARANA AND PARAGUAY RIVERS,
Motor-Columbus Consulting Engineers, Inc., Baden (Switzerland).
W. Keller, J. van Duivedijk, and G. Mondada.
International Water Power and Dam Construction, Vol 33, No 7, p 36-43, July, 1981. 7 Fig, 2 Tab.

Descriptors: *Flood control, *Rivers, *Reservoirs, Diversion, Storage, Model studies, Mathematical models, Floods, *Argentina, *Paraguay, Economic aspects, Flood damage, Social impact, Parana River, Paraguay river.

The objectives of flood studies conducted on the Parana and Paraguay Rivers were to obtain an understanding of the extraordinary floods with a return period of 10 to 100 years which have devastating effects on the riverine areas in Argentina and Paraguay; to obtain the same for extreme floods resulting either from natural causes or from the rupture of dams upstream; to determine precisely the hydraulic and economic consequences of these types of floods; and to propose, evaluate and carry out preliminary designs for possible flood-protection works. The study area was influenced by the reach of the Parana river between the mouth of the Iguazu and Baradero in the delta of the Parana river, and the reach of the Paraguay river between Asuncion and its confluence with the Parana river, for a total river length of about 2000 km. Extensive surveys and studies were made in the area to evaluate the economic consequences of the floods. The extent of flooding differed considerable along the river and mainly depended on the topographical situation. To obtain a proper understanding of the inundation phenomena under various flow conditions, a mathematical model of the river system was designed, including the flood plains and adjacent areas which are inundated only during extraordinary floods. One of the possibilities for protection against floods is the temporary storage of flood water in reservoirs. Other plans include the diversion of high discharges through floodways and the local embankments around urban or rural centers. Cost aspects are considered briefly. (Baker-FRC)
W82-01707

LOG PEARSON III DISTRIBUTION - IS IT APPLICABLE TO FLOOD FREQUENCY ANALYSIS OF AUSTRALIAN STREAMS,
Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
T. A. McMahon, and R. Srikanthan.
Journal of Hydrology, Vol 52, No 1/2, p 139-147, June, 1981. 4 Fig, 1 Tab, 8 Ref.

Descriptors: *Flood frequency, Flood forecasting, Forecasting, Floods, Streams, *Australia, *Mathematical studies, Maximum flow, Annual runoff, *Log Pearson distribution.

An analysis was made using moment ratio diagrams of peak annual discharges of 172 Australian streams. The study made use of the log Pearson Type III distribution as it has been adopted for use in flood frequency analysis. To test the acceptability of the LP-III distribution as a general flood frequency distribution for Australian streams, moment ratio values for the peak annual discharge series were plotted. When the study had been completed it was concluded that the log Pearson III distribution could be recommended as a suitable general distribution for flood frequency analysis. The theoretical distributions - normal, 2-parameter log-normal, gamma, Gumbel, Weibull, and exponential - fitted the data poorly. The procedure of setting the coefficient of skewness (g) of the logarithms of peak annual discharges to zero, if the sample value of g is not statistically different from zero, is questioned. It is concluded that, at least for the case where g is greater than zero, this practice is not to be followed, but rather the sample value of g should be used. (Baker-FRC)
W82-01731

LOW-FLOW FREQUENCY AND FLOW DURATION OF TENNESSEE STREAMS,
Geological Survey, Nashville, TN. Water Resources Div.
R. L. Gold.
Geological Survey Open-File Report 78-807, 1981. 361 p, 7 Fig, 1 Plate, 2 Tab, 20 Ref.

Descriptors: *Low flow, *Flow duration, *Streamflow, *Flow rates, Hydrologic data, Gaging stations, Sites, Drainage area, *Frequency analysis, Streams, Flow characteristics, Regulated flow, Average flow, Discharge measurement, Streamflow forecasting, Maps, *Tennessee.

Low-flow frequency and duration data are presented to define variations of the low flow of Tennessee streams both in time and place. Analysis has been made of 204 continuous record stations, both regulated and unregulated and 651 partial-record stations operated either by the U.S. Geological Survey or Tennessee Valley Authority through the 1975 water year. Flow duration and frequency data have been tabulated for the continuous record sites using the digital computer and graphical

methods. Frequency data only is presented for partial-record sites computed in most cases by comparing several discharge measurements at the site with concurrent daily mean flow for an appropriate gaging station. Flow duration data can be used to define a flow duration curve, with the slope at points on that curve used to establish the dependability of the stream to sustain a particular flow. Low-flow frequency data are presented to predict the probability that a specified flow or lesser flow will recur through time. (USGS)
W82-01779

LOW-FLOW CHARACTERISTICS OF STREAMS IN THE DESCHUTES RIVER BASIN, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
J. E. Cummans.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Price: $3.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-639, 1981. 20 p, 4 Fig, 4 Tab, 5 Ref.

Descriptors: *Low flow, *Streamflow, *Streamflow forecasting, *Data collections, Flow rates, Discharge measurements, Correlation analysis, Gaging stations, Precipitation, Fish management, Hydrologic data, *Washington, Deschutes River basin.

The streams in the basin usually have their low flows in August and September. Seven-day low flows were smallest in 1952 when annual rainfall at the Olympia airport was also the least during the 1945-75 period of continuous gaging-station records in the basin. The magnitude and frequency of seven-day low flows were estimated for 23 streamflow sites, either from frequency analysis of data at long-term stations or from correlation of measured or computed discharges at a streamflow site with data at a long-term station. Seven-day low flows ranged from no-flow at one tributary of Deschutes River having a drainage area of 1.85 square miles to 98 cubic feet per second for Deschutes River near its mouth, where the drainage was 162 square miles. Mean monthly flows were determined for two long-term stations and estimated for months of July to September for the other streamflow sites. (USGS)
W82-01781

STAGE-DISCHARGE RELATIONS AT DAMS ON THE ILLINOIS AND DES PLAINES RIVERS IN ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 4A.
W82-01793

A MATHEMATICAL MODEL OF THE HYDROLOGIC REGIME OF THE UPPER NILE BASIN,
Snowy Mountains Engineering Corp., Cooma (Australia).
For primary bibliographic entry see Field 2A.
W82-01857

STATISTICAL DETERMINATION OF DESIGN LOW FLOWS,
Bechtel, Inc., San Francisco, CA.
A. Prakash.
Journal of Hydrology, Vol 51, No 1-4, p 109-118, May, 1981. 1 Fig, 4 Tab, 6 Ref.

Descriptors: *Statistical methods, *Design flow, *Low flow, Prediction, Flow, Mathematical studies, Probabilistic process, Minimum flow, Streamflow, River low.

In designing non-safety-related and safety-related hydraulic structures for use in the nuclear power industry, it is necessary to ensure that these facilities are able to perform their design functions during the n-year low and the probable minimum flow, respectively. Although probabilistic approaches have been developed to estimate low stream flows of a recurrence interval of n years, no attempt appears to have been made to define the probable minimum flow. Analysis of the low stream flows of 66 streams in the United States has deomonstated that the SMEMAX transformation normalizes the available data for all of the streams and provides reasonable estimates of low flows up to a recurrence interval of 100 years. For higher recurrence intervals, predictions made with SMEMAX are overly conservative. Qualitatively, the probable minimum flow is defined as a hypothetical flow that can be considered to correspond to the least runoff available from existing geomorphic conditions and a critical combination of reasonably possible hydrometeorological factors which are conducive to minimum stream flows. Two statistical approaches can be adopted to obtain a quantitative estimate of the probable minimum flow. The first involves defining the probable minimum flow as the lower boundary parameter in the three-parameter Gumbel's bounded exponential distribution. The second approach involves assigning a low frequency of occurrence to the probable minimum flow, frequently 10 to the minus 7th power. Since the first approach was found to provide an overestimation of the probable minimum flow for seven out of the ten streams analyzed, it is suggested that a variety of appropriate distributions be tried and the one giving the best fit be used for deriving a quantitative estimate of probable minimum flow. (Carroll-FRC)
W82-01858

MODELING STORMWATER STORAGE/TREATMENT TRANSIENTS: APPLICATIONS,
Duke Univ., Durham, NC. Dept. of Civil Engineering.
M. A. Medina, Jr., W. C. Huber, and J. P. Heaney.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE4, p 799-816, August, 1981. 18 Fig, 2 Tab, 20 Ref.

Descriptors: *Mathematical models, *Storm runoff, Storm water, Urban runoff, Wastewater treatment, Simulation models, Water quality, Computers, Biological oxygen demand, Prediction, Water pollution, Des Moines, Des Moines River.

Mathematical models derived from a unified concept of pollutant mass transport through the various components of the physical system have been developed to describe the response of storage/treatment systems to highly variable storm water inflows. This methodology has been successfully applied to the actual urban area configuration of Des Moines, Iowa, and its receiving water, the Des Moines River. Continuous simulation was used to examine system behavior in terms of both historical sequence of events and frequency of occurrence of events of various magnitudes. Use of a well-mixed constant volume model to represent a hypothetical urban runoff control facility, combined with increases in the hydraulic detention times while providing secondary treatment to dry weather flow, resulted in predictions of appreciable increases in the frequency of occurrence of events which equaled or exceeded a given dissolved oxygen concentration in the receiving water. Comparison of measured effluent biological oxygen demand mass rates showed that the well-mixed constant volume model closely described the performance of a detention tank in Milwaukee, Wisconsin. The well-mixed storage/treatment models predict an immediate response at the system outfall to variations in storm water volume. Any well-mixed constant volume basin providing a sufficiently long detention for inflows accomplishes concentration equalization by both volumetric mixing and pollutant decay. Although the primary function of variable volume systems is to provide flow equalization, the pollutant peak and mean mass rates from these systems can be effectively decreased by reducing peak and mean outflow rates. (Carroll-FRC)
W82-01981

LEARNING FROM THE SKIPTON FLOOD,
R. B. Russell.
Water, No 30, p 20-22, January, 1980. 6 Fig, 3 Ref.

Descriptors: *Flood forecasting, *Flash floods, *Forecasting, Floods, Warning systems, Flood data, Meteorological data collection, Satellite technology, Hydrologic data, *Great Britain.

The flood which occurred in Skipton, Great Britain, in June 1979 followed a rainstorm with return periods in excess of 500 years. Such storms occur over some urban area in England and Wales on the average of once a year. A total of about 5 hours elapsed between the first appearance of the storm on the record of the radar sited about 170 kilometers away and the cessation of the storm. The flood peak occurred only an hour after the beginning of the intense rainfall in the area and at about the same time as the end of rainfal. Although only a very alert analyst would have deduced from the radar mosaic alone that a potentially dangerous situation was developing prior to the commencement of intense rainfall, a trained forecaster with access to radar and satellite data would have been alert to the development of the possibility for rapid storm growth in the area much earlier. Consultation between trained meteorologists and hydrologists could have provided warning of the flood 1 to 2 hours before the event. Even such a short lead time can result in significant financial savings and avoidance of losses of life, as well as appropriate diversions of traffic and mobilization of relief services. A radar system served by appropriately trained meteorological and hydrological staff and integrated with satellite information provides the best chance for issuing flood warnings in cases such as this. There is also a possibility that surveys could be conducted to identify urban areas potentially at risk from such localized events of extremely long return period. (Carroll-FRC)
W82-02063

THE DAY THAT THE RAIN CAME DOWN,
L. Freeman.
Water, No 31, p 2-4, March, 1980.

Descriptors: *Flood control, *Warning systems, *Flood damage, *Great Britain, Flood protection, Regional floods, Floodproofing, Management planning.

Extensive flooding which resulted from record rainfalls in areas served by the Welsh, Wessex, and South West water authorities in Great Britain provided many lessons for the water industry. A total of more than 125 communities experienced some flooding ranging in degree from 30 to over 100 year return periods. Heavy constant rainfall over a 24-hour period permitted warnings up to 16 hours in advance of the flood event on long and fairly easily predictable rivers, but very short warning periods on other short, sharp, and flashy rivers. In some cases, flood waters were significantly higher than predicted. While the warnings resulted in significant reductions of property losses in many communities, in others people felt a false sense of security resulting from fairly recent construction of flood protection works and failed to take precautionary measures. Lessons provided to the water authorities by these floods included the need for training exercises, especially in areas which experience only infrequent floodings; the need to review the strength of essential private flood protection walls and banks and to determine whether water authorities should take over responsibility for them; the need to make provisions for evacuation of water after the rivers subside, especially in areas where protection works prevent the flow of water back into the river bed; the need to evaluate the security of communications systems; and the need to record flood experiences so that future water authority personnel can benefit from what is learned during such events. The effectiveness of flood alleviation schemes in many communities during this flood event should encourage other communities to proceed with planned flood control measures. (Carroll-FRC)
W82-02064

METHODS OF STUDYING INVERTEBRATE DRIFT IN RIVERS,
Akademiya Nauk SSSR, Petrozavodsk. Karelskii Filial.
For primary bibliographic entry see Field 7A.
W82-02074

HYDROLOGIC AND ANTHROPOGENIC FACTORS AFFECTING WATER QUALITY IN THE RIVERS OF THE UKRAINIAN CARPATHIANS,
Akademiya Nauk URSR, Kiev. Inst. Hydrobiologii.
For primary bibliographic entry see Field 5B.
W82-02076

2F. Groundwater

A GRAPHICAL APPROACH TO PREDICTION OF GROUNDWATER POLLUTANT MOVEMENT,
North Carolina State Univ. at Raleigh. Dept. of Marine Earth, and Atmospheric Sciences.
For primary bibliographic entry see Field 5B.
W82-01634

GROUNDWATER DISCHARGE TO THE PACIFIC OCEAN,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
I. S. Zektser, and R. G. Dzhamalov.
Hydrological Sciences Bulletin, Vol 26, No 3, p 271-279, September, 1981. 1 Fig, 1 Tab, 9 Ref.

Descriptors: *Groundwater movement, *Ocean circulation, Pacific Ocean, Inflow, Hydrology, Discharge measurement, Coastal aquifers.

Concepts concerning groundwater outflow to the oceans of the world are presented. A method for evaluating submarine groundwater is discussed, with estimates for discharge to the Pacific Ocean along all its coastline and major islands. Through the analysis of groundwater discharges over a generation of time to the Pacific Ocean it is noted that this global process depends on a complex combination of various natural factors such as climate, topography, geology and hydrogeology. The dynamics of groundwater flow, permeability and storage properties of the unsaturated zone and aquifers, and other factors strongly influence submarine groundwater discharge. In the main, however, groundwater discharge value depends on the structure of inflow and outflow elements of the water balance of drainage basins, which in turn are governed by the ratio of heat and moisture as the main indicator of the natural physiographical zoning. The distribution of values of groundwater discharge to the world ocean on a global scale is therefore subject to latitudinal physiographical zoning. These values gradually increase from subtropic regions to moderate areas, sharply increase in wet subtropics and tropics, and decrease in semiarid and arid regions. Anomalous large or small values of submarine groundwater discharge, associated with the shielding effect of mountains on atmospheric circulation patterns, wide karst development, drainage effects of river valleys, and other factors are confined to local coastal areas and generally are known not to affect the general dependence of groundwater discharge to the ocean on the latitudinal physiographic zoning. (Baker-FRC)
W82-01647

INVESTIGATIONS INTO THE DYNAMICS OF WATER MOVEMENT ON A LOW RELIEF LANDSCAPE ON THE EASTERN SHORE OF MARYLAND,
Maryland Univ., College Park.
M. S. Christy.
PhD Dissertation, 1980. 172 p, 27 Fig, 3 Tab, 87 Ref, 2 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-03869.

Descriptors: Groundwater, Runoff, *Soil moisture, Water table, *Storm runoff, Watersheds, Maryland, *Dorchester County, *Groundwater runoff, Coastal aquifers, Tidal flats.

The role of groundwater in storm runoff events and the dynamics of the subsurface watershed were the focal points of this study. The investigations were carried out over a three year period at a study site on a tidewater peninsula in Dorchester County on the Eastern Shore of Maryland. The role of groundwater in runoff was evaluated with a recently developed storm hydrograph separation technique using naturally occurring isotopes as basin wide tracers. Results of the study showed both typical behavior patterns of water movement and patterns that were seemingly unique to a flat landscape. Traditional and modeled evaluations of storm runoff show groundwater to be only a minor contributing factor. Quantitative isotopic analysis showed that in fact there was a major groundwater contribution to the runoff occurring at this study site. A factor of runoff that appears to be unique to landscapes of low relief is the distinct threshold between high storm yield and no storm yield. When both the soil moisture and the watertable are relatively high, there is substantial runoff even from low volume rain events. However, regardless of rainfall volume and/or intensity, when the soil moisture and the height of the watertable are low, there is no apparent runoff. An average watertable depth of 36 cm below the ground surface was the apparent threshold for storm runoff at this site. Above and below this level there was and was not runoff, respectively. (Sinha-OEIS)
W82-01673

NUMERICAL ANALYSIS OF TRANSIENT SALT/FRESH-WATER INTERFACE IN COASTAL AQUIFERS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
R. I. Layla.
PhD Dissertation, 1980. 206 p, 24 Fig, 4 Tab, 101 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-22411.

Descriptors: *Numerical analysis, *Aquifers, *Saline water intrusion, Interfaces, Coasts, Estuaries, *Coastal aquifers, Saline-freshwater interfaces.

The simultaneous effect of the salt-and the freshwater flow on the areal distribution of the interface in coastal aquifers was studied under transient conditions. A two-dimensional model was developed to simulate the growth or the decay of the interface in confined or unconfined aquifers. The contribution from the capillary region to the interface elevation change was also studied. A numerical model using the Galerkin-finite element method was developed to solve the flow equations describing the flow of fresh and salt waters. The adequacy of the numerical model in predicting the interface elevation was verified by comparing its results with existing physical and steady-state analytical solutions. The numerical model was used to solve various problems pertaining to different flow conditions in order to illustrate the effect of salt-water friction, capillary flow and capillary storage on the transient development of the interface. The results indicate that salt-water flow significantly influences the rate of growth of the interface. The influence of capillary flow on the interface elevation is more pronounced at small initial saturated thickness, while the contribution of the static moisture profile on the capillary storage is greatest at small depths to the water table. (Sinha-OEIS)
W82-01693

COMPONENTS OF SATURATED ZONE THICKNESS IN A NIGERIAN BASEMENT COMPLEX REGOLITH,
Ife Univ. (Nigeria). Dept. of Geography.
E. O. Omorinbola.
Hydrological Sciences Bulletin, Vol 26, No 3, p 291-303, September, 1981. 5 Fig, 2 Tab, 21 Ref.

Descriptors: *Saturation zone, Groundwater hydrology, Saturated soils, Saturated flow, Mathematical studies, *Nigeria, Spatial distribution, *Groundwater, *Geohydrology.

An attempt is reported to obtain an optimum prediction of the gross spatial distribution of the thickness of the zone of saturation in the regolith of a typical deeply weathered Basement Complex area in southwestern Nigeria. The technique employed is a combination of the algebraic polynominal trend surface and conventional regression models. The study attempted to determine the components of saturated zone thickness in the regolith of the study area and identify environmental factors or processes responsible for their presence, and to obtain an optimally determined equation by which depths of the groundwater medium to be penetrated by wells at specific sites within the study area could be predicted ahead of the actual sinking operations with a reasonably high level of confidence. The tentative conclusion drawn from this study applies more to the humid and low relief areas of the Basement Complex. It states that the thickness of the saturated zone in the regolith has a regional trend, increasing from the major river channel to the interfluve. While the regional component follows the general spatial trend of weathering depth, the local component of the gross spatial distribution arises from the irregular contour of the basal surface of weathering and differential rates of regolith removal by fluvial erosional processes. The local component, about 16% of the gross spatial distribution, is adequately described by a conventional regression equation in which the independent variable is weathering depth. This method has several advantages over that of fitting progressively higher-order trend surfaces to spatial data. (Balker-FRC)
W82-01710

THE RELATIONSHIP BETWEEN MACRO-TOPOGRAPHY AND THE GROUNDWATER QUALITY IN THE GREAT FISH RIVER BASIN, EASTERN CAPE PROVINCE,
Orange Free State Univ., Bloemfontein (South Africa). Dept. of Geology.
E. A. W. Tordiffe, and B. J. V. Botha.
Water SA, Vol 7, No 3, p 113-138, July, 1981. 21 Fig, 4 Tab, 10 Ref.

Descriptors: *Topography, *Groundwater hydrology, *Impaired water quality, *Geohydrology, Calcium, Sodium, Chlorine, Connate water, *South Africa, Water pollution sources, Chemical properties, Geochemistry, Chemistry of precipitation, Water quality, Great Fish River basin.

The relationship between the geomorphologic region and ground water quality was investigated in the Great Fish River Basin in Eastern Cape Province, South Africa. The area studied is about 25,000 sq km and contains the following geomorphologic regions: the Margin Region, the Great Escarpment, the Headbasin, and the Interior Plateau. A distinct relationship was found between the regions and ground water characteristics. High percentages of Ca(+2) and HCO3(-1) were determined in the higher lying Interior Plateau, and high Na(+1) and Cl(-1) were found in the ground water of the Headbasin and Marginal Region. Groundwater movement is almost stagnant in these last two low lying regions. The differences in quality may be due to the influence of connate marine waters from the sedimentary rocks of the Dwyka Formation and Ecca Group. Atmospheric salts may also be deposited. Meteoric water in the Interior Plateau can dissolve CaCO3, but as this water percolates down toward the lower regions it becomes saturated with Ca(+2) and HCO3(-1). Then the CaCO3 is precipitated as calcrete. (Small-FRC)
W82-01718

GROUNDWATER DISCHARGE THROUGH SPRINGS WITH WELL-DEFINED OUTLETS--A CASE STUDY FROM JELOYA-MOSS, S. NORWAY,
Norges Landbrukshoegskole, Vollebekk. Dept. of Geology.
J. O. Englund, and K. F. Meyer.
Nordic Hydrology, Vol 11, No 3/4, p 145-158, 1980. 5 Fig, 4 Tab, 9 Ref.

Descriptors: *Springs, Artesian wells, Recharge, Groundwater recharge, Wells, Aquifers, Fissure water, *Norway, *Geohydrology, *Geochemistry.

The hydrogeology and chemistry of five springs and an artesian well in the Jeloya-Moss area were investigated for a year starting June 7, 1977, as part of a project concerning groundwater in Norway. All the springs drain fissured-rock aquifers and are of the overtopped, unconfined type. The artesian well drains confined water from a sand and gravel

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aquifer below marine clay. Discharges are variable, and can be described by the variability index, or ratio of the lowest yield to the greatest. The well has a discharge of 1944-2736 liters per hour and a variability index of 0.71. The springs' variability indexes range from 0.01 to 0.53. If no discharge occurs, the springs would theoretically dry up within 2 months to 3 years and the well, in 6.5 years. Average residence time of the water in the aquifers ranges from 4.5 days to 180 days in the springs and 301 days in the well. Chemical composition of the water is similar to that of the deep groundwater, 30-100 meters below land surface. However, changes in composition take place as the water moves through the rocks. The longer the residence time, the higher the concentration of dissolved solids. Brackish water in the well is a result of dissolution of fossil sea salts. Most of the protons in precipitation are consumed in the chemical weathering process; only 1-2% of the weathering is caused by precipitation. (Cassar-FRC)
W82-01748

SELECTED DRILL-STEM-TEST DATA FROM THE NORTHERN GREAT PLAINS AREA OF MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-01774

SELECTED HYDROGEOLOGIC DATA FROM THE NORTHERN GREAT PLAINS AREA OF MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-01777

HYDROGEOLOGY OF WELL-FIELD AREAS NEAR TAMPA, FLORIDA, PHASE 1--DEVELOPMENT AND DOCUMENTATION OF A TWO-DIMENSIONAL FINITE-DIFFERENCE MODEL FOR SIMULATION OF STEADY-STATE GROUND-WATER FLOW,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 6A.
W82-01780

HYDROGEOLOGY OF THE GATLINBURG AREA, TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
A. Zurawski.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Price $12.00 in paper copy, $8.00 in microfiche. Geological Survey Open-File Report 79-1167 (WRI), August, 1979. 79 p, 45 Fig, 5 Tab, 12 Ref.

Descriptors: *Geohydrology, *Groundwater availability, *Water supply, *Aquifer characteristics, Test wells, Water yield, Geologic fractures, Water quality, Chemical analysis, Well logs, Water management, Planning, Evaluation, *Tennessee, Gatlinburg.

A study of ground-water availability in the Gatlinburg area, Tenn., was undertaken to improve concepts of ground-water occurrence in the Blue Ridge and demonstrate that ground water is present in sufficient quantities to provide an alternative to surface water as a source of supply. Of 25 test wells, 8 produced between 50 and 116 gallons per minute. The Gatlinburg area, located on the northern flank of the Great Smoky Mountains, is underlain by fractured, variably metamorphosed, sedimentary rocks. The most effective criteria for choosing well sites were valley areas with 7 percent or less land slope, presence of fracture traces, and deep overburden. Mapped faults were not a good indicator of ground-water occurrence. The largest amounts of ground water occur in irregularly shaped zones of deep and intense weathering in the rocks underlying broad, fracture-controlled valleys. Permeable zones along fractures at depths of 170 feet or less supply most of the water. (USGS)
W82-01782

GROUNDWATER LEVELS IN NEBRASKA 1980,
Geological Survey, Lincoln, NE. Water Resources Div.
M. S. Johnson, and D. T. Pederson.
Nebraska Water Survey Paper Number 51, September 1981. 65 p.

Descriptors: *Groundwater, *Wells, *Water level, *Water level fluctuations, Observation wells, Hydrographs, Well data, Aquifer characteristics, Hydrologic data, *Nebraska.

This report summarizes the 1980 water-level changes in Nebraska on a statewide basis and by major areas where significant changes from estimated predevelopment levels have occurred. It describes the availability of data on water levels, provides information on changes in the water-level measurement program during the year, and summarizes data on the two major causes of water-level changes--precipitation and groundwater use. Because of the large amount of available data, much of the information presented in this report is of a generalized nature. The maps showing areas where water levels have risen or declined are an interpretation of point-value data, and some areas may not be precisely delineated. Changes in water levels are illustrated by hydrographs of 89 continuous-record wells for the period of record. (USGS)
W82-01785

RECORDS OF WATER LEVELS IN UNCONSOLIDATED DEPOSITS IN EASTERN SOUTH DAKOTA,
Geological Survey, Huron, SD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-01788

AN AQUIFER SIMULATION PROGRAM FOR MICRO-BASED PROCESSORS,
Osmania Univ., Hyderabad (India). Centre of Exploration Geophysics.
B. H. Briz-Kishore, and R. V. Avadhanulu.
Ground Water, Vol 19, No 4, p 400-406, July/August, 1981. 4 Fig, 1 Tab, 3 Ref.

Descriptors: *Computer programs, *Simulation analysis, *Aquifers, Groundwater movement, Pumping tests, Aquifer characteristics, Aquifer systems.

A computer program for simulating an aquifer system was devised for use with a microprocessor. Written in both FORTRAN IV and BASIC languages, the program requires only 10K bytes of memory for the generate code. It can be used to study the aquifer system under steady-state and dynamic conditions with constant flux or no-flux boundaries, conversion from confined to unconfined conditions in both homogeneous and heterogeneous aquifer systems, as well as the effects of evapotranspiration and constant recharge. The effect of pumping on an aquifer is studied for multiple pumping periods, and predictions can be reviewed at various time steps within each pumping period. The program is illustrated using a problem solved by Trescott et al. (1976) on an IBM/370 with a program of 100K bytes length. Results were essentially the same on both computers, with convergence after 45 iteractions on the microprocessor and 34 on the larger computer. (Cassar-FRC)
W82-01879

DRAWDOWNS AT THE FREE WATER TABLE DURING PUMPING TESTS IN ARTESIAN AND SEMIARTESIAN AQUIFERS,
TERRAQUA Aps, Kalundborg (Denmark).
H. Kaergaard.
Nordic Hydrology, Vol 11, No 3/4, p 159-168, 1980. 5 Fig, 13 Ref.

Descriptors: *Water table, *Groundwater storage, *Drawdown, Transmissivity, *Pumping tests, Aquifer testing, Artesian aquifers, Well hydrographs.

Long term storage in artesian and semiartesian aquifers was calculated from relatively short pumping tests (3-5 weeks) by studing the drawdown at the water table. Although the fluctuations are small under these conditions, results may be improved by performing the tests during dry periods such as summer or frost, choosing wells with small daily fluctuations, and observing the largest possible number of wells in the observation area. Pumping tests were used to study two aquifers, at the Torkildstrup-Lillebraende Waterworks and at the Karup Waterworks, Denmark. The first was a white chalk aquifer overlain by a clay aquitard, and the second, an anisotropic aquifer 50-60 meters thick. Reasonable estimates of transmissivity were obtained using mathematical models created for drawdown at the water table from pumping of deep groundwater. (Cassar-FRC)
W82-01890

MORPHOLOGY, HYDROLOGY AND HYDROCHEMISTRY OF KARST IN PERMAFROST TERRAIN NEAR GREAT BEAR LAKE, NORTHWEST TERRITORIES,
National Hydrology Research Inst., Calgary (Alberta).
R. O. van Everdingen.
National Hydrology Research Institute, Paper No 11, Inland Waters Directorate Scientific Series No 114, 1981. 53 p, 32 Fig, 8 Tab, 53 Ref.

Descriptors: *Karst hydrology, Hydrologic measurements, *Precipitation, Rainfall, Geochemistry, *Snowmelt, Subsurface runoff, Bedrock stratigraphy, Permafrost, Sinkholes, Soluble rocks, Contaminants, Morphology, Stratigraphy, Great Bear Lake, *Northwest Territories, Canada.

Collapse karst is widespread in the Franklin Mountains, Colville Hills and Great Bear Plain between Great Bear River and 67 N. Collapse features in the area are interpreted as being the result of subsurface solution of evaporites from the Upper Cambrian Saline River Formation and the Lower Devonian Bear Rock Formation; they appear to be concentrated on and around a number of small 'domes' on the Keele Arch. Integrated surface drainage is limited or lacking over portions of the karst area. Hydrologic measurements (rates of inflow into sinkholes; water levels in seasonally flooded depressions; discharge from springs) indicate that subsurface runoff may be as high as 40 mm per year or about 15% of the annual precipitation and that rainfall rates as low as 6 mm per day can initiate recharge to the karst-water system. Results of deuterium and oxygen-18 analyses show that snowmelt provides a major portion of the recharge; tritium levels in discharge from springs indicate that residence times in the karst-water system are relatively short. Seasonal flooding of karst depressions may cause problems for future engineering developments in the region; the tendency of the karst to collapse presents a special geotechnical hazard in addition to the problems related to the widespread occurrence of ice-rich permafrost. The karst-water system is extremely vulnerable to contamination from the surface because of the close spacing of high-rate recharge points and the unfiltered nature of the recharge. Once a contaminant has entered the karst-water system, rapid subsurface transport will make containment, recovery and cleanup after an accidental spill difficult or impossible. (WATDOC)
W82-01904

MATHEMATICAL MODEL FOR REGIONAL LAND SUBSIDENCE DUE TO PUMPING 1. INTEGRATED AQUIFER SUBSIDENCE EQUATIONS BASED ON VERTICAL DISPLACEMENT ONLY,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
J. Bear, and M. Y. Corapcioglu.
Water Resources Research, Vol 17, No 4, p 937-946, August, 1981. 2 Fig, 2 Tab, 23 Ref.

Descriptors: *Subsidence, *Aquifers, *Compressibility, *Model studies, Mathematical models, Com-

paction, Groundwater mining, Piezometric head, Confined aquifers, Terzaghi equation.

A regional land subsidence model is developed using Terzaghi's concept of effective stress, essentially horizontal flow in the aquifer, and only vertical soil compressibility. First, the three-dimensional equation of (saturated) water mass conservation is obtained for the compressible fluid and solid matrix. This is then integrated over the aquifer's thickness, considering conditions on the top and bottom surfaces bounding the aquifer. The result is a flow equation in terms of averaged piezometric head. By relating changes in head to land subsidence, an equation for land subsidence as a single dependent variable results. Examples are given for single- and multi-layered confined aquifers and a phreatic aquifer. The equation is applied to pumping from a hypothetical 6-layered confined aquifer. (Cassar-FRC)
W82-01926

MATHEMATICAL MODEL FOR REGIONAL LAND SUBSIDENCE DUE TO PUMPING 2 INTEGRATED AQUIFER SUBSIDENCE EQUATIONS FOR VERTICAL AND HORIZONTAL DISPLACEMENTS,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
J. Bear, and M. Y. Corapcioglu.
Water Resources Research, Vol 17, No 4, p 947-958, August, 1981. 4 Fig, 12 Ref.

Descriptors: *Subsidence, *Aquifers, *Compressibility, Model studies, Mathematical models, Compaction, Groundwater mining, Piezometric head, Confined aquifers, Biot's equations.

A model for regional aquifer consolidation due to pumping considers both vertical land subsidence and horizontal displacement. It is based on Biot's work on coupled three-dimensional consolidation. These equations are averaged over the vertical thickness of an aquifer, assuming shear-free boundaries and plane stress. An analytical solution is given for the case of a single well pumping from an infinite homogeneous isotropic aquifer. Estimates of changes in averaged values of piezometric head, vertical subsidence, and horizontal displacement can be obtained. About half the volume strain is produced by vertical subsidence and half by horizontal displacement. The piezometric head obtained for the special case of radial flow is identical to that obtained by non-coupled models. However, for general cases, non-coupled models which neglect horizontal displacement give vertical subsidence values twice that of the values obtained in the model described here. (Cassar-FRC)
W82-01927

THE STATISTICAL MECHANICAL THEORY OF GROUNDWATER FLOW,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
G. Sposito, and S. Y. Chu.
Water Resources Research, Vol 17, No 4, p 885-892, August, 1981. 1 Fig, 25 Ref.

Descriptors: *Aquifers, *Statistical mechanics, *Energy equation, Fluid mechanics, *Groundwater movement, Porous media, Theoretical analysis.

Macroscopic differential equations of transport in porous media are derived according to statistical mechanics. The general method is applied to derive the balance of mass and of linear momentum in the groundwater component of an aquifer that is not deformed by water flowing through it. Statistical mechanics is used to define the components of the internal energy and to derive a microscopic equation of total energy balance. The partial specific internal energy and the kinetic energy of groundwater in a pore is affected by a force such as gravity, but the total energy of groundwater is not. The standard groundwater flow equation is shown to be a special case of the macroscopic equation of internal energy balance. The derivation of this equation is not connected with mass balance, but instead is the equation of internal energy balance for isothermal groundwater movement in a homogeneous, isotropic aquifer whose solid phases are unaffected by changes in groundwater pressure. (Cassar-FRC)
W82-01982

STEADY PERIODIC FLOW THROUGH A RECTANGULAR DAM,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Mathematics and Statistics.
J. H. Knight.
Water Resources Research, Vol 17, No 4, p 1222-1224, August, 1981. 11 Ref.

Descriptors: *Dupuit-Forchheimer theory, *Groundwater level, *Groundwater movement, Tidal effects, Oscillatory waves, Water level, Sea level, Reservoirs, Aquifers, *Coastal aquifers.

The Dupuit-Forchheimer formula (D-F) for discharge through a homogeneous rectangular dam gives the average discharge when reservoir levels oscillate, if the mean squares of the levels are used. In the case of steady oscillation, the time average of the pressure integral can be found, which leads to a generalization of the D-P discharge formula. In the tidal oscillation case, groundwater in a coastal aquifer responds to the tides, so that the equilibrium water level far from the sea equals the root mean square of the sea level. For a deep aquifer the water level is near mean sea level, and for a shallow aquifer, about 23% higher than mean sea level. The integral properties predicted for the D-F theory via the Boussinesq equation are exact in spite of controversy on the validity of the D-F assumptions that the pressure distribution is almost hydrostatic. (Cassar-FRC)
W82-01983

AN INTEGRAL TRANSFORM METHOD FOR THE LINEARIZED BOUSSINESQ GROUNDWATER FLOW EQUATION,
Cold Regions Research and Engineering Lab., Hanover, NH.
C. J. Daly, and H. J. Morel-Seytoux.
Water Resources Research, Vol 17, No 4, p 875-884, August, 1981. 11 Fig, 2 Tab, 10 Ref.

Descriptors: *Aquifers, *Velocity, *Potentiometric head, *Groundwater movement, Porous media, Confined aquifers, Unconfined aquifers, Water table, Anisotropy, Darcys law, Mass transfer, Boussinesq Equation.

The potentiometric head in nonhomogeneous aquifers under both steady and unsteady flow conditions is determined by an analytical procedure based on the use of orthogonal functions. Selection of the appropriate sets of orthogonol functions permits the solution of problems over finite, semi-finite, and unbounded domains. Continuous and differentiable solutions, which are especially important in accurate determination of velocity field, are produced. The solution can be directly calculated at any point in the domain of the problem at any time; no grid or discretization is needed. Flow problems subject to nonhomogeneous boundary conditions and constant gradient boundary conditions may be solved by the integral transform approach. Point source problems are solved by use of a Dirac forcing term in the differential equation. The technique is applied to one- and two-dimensional flow problems where conditions are described by the linearized Boussinesq equation and results in the expression of potentiometric heads in analytic form. Limitations of this technique are: (1) flow domains are restricted to a rectangular geometry, and (2) rapidly varying potentiometric fields require solution of large numbers of equations. (Cassar-FRC)
W82-01984

SCALE-DEPENDENT DISPERSION IN A STRATIFIED GRANULAR AQUIFER,
National Hydrology Research Inst., Ottawa (Ontario).
J. F. Pickens, and G. E. Grisak.
Water Resources Research, Vol 17, No 4, p 1191-1211, August, 1981. 17 Fig, 10 Tab, 77 Ref.

Descriptors: *Solute transport, *Sampling, *Dispersivity, Porous media, Tracers, Aquifers, Sand aquifers, Chalk River Nuclear Plant, Scale effects, *Groundwater movement, Hydraulic conductivity, Wells.

A constant value for dispersivity of 0.7 cm was found to be representative and independent of travel distance at the scale of an individual level within a sand aquifer at the Chalk River Nuclear Laboratories. The laboratory-scale dispersivity for sand from the study site was 0.035 cm. Differences in scale between the laboratory and individual level dispersivities result from the greater inhomogeneity in the aquifer and from averaging caused by the groundwater sampling system. Full-aquifer dispersivities (single well tests using I131 as a tracer) were 3 and 9 cm. This indicates a scale effect with the value obtained dependent on the effect of transverse migration of tracer between the layers and the total injection volume. In 2-well tests (using Cr51-EDTA tracer) the full-aquifer dispersivity of 50 cm was scale-dependent, controlled by the distance between the injection and withdrawal wells and hydraulic conductivity distribution in the aquifer. Expressions for scale-dependent full-aquifer dispersivity (as a function of the mean travel distance) related distance to the statistical properties of a stratified geologic system where the hydraulic conductivity distribution is normal, log normal or arbitrary. These results show the importance of the groundwater sampling scale in interpreting values of dispersivity. (Cassar-FRC)
W82-01986

APPLICATIONS OF AERIAL PHOTOGRAPHY,
For primary bibliographic entry see Field 7B.
W82-01988

HYDRAULIC CONNECTION BETWEEN LAKE MICHIGAN AND A SHALLOW GROUNDWATER AQUIFER,
Wisconsin Univ.-Milwaukee. Dept. of Geological Sciences.
D. S. Cherkauer, and B. Zvibleman.
Ground Water, Vol 19, No 4, p 376-381, July/August, 1981. 7 Fig, 22 Ref.

Descriptors: *Hydraulic gradient, *Aquifers, *Lake beds, *Lake Michigan, Carbonate aquifers, Sediments, Lakes, Plumes, Recharge, Groundwater recharge, Hydraulic conductivity, Groundwater movement, Permeability, *Surface-groundwater relations.

Heavy pumping from a dolomite aquifer, source of water for the City of Mequon, Wisconsin, on the Lake Michigan shore, reversed the natural hydraulic gradient and allowed lake water to flow into the aquifer. In July 1978, high quality lake water (total dissolved solids, 200 ppm) was identified as a plume extending about 2 km into the aquifer (600-800 ppm total dissolved solids). The hydraulic connections between lake and aquifer are located in the lake bed, where areas of thin sand and gravel sediment contact permeable bedrock ridges. Flow seems to follow the ridges toward the center of the cone of depression formed in the aquifer by heavy pumping. In the spring of 1979 recharge and reduced pumping produced changes in configuration and reduction in size of the plume. (Cassar-FRC)
W82-02010

EXTENSION OF THE INTEGRODIFFERENTIAL APPROACH TO INHOMOGENEOUS MULTIAQUIFER SYSTEMS,
Universidad Nacional Autonoma de Mexico, Mexico City. Centro de Investigaciones en Matematicas Applicadas y en Sistemas.
J. P. Hennart, R. Yates, and I. Herrera.
Water Resources Research, Vol 17, No 4, p 1044-1050, August, 1981. 2 Fig, 11 Ref.

Descriptors: *Leaky aquifers, *Heterogeneity, Aquitards, Groundwater movement, Aquifers, Model studies, Mathematical models, *Aquifer systems.

The integrodifferential model for multiaquifer systems, which assumes homogeneity in the vertical direction, has been extended to general heterogeneous multiaquifer systems. This paper develops an approach for a heterogeneous leaky aquifer system in which properties of the system are arbitrary functions of position in both horizontal and vertical directions. Aquitards are eliminated, leading to a system of integrodifferential equations. Details of numerical implementation of the system are given with particular emphasis on efficient approximation of the horizontal heterogeneity in the aquifers and on the use of a class of finite element in time integration schemes, including most well-known time integration schemes and leading to consistent updating formulas for the memory and influence terms. (Cassar-FRC)
W82-02017

GROUNDWATER CHEMISTRY OF SOME SELECTED AREAS IN SOUTHEASTER NORWAY,
Norges Landbrukshoegskole, Vollebekk.
For primary bibliographic entry see Field 2K.
W82-02020

TERRAIN, GROUNDWATER AND SECONDARY SALINITY IN VICTORIA, AUSTRALIA,
Soil Conservation Authority of Victoria, Kew (Australia).
J. J. Jenkins.
Agricultural Water Management, Vol 4, No 1/3, p 143-171, 1981. 11 Fig, 5 Tab, 24 Ref.

Descriptors: *Salinity, *Soil properties, *Groundwater pollution, Water pollution sources, Groundwater movement, Groundwater hydrology, Terrain analysis, Topography, Hydrology, *Victoria, Australia.

The problems of increasing secondary salinity in Victoria, Australia, are reviewed. Regional and local geological conditions including land form, the present and past climate and its ecological effects, and the specific forms of land use applied all affect the degree of salinization insofar as area and severity are concerned. Salinization occurs in all but the highest and wettest areas in Victoria. The dryland salinity phenomena can only be explained in terms of groundwater movement. Soil throughflow is clearly inadequate in all the Victorian physiographic situations in which persistent salting occurs. Reasons for this include an inadequate quantity of available soluble ions stored in the soil to maintain continuing salt seeps, the excessively low horizontal hydraulic conductivities of the soil compared with their substrates, and the presence of saline groundwater either unconfined or under pressure, or frequently both. The major controlling factor in salinization is the water recharge-discharge system. Any solution must therefore involve the control of water both at and below the surface. The additional recharge which follows clearing must be prevented, and the pressures which have built up in confined aquifers and water tables which have risen must be reduced. In order to control the problem, a detailed knowledge of the conditions prevailing in each area in relation to the causative factors involved must exist. The corollary of a permanent reduction in soil salting therefore is a corresponding improvement in water supply quality. (Baker-FRC)
W82-02046

EXCESS AIR IN GROUNDWATER,
Council for Scientific and Industrial Research, Pretoria (South Africa). Natural Isotopes Div.
T. H. E. Heaton, and J. C. Vogel.
Journal of Hydrology, Vol 50, No 1-3, p 201-216, March, 1981. 4 Fig, 3 Tab, 24 Ref.

Descriptors: *Recharge, *Soil gases, *Air entrainment, *Nitrogen, *Argon, Groundwater, Infiltration, Excess air, South Africa.

Examination of dissolved nitrogen and argon in 81 groundwater samples from 6 areas in South Africa showed that many samples contained air in excess (up to 10 ml per kg water) of the amount expected for equilibrium in the atmosphere. The excess gas is ascribed to the solution of air bubbles trapped by infiltrating water in the unsaturated zone during recharge. Data show that N and A concentrations have not been significantly modified by chemical reactions, such as nitrification, or radioactive decay within the aquifer. Factors that favor air entrapment are fine soil with its small pores and narrow capillary channels and intermittent recharge caused by heavy rainfall interspersed with long dry periods. (Cassar-FRC)
W82-02099

2G. Water In Soils

SIMULATION OF THE TOPOGRAPHIC INFLUENCE ON SLAR DATA FOR SOIL MOISTURE DETECTION IN A HILLY AREA,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
R. Meier.
Remote Sensing of Environment, Vol 11, No 2, p 245-251, July, 1981. 6 Fig, 5 Ref.

Descriptors: *Soil water, *Remote sensing, *Model studies, Topography, Terrain analysis, *Radar, Moisture profiles, Simulation analysis, Mathematical studies, Catchment areas.

Although side-looking airborne radar (SLAR) has great potential for remote sensing of soil moisture conditions, the variability of the recorded signal in a hilly area can affect all of the other parameters which influence the signal. The effects of a hilly terrain may be minimized by estimating the influence of the topography on the microwave backscatter. A SLAR image may be simulated by a digital terrain illumination model. Grid elements of 50 m of a 3.2 sq km catchment were modeled and correlated to the corresponding model, with favorable results. Remaining variations were explained, to a great extent, by changes in soil moisture in the catchment area. The sensitivity of microwave backscatter to decreasing incidence angle was demonstrated when two extremely different moisture conditions were compared. The spatial distribution of soil moisture was unavailable due to inadequate spatial resolution of the heterogeneous catchment. (Geiger-FRC)
W82-01605

SOIL MOISTURE UPDATING AND MICROWAVE REMOTE SENSING FOR HYDROLOGICAL SIMULATION,
Science and Education Administration, Beltsville, MD. Hydrology Lab.
T. J. Jackson, T. J. Schmugge, A. D. Nicks, G. A. Coleman, and E. T. Engman.
Hydrological Sciences Bulletin, Vol 26, No 3, p 305-319, September, 1981. 5 Fig, 7 Tab, 19 Ref.

Descriptors: *Model studies, *Soil moisture, Remote sensing, Microwaves, Radiation, Soil water.

The possibility of measuring soil moisture in the upper soil layer using microwave remote sensing was investigated. Four different simulations were performed on each of the four basins studied. The first two simulations compared the effects of using daily total and breakpoint precipitation input data. The second two simulations resembled the first two, except that in addition soil moisture updating was performed. This was accomplished by modifying the model to read in all of the observed soil moisture values and store them. When the simulation reached a day on which soil moisture was measured, the measurements were substituted for the current simulation values of both soil layers. The findings indicate that both soil moisture simulation and input rainfall were affecting the model stimulations. Using updates or breakpoint precipitation values individually did not improve the simulation, whereas using both did. It was concluded that soil moisture observations for updating are valuable when the model exhibits a bias in simulating soil moisture. A second problem relates to the particular model structure used. A third problem was the lack of sensitivity to soil moisture updates, which could be related to the spatial scale of the basins used in the studies. Finally, annual runoff was the only criterion used to judge the model's performance. Additional tests are needed. (Baker-FRC)
W82-01611

SIMPLE IN SITU DETERMINATION OF HYDRAULIC CONDUCTIVITY BY POWER FUNCTION DESCRIPTIONS OF DRAINAGE,
Hawaii Univ., at Manoa, Honolulu. Water Resources Research Center.
S. K. Chong, R. E. Green, and L. R. Ahuja.
Water Resources Research, Vol 17, No 4, p 1109-1114, August, 1981. 7 Fig, 1 Tab, 16 Ref. OWRT-B-054-HI(5).

Descriptors: *Hydraulic conductivity, *Drainage, *Hydraulic gradient, *Soil water, Infiltration, Pressure head, Darcys law.

A method of calculating soil hydraulic conductivity from field measurements of soil water content and soil water pressure head during infiltration and redistribution was developed. This method is applicable to a wider range of soil water contents than the Nielsen et al. (1973) method for estimating hydraulic conductivity. A unit hydraulic gradient was assumed, and a power function described the changes in water content and pressure head with time during the redistribution period. The method was used at 7 experimental sites (tilled sugar cane fields on oxisols) at Oahu, Hawaii, where the total hydraulic head gradient varied from 0.3 during early stages of drainage to 2.0 after several days. Unit hydraulic gradient was usually approached during the intermediate stages of drainage (1,000-10,000 min), and this is the point where hydraulic conductivity values would be most reliable. Comparisons with the more complicated Darcy method showed that the simplified method was reliable for field use in well-drained soils. (Cassar-FRC)
W82-01666

SIMULATION OF WATER AND NITROGEN MOVEMENT AND NITROGEN TRANSFORMATIONS IN FOREST SOILS,
Washington State Univ., Pullman. Dept. of Agronomy and Soils.
S. J. Riha.
PhD Dissertation, 1980. 174 p, 33 Fig, 25 Tab, 65 Ref, 6 Append. University Microfilms International, Ann Arbor, MI; Order No. GAX80-25956.

Descriptors: *Soil moisture, *Nitrogen cycle, *Model studies, Forest soils, Soil water, Soil water movement, Water transport.

A model was developed to simulate rates of nitrogen transport and transformation in forest soils under Douglas-fir. Simulations were run for soils which were undisturbed, fertilized with urea-N or in which no root uptake of nitrogen was occurring. The model required inputs of basic soil, microbe, and plant characteristics. Environmental inputs were daily precipitation and maximum and minimum air temperature. The model predicts the rates of mass flow and diffusion of nitrogen to roots, immobilization of NH_4^+ by soil heterotrophs, mineralization of organic nitrogen by heterotrophs, nitrification of NH_4^+ by autotrophs and leaching of nitrogen below the root zone. The model was tested against water and nitrogen data collected in the field. Soil water flow was modeled using a one-dimensional finite element numerical solution of the Richards equation. Solutes were assumed to be transported by convection with the water. Rates of nitrogen transformation and active root uptake were described by Michaelis-Menten equations. It was assumed that tree roots, heterotrophs, and autotrophs compete simultaneously for soil NH_4^+. The flux of NH_4^+ to these three groups was assumed to be limited by the diffusion of NH_4^+ within the soil which has made a function of the water content of the soil. The model predicted fairly constant levels of NH_4^+ throughout the year and in general a return to these levels after a forest soil is perturbed. In an undisturbed soil, it was estimated that approximately 10% of the total nitrogen mineralized is immobilized, 45% diffuses to roots, and 45% is nitrified. (Sinha-OEIS)
W82-01668

EFFECT OF PERIODS OF MOISTURE AVAILABILITY ON GROUNDNUT CROP IN THE SAURASHTRA REGION OF GUJARAT,
Bansilal Amritlal Coll. of Agriculture, Anand (India).
K. R. Patel, and P. D. Mistry.
Indian Journal of Agricultural Sciences, Vol 51, No 4, p 266-270, April, 1981. 5 Tab, 11 Ref.

Descriptors: *Soil moisture, *Crop yield, Groundnut, Rainfall, Moisture availability, Soil water, Available water, Moisture content, *Soil-water-plant relationships, *India.

The probable period(s) of availability of soil moisture were estimated by the water budget technique in groundnut, which is rainfed in the Saurashtra region of Gujarat, India. Daily temperature data for the 1960-1974 period were collected, along with information on field capacity, bulk density and permanent wilting point as well as root depth at different stages of plant growth. The rainfall was taken as the income and evapotranspiration as the loss of water. Potential evapotranspiration was computed according to Thornthwaite's formula and was adjusted by multiplying with the day-length factor for different months during the growing season. The analysis indicated that the yield of groundnut was linearly related to the percentage of moisture available days on fitting a linear equation. On the average, a 60% reduction in yield was noted as due to lack of adequate soil moisture. The crop suffered for want of soil moisture in a majority of the years. The short duration bunch variety was found to be more suitable than the spreading type. The stations studied were ranked in suitability for groundnut production. (Baker-FRC)
W82-01708

LEACHING OF FERTILIZER IONS IN A ULTISOL FROM THE HIGH RAINFALL TROPICS: LEACHING THROUGH UNDISTURBED SOIL COLUMNS,
International Inst. of Tropical Agriculture, Ibadan (Nigeria).
J. L. Pleysier, and A. S. R. Juo.
Soil Science Society of America Journal, Vol 45, No 4, p 754-760, July/August, 1981. 7 Fig, 5 Tab, 24 Ref.

Descriptors: *Nitrate, *Leaching, *Soil columns, Fertilizers, Ion transport, Infiltration, Aluminum, Calcium, Potassium, Magnesium, Tropical regions, Excess rainfall.

The leaching and downward movement of Ca(+2), K(+1), Mg(+2), and NO3(-1) applied to the barge surface of undisturbed soil columns of a Ultisol (Typic Paleudult) from the high rainfall region of southeastern Nigeria were studied. The soil columns were leached with 2420 mm of water, the average annual rainfall at the sampling site. Nitrate added in the form of Ca, Mg, or K salts leached readily through the profile. The leachability of cations was K less than Al which was about the same as Ca and Mg but less than Na. Nitrate was accompanied mainly by Al(+3) ions. When the profile contains a high degree of exchangeable Al saturation, the downward movement of Ca may be predicted by Walter's formulation of ion exchange chromatography. Because nitrate leached along with Al(+3) ions in the strongly acid Ultisols, it is questionable whether common crop and fallow plant species would be capable of utilizing the subsoil nitrate in this environment. (Small-FRC)
W82-01721

SIMULATION OF SOIL WATER WITHIN THE ROOT ZONE OF A CORN CROP,
Kentucky Univ., Lexington. Dept. of Agronomy.
D. Radcliffe, T. Hayden, K. Watson, P. Crowley, and R. E. Phillips.
Agronomy Journal, Vol 72, p 19-24, January/February, 1980.

Descriptors: *Soil-water-plant relationships, *Corn, *Root zone, Model studies, Agriculture, Soil water, Infiltration, Evaporation, Transpiration, Drainage, Leaf area index.

A model was developed to calculate the infiltration, evaporation, transpiration and deep drainage of soil water in the root zone of corn (Zea mays L.) throughout a growing season. Inputs are data such as solar radiation, maximum and minimum temperature, leaf area index, and rainfall. Components of the model are potential evaporation, leaf area index, infiltration and distribution of surface water, and uptake of water. This model incorporates the effect on the distribution of rainwater due to channelizing in the cracks and non-capillary pores of a highly structured soil. The model was tested on two soils using soil moisture records from 4 years in one case and 1 year in the other. Agreement of simulated and actual soil water contents in silt loams in Kentucky was good. Two methods of modeling plant uptake of soil water, mechanistic and empirical, were very similar in accuracy. (Cassar-FRC)
W82-01834

EFFECT OF BULK DENSITY ON CALIBRATION OF NEUTRON MOISTURE PROBE FOR ORGANIC SOILS,
Florida Univ., Belle Glade. Dept. of Agricultural Engineering.
G. S. Rahi, and S. F. Shih.
Transactions of the ASAE, Vol 24, No 5, p 1230-1233, 1240, September-October, 1981. 4 Fig, 2 Tab, 19 Ref.

Descriptors: *Soil water, *Density, Measuring instruments, *Organic soils, Soil types, Peat soils, Soil organic matter.

The effect of bulk density on water content estimation by the neutron probe was evaluated, a technique to improve the water content estimation was developed, and the performance of the technique was compared in relation to the original calibration curve. The bulk density significantly affected the water content measurements in organic soils if the neutron thermalization technique was used to monitor the water content. The original calibration curve in the laboratory studies indicated a difference of up to 0.10 cubic centimeter/cubic centimeter in volumetric water content for a bulk density difference of only 0.04 g/cubic centimeter in soil wetted to identical water contents. Volumetric water content over a depth of 75 cm in lysimeters varied between 0.006 to 0.167 cubic centimeters/cubic centimeter when gravimetric determination was compared with the calibration curve estimation. Bulk density of organic soil at different depths in lysimeters ranged from 0.26 to 0.37 g/cubic centimeter. A modified technique was tested to adjust neutron count ratio to account for differences in bulk density. The technique was based on the relation between count ratio and macroscopic neutron cross section of components of soil, including water. The water content estimated by the modified method was more precise than that determined by the original method. The measured water content differences between the gravimetric method and the original method decreased by 50 to 90% with the modified method. (Baker-FRC)
W82-01861

TRANSPORT OF SALTS IN CATCHMENTS AND SOILS,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Forest Research.
T. Talsma.
Agricultural Water Management, Vol 4, No 1/3, p 103-113, 1981. 4 Fig, 2 Tab, 25 Ref.

Descriptors: *Salts, *Soil properties, Catchment areas, Rainfall-runoff relationships, Catchment basins, Water pollution sources, *Watersheds, Convection, Diffusion coefficient, *Saline soils, Runoff, Stream discharge, *Australia.

A rapid assessment technique was used to measure and evaluate catchment hydraulic conductivity at various soil depth intervals. The mean hydraulic conductivities were shown to provide a satisfactory basis for explaining the contrasting runoff hydrographs. Changes in the quality of streamwater in relation to runoff were considered for the Picadilly catchment with deep and permeable soils, and for the Greens catchment with shallow and slowly permeable soils. Total salinity, as well as potassium concentration, varies very little with increasing discharge at Picadilly. Different relationships were apparent for the Greens catchment, where the dilution of salt concentrations in groundwater with substantial quick return and overland flow at high discharge rates yielded a decreasing relationship between electrical conductivity and discharge rate, with low overall electrolyte concentration at high discharge. The transport of salt through leaching occurs via water which does not join the stream as surface runoff, but instead enters the soil profile. In studies on the Picadilly catchment, a 90 kg/ha surface applied potassium chloride solution was leached through the soil. Soluble chloride did not move beyond 1.2 meters soil depth, and became increasingly adsorbed in the deeper part of the soil profile. It was concluded that solute concentrations reaching stream water in catchments, with soils of similar chemical properties as at Picadilly, would be very much retarded and strongly attenuated. Measured soil properties were also used to examine the critical water table depths for surface soil salinization under irrigated and dryland conditions. (Baker-FRC)
W82-01880

PENETRATION AND DISTRIBUTION OF TRITIATED WATER IN SOILS OF A LYSIMETER,
Eotovs Lorand Univ., Budapest (Hungary). Dept. of Physical Chemistry and Radiology.
P. Fodor-Csanyi, S. Takala, L. Alhonen-Hongisto, J. K. Miettinen, and G. L. Horvath.
Nordic Hydrology, Vol 11, No 3/4, p 169-186, 1980. 11 Fig, 5 Tab, 9 Ref.

Descriptors: *Tritium, *Soil water, *Infiltration rate, Radioactive tracers, Tracers, Lysimeters, Gravel, Sand, Soil types.

The movement of tritiated water was much faster through gravel than through fine sand in lysimeter experiments, started June 21, 1977, in Finland. Simulated precipitation (30-60 mm) was applied to three plots of soil, 10 sq meters and 1.5 meters deep, one containing gravel and two containing fine sand, all without plants. Under the same amount of rain and irrigated water, the total tritium activity (or tritium pulse) in gravel was between 30-45 cm the second day and between 45-60 cm the eighth day. There was nearly zero activity between 0 and 135 cm at 150 days. In the fine sand plots, the maximum tritium activity was located at 15-30 cm after 34 days, and at 60-135 cm after 1 year. Velocity of infiltration in gravel was 16 cm per day at the beginning of the experiment and 6 cm per day at the end; in sand, 0.5 cm per day. The tritium activity reached the lysimeter bottom considerably later than predicted by a mathematical equation. (Cassar-FRC)
W82-01886

PROPERTIES OF THE SORPTIVITY FOR EXPONENTIAL DIFFUSIVITY AND APPLICATION TO THE MEASUREMENT OF THE SOIL WATER DIFFUSIVITY,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
R. D. Braddock, J. Y. Parlange, and I. G. Lisle.
Soil Science Society of America Journal, Vol 45, No 7, p 705-709, July/August, 1981. 3 Tab, 29 Ref.

Descriptors: *Soil water, *Sorption, *Diffusion coefficient, Mathematical studies, Soil properties.

The integral relation used to calculate diffusivity developed by Parlange et al. (1980) is replaced by an expression which is exact when the soil-water diffusivity obeys an exponential law. This new expression will be more appropriate for normal soils. The power law or exponential function can be used where the diffusivity depends on the water concentration. The exponential case is related to the power case, but there are some complications. Some of the properties of the solutions are generated. Sorptivity can be represented by a simple relation to a universal function of the water content. Optimization method results are compared with results obtained here, and both are applied to the

measurement of soil-water diffusivity. Also, the method can be used to determine soil-water diffusivity when sorptivity is measured for variable water content at the surface. (Small-FRC)
W82-01897

EFFECT OF FIELD VARIABILITY IN SOIL HYDRAULIC PROPERTIES ON SOLUTIONS OF UNSATURATED WATER AND SALT FLOWS,
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Dept. of Soil Physics.
D. Russo, and E. Bresler.
Soil Science Society of America Journal, Vol 45, No 4, p 675-681, July/August, 1981. 6 Fig, 1 Tab, 17 Ref.

Descriptors: *Soil properties, *Permeability coefficient, *Flow, Salt, Spatial distribution, Soil properties, *Unsaturated flow, Mathematical studies, *Soil water, Hydraulic conductivity.

The extent to which the inherent spatial variability of soil hydraulic properties influences water and salt flow distributions was investigated. Also, predicted salt and water flows are examined in terms of their structures and their effects on the utilization of field-measured soil data. The governing water and salt flow equations are solved numerically using actual field data of soil hydraulic conductivity and differential water capacity. The data were from measurements made in 30 different field locations and matched data obtained from a Monte-Carlo simulation that considered the correlations between the parameters of the hydraulic functions. Simulated values of variables were used to estimate distribution types and its moments for pressure head, water fluxes, wetting front position, and solute concentration. Distances in the field where the horizontal flow components were negligibly small compared to vertical flow components were about 10 cm. Values of field scale dispersivity were larger than pore scale dispersivity and increased with soil depth. (Small-FRC)
W82-01898

THE INFLUENCE OF TILLAGE ON SOIL WATER BEHAVIOR,
Western Australia Univ., Nedlands. Dept. of Soil Science and Plant Nutrition.
A. P. Hamblin, and D. Tennant.
Soil Science, Vol 132, No 3, p 233-239, September, 1981. 5 Fig, 2 Tab, 12 Ref.

Descriptors: *Soil water, *Available water, *Agricultural engineering, *Wheat, Farming, Sand, *Australia, Soil types, Water conservation, Soil-water-plant relationships, Climates.

A soil water study was performed at a site located in the West Australian wheat belt which has a Mediterranean climate. Of the annual average rainfall of 348 mm, 83% falls between May and October. The soil is a deep yellow sandy loam of weak, incohesive structure, overlying sandy lateritic gravel occurring at 1.5 to 2 meters, containing 10% clay and having 1.2% organic matter in the top 10 cm. The site was cropped to lupins in the year before the study and then cropped to wheat for three consecutive years. Undisturbed 5.5 and 7.0 cm diameter cores were taken from the surface 10 cm for measuring soil physical parameters. Three intensities of tillage disturbance were then imposed for the three successive years. One intensity was a conventional district practice (CON) of one disk ploughing, one pass with a scarifier, and seeding with a tyne-drill (combine). The second method involved a minimum tillage treatment (MIN) consisting of one application of paraquat-diquat at 2 liters per ha, followed by tyne-drill seeding. The third technique involved a zero tillage treatment (ZERO) using the same herbicide, but followed by seeding with a triple-disk seeder. The CON treatment disturbed the soil to about 10 cm, the MIN to about 4 cm, and the ZERO cut only shallow slots, between which the soil was not disturbed. The findings of the study infer that, whereas most soil water could be lost through drainage from the ploughed treatment in a wet year, most soil evaporation will take place from the direct drilled soil (especially zero tillage), and during the average growing season, water will move more rapidly within the ploughed profile than in the other two treatments. Where direct drilling is adopted on sandy soils, minimum rather than zero tillage should be the aim. (Baker-FRC)
W82-02022

DIRECT EVIDENCE OF WATER-SOLUBLE ORGANIC MATTER LEACHING IN BROWN EARTHS AND SLIGHTLY PODZOLIZED SOILS,
Luxembourg Foundation Univ., Arlon.
J. Herbauts.
Plant and Soil, Vol 54, No 2, p 317-321, 1980. 2 Tab, 14 Ref.

Descriptors: *Organic matter, *Leaching, Soil porosity, Carbon, Lysimeters, Moisture meters, Soil moisture, Podzols, Soil types, Nitrogen, *Brown soils.

The leaching of organic carbon, organic nitrogen and mineral nitrogen was measured at different depths in four different forest soils using semi-active tension lysimeters. Drainwaters were collected in the soil under surface holorganic layers and under the humic layer. Precipitation beneath forest canopy was simultaneously collected with pluviometers at each lysimeter site. Determination of organic carbon was made using a Dohrmann DC-50 Total Organic Carbon Analyzer. Inorganic nitrogen was determined colorimetrically and total nitrogen measured after a sulfo-perchloric pretreatment. Organic carbon contents in waters collected beneath forest canopy were similar at the two study sites, with a seasonal fluctuation apparently related to the amount of rainfall. Under leaf litter layers, leachates were enriched in water-soluble carbon, and this enrichment was stronger under holorganic layers of the brown podzolic soil. Under humic layers the organic carbon concentrations of leachates were appreciably lower than under holorganic layers, but the decrease is less pronounced beneath the moder than beneath the mull. Mobilization of organic carbon beneath the horizons is always higher in weakly podozolized soils than in non-podzolized acid brown earth. The contents of mineral nitrogen are usually higher in the brown soil, probably as a consequence of contrasting nitrogen mineralization rates in the humic layers of these soils. (Baker-FRC)
W82-02034

WAYS OF SUCCESSIVE REFINEMENT OF METHODS OF CALCULATING THE DUTY OF WATER,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 2D.
W82-02094

2H. Lakes

A METHOD OF OBJECTIVE ANALYSIS FOR CURRENTS IN A LAKE WITH APPLICATION TO LAKE ONTARIO,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
D. B. Rao, and D. J. Schwab.
Journal of Physical Oceanography, Vol 11, No 5, p 739-750, May, 1981. 8 Fig, 4 Tab, 14 Ref.

Descriptors: *Lakes, *Mathematical studies, *Wind-driven currents, *Water circulation, Great Lakes, *Lake Ontario, Vortices, Mathematical equations, Water currents, Lake basins, Flow pattern, Air circulation.

The flow field of large lakes was represented in terms of transport stream function based on the observation that the mean circulation in large lakes is almost non-divergent in character. An equation was formulated in which the transport stream function may be calculated when the vorticity field is known. Another equation is provided for the determination of the current vector. However, since currents are measured and not vorticity, the proposed objective analysis method expands the transport streamfunction in terms of the eigenvectors of a third equation. A Lanczos procedure is used to calculate the eigenvalues and eigenvectors which are characteristic of a particular lake. The expansion coefficients are determined by minimizing the squared error between the calculated horizontal velocity vector field and available current meter data. Currents may be reconstructed at any point, since the eigenvector functions are known for the entire domain of the basin. The present procedure has been used in gathering winter data from Lake Ontario in connection with the International Field Year for the Great Lakes. (Geiger-FRC)
W82-01616

ABUNDANCE, LIFE HISTORY, AND GROWTH OF INTRODUCED POPULATIONS OF THE OPOSSUM SHRIMP (MYSIS RELICTA) IN SUBALPINE CALIFORNIA LAKES,
California Univ., Davis. Div. of Environmental Studies.
M. D. Morgan.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 8, p 989-993, August, 1981. 4 Fig, 2 Tab, 12 Ref.

Descriptors: *Opossum shrimp, *Productivity, *Growth, *Lakes, Donner Lake, Fallen Leaf Lake, Lake Tahoe, *California, Invertebrates, *Fish food, Population growth, Ecosystems, Fish populations.

Lake productivity was an important factor in the growth of opossum shrimp (Mysis relicta), introduced into Donner Lake and Fallen Leaf Lake, California, in 1965. This species is important in the food dynamics of fish populations. The overall densities of populations in Donner Lake were 238 per sq meter in August 1978, 123 per sq meter in June 1979, and 108 per sq meter in November 1980. In Fallen Leaf Lake, the densities were 114 per sq meter in August 1978 and 103 per sq meter in June 1979. These figures indicate that the mysids are well-established throughout both lakes. Mysids reproduced in the spring at ages 1 and 2 years, living for 2 years. In nearby Lake Tahoe, a much less productive lake, the growth rate of mysids was much slower, taking twice as long to reach similar population densities. The Lake Tahoe population was not reproductive during its first 2 years. (Cassar-FRC)
W82-01638

RELATIONSHIPS BETWEEN NANNOPLANKTON AND LAKE TROPHIC STATUS,
McGill Univ., Montreal (Quebec). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-01640

DESTRATIFICATION AND REAERATION AS TOOLS FOR IN-LAKE MANAGEMENT,
Salford Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W82-01648

EUTROPHICATION OF THE SALT VALLEY RESERVOIRS, 1968-73. I. THE EFFECTS OF EUTROPHICATION ON STANDING CROP AND COMPOSITION OF PHYTOPLANKTON,
Nebraska Univ., Lincoln. School of Life Sciences.
For primary bibliographic entry see Field 5C.
W82-01653

PHYTOPLANKTON PHOTOSYNTHESIS AND ITS RELATION TO STANDING CROP AND NUTRIENTS IN TWO WARM-MONOMICTIC SOUTH ISLAND LAKES,
Otago Univ., Dunedin (New Zealand). Dept. of Zoology.
S. F. Mitchell, and C. W. Burns.
New Zealand Journal of Marine and Freshwater Research, Vol 15, No 1, p 51-67, 1981. 8 Fig, 6 Tab, 58 Ref.

Descriptors: *Seasonal variation, *Phytoplankton, *Photosynthesis, Nutrients, Standing crops, Phos-

phate, Nitrates, Algal blooms, Stagnant water, Lakes, *New Zealand, Eutrophication, Lake Hayes, Lake Johnson.

Lake Hayes and Lake Johnson, New Zealand, were assessed for seasonal and vertical changes in phytoplankton, photosynthesis, chlorophyll, nutrients, pH, and major ions over a two-year period. These results were related to previously published results for phytoplankton species composition and standing crop, zooplankton, and oxygen for the same period. Accumulations of the nutrients PO4-P and NH4-N in the anoxic hypolimnia were important cyclic phenomena. In the autumn, surface concentrations of PO4-P reached 40-50 mg/cu m and NH4-N reached 150-400 mg/cu m, while the surface maxima of NO3-N were 26 mg/cu m in Lake Johnson and 60 mg/cu m in Lake Hayes. In 1970, Lake Johnson had a large accumulation of chlorophyll degradation products in the anoxic hypolimnion, and metalimnetic maxima were record occasionally. Stagnation was related to annual minima of photosynthesis and chlorophyll, with secondary minima occurring in winter. Autumn increases in photosynthesis and total chlorophyll content of the lakes were related to nutrient entrainment as the thermocline sank. In some summers, algal blooms were related to PO4-P concentrations. (Small-FRC)
W82-01700

BENTHIC MACROINVERTEBRATES OF LAKE TAUPO,
Department of Scientific and Industrial Research, Taupo (New Zealand). Ecology Div.
D. J. Forsyth, and I. D. McCallum.
New Zealand Journal of Marine and Freshwater Research, Vol 15, No 1, p 41-46, 1981. 3 Fig, 3 Tab, 13 Ref.

Descriptors: *Macroinvertebrates, *Seasonal variation, *Lakes, Lake sediments, Population density, Water depth, Oligochaetes, Snails, Midges, Lake Taupo, *New Zealand, Benthic fauna, Bays, Sediments, *Limnology.

The seasonal abundance of benthic macroinvertebrates was determined as part of a study of the limnology of Lake Taupo. Samples were collected from the profundal zone and from two transects from the littoral to the profundal zone of Lake Taupo from August 1974 to July 1975. Samples were also collected from Lake Taupo's six bays in the winter of 1975 and 1976. Chironomus zealandicus Hudson dominated chironomid populations at most sites, and Potamopyrgus antipodarum or oligochaete worms dominated the fauna at most sites. Seasonal changes in population densities were noticed. Oligochaetes dominated the fauna in four of the bays, and P. antipodarum was dominant in two bays. In the Lake Taupo area there were fewer than eight species of chironomid, four of gastropod mollusc, and two fo bivalve mollusc, along with the oligochaete worms. The annual mean standing crop of total microinvertebrates was 714 + or - 76 per sq m. Differences in species composition between the profundal zone and the transects were due to the depth preferences of different species. (Small-FRC)
W82-01702

LIMNOLOGY OF LAKE REREWHAKAAITU,
Waikato Univ., Hamilton (New Zealand). School of Science.
M. A. Chapman, V. H. Jolly, and E. A. Flint.
New Zealand Journal of Marine and Freshwater Research, Vol 15, No 2, p 207-224, 1981. 8 Fig, 4 Tab, 33 Ref.

Descriptors: *Limnology, *Lake morphometry, *Agricultural watersheds, Thermal stratification, Water depth, Lakes, Craters, Zooplankton, *Lake Rerewhakaaitu, *New Zealand.

The liminology of Lake Rerewhakaaitu was studied, and a comparison was made between the main lake and a connected, deeper crater lake. The lake has a catchment area of 4969 ha, of which 88% has been developed for agriculture, mostly dairy farming. Results emphasized the importance of morphometry. The main lake was usually homothermal, although temporary stratification occurred periodically and the oxygen content of the deeper water could be as low as 2 gm/cu m. The crater area had strong thermal and chemical stratification that persisted well into winter. Morphometry was related to the failure of the crater to become fully reoxygenated during its brief period of homothermy. Zooplankton populations of the two lakes also differed. In the main lake there were usually more bosmina but considerably fewer Ceriodaphnia and greater numbers of Piona. In the crater, adult Calamoecia were generally more abundant. (Small-FRC)
W82-01705

ON THE USE OF CAROTENOID STRATIGRAPHY IN LAKE SEDIMENTS FOR DETECTING PAST DEVELOPMENTS OF PHYTOPLANKTON,
H. Zullig.
Limnology and Oceanography, Vol 26, No 5, p 970-976, September, 1981. 2 Fig, 3 Tab, 24 Ref.

Descriptors: *Carotenoids, *Eutrophication, *Bottom sediments, *Lakes, Sedimentology, Lake sediments, Algal growth, Diatoms, Phytoplankton, Lake Zurich, *Switzerland.

The concentrations of certain carotenoids in cores of sediments were measured, and their accumulation rates over time were determined in an attempt to trace the development of the phytoplankton over the last 150-500 years in several eutrophic Swiss lakes. Ten lakes were investigated, and the results from Lake Zurich are presented and discussed. A method involving one-dimensional chromatography with four sequential development steps was used for the separation of plankton carotenoids and sediment carotenoids. Annual couplets of sediment are formed in the lake, consisting of black layers of iron sulfide formed from late summer until the beginning of winter and a light-colored layer of allochthonous clay deposited during spring and summer. The first sign of eutrophication occurred in 1896; sediments from this year contained the diatom Tabellaria fenestrata and the carotenoids fucoxanthin and diadinoxanthin. Later sediments indicated a wavelike development of the plankton, dominated by diatoms and 0. rubescens. Since 1970, oscillaxanthin has declined to the limit of detection, but other pigments are present. Algae are also still present, although there has been a decline. (Small-FRC)
W82-01706

RECENT CHANGES IN LEVEL OF LAKE VICTORIA,
Hydrometeorological Survey of the Catchments of Lakes Victoria, Kyoga and Mobutu Sese Seko, Entebbe (Uganda).
For primary bibliographic entry see Field 4A.
W82-01711

ECOLOGICAL CHARACTERISTICS OF THE RHIZOSPHERE MICROFLORA OF MYRIOPHYLLUM HETEROPHYLLUM,
Massachusetts Univ., Waltham. Department of Environmental Science.
For primary bibliographic entry see Field 4A.
W82-01796

EUTROPHICATION OF THE SALT VALLEY RESERVOIRS 1968-73. III. THE MACROINVERTEBRATE COMMUNITY: ITS DEVELOPMENT, COMPOSITION, AND CHANGE IN RESPONSE TO EUTROPHICATION,
Nebraska Univ., Lincoln. School of Life Sciences.
For primary bibliographic entry see Field 5C.
W82-01797

ABIOTIC VERSUS BIOTIC UPTAKE OF RADIOPHOSPHORUS IN LAKE WATER,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
S. J. Tarapchak, D. R. Slavens, and L. M. Maloney.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 8, p 889-895, August, 1981. 4 Fig, 2 Tab, 26 Ref.

Descriptors: *Phosphorus removal, *Accumulation, *Algae, Lakes, Radioisotopes, Phosphorus radioisotopes, Selenastrum, Lake Michigan, Glutaraldehyde, Formaldehyde, Carbonylcyanide m-chlorophenylhydrazone, Inhibitors.

Carbonylcyanide m-chlorophenylhydrazone (CP), a phosphorylation inhibitor, was a more satisfactory agent for estimating abiotic uptake of radiophosphorus in lake water than the commonly-used glutaraldehyde or formalin. It effectively blocked biological P uptake and did not cause release of detectable amounts of inorganic P31 from algae into the water. Tests using Selenastrum capricornutum and Lake Michigan water showed that uptake of inorganic P33 in the presence of 0.001 mol per liter CP was less than or equal to 0.01% and that inorganic P31 release from microorganisms was nondetectable. When particulate matter recovered from heat- or glutaraldehyde- treated samples was resuspended in water, insignificant amounts of inorganic P33 were taken up, less than or equal to 2% of controls. Although P uptake in moderately buffered Lake Michigan water is almost exclusively biotic, waters with high concentrations of silt, clay, iron, calcium, or humic materials show considerable abiotic uptake. The CP method should produce the highest possible values for the abiotic mechanism in these waters. (Cassar-FRC)
W82-01824

METHANOGENESIS IN FRESHWATER SEDIMENTS: INHERENT VARIABILITY AND EFFECTS OF ENVIRONMENTAL CONTAMINANTS,
Tennessee Univ., Knoxville. Dept. of Microbiology.
For primary bibliographic entry see Field 5C.
W82-01825

THE ROLE OF PHOTOTROPHIC BACTERIA IN THE SULFUR CYCLE OF A MEROMICTIC LAKE,
Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences.
T. B. Parkin, and T. D. Brock.
Limnology and Oceanography, Vol 26, No 5, p 880-890, September, 1981. 7 Fig, 2 Tab, 29 Ref.

Descriptors: *Sulfur cycle, *Bacteria, *Meromictic lakes, Lakes, Sulfur, Photoropism, Agricultural watersheds, Hydrogen sulfide, Diurnal variation, *Lake Knaack, Wisconsin.

The sulfur cycle at the thermocline of meromictic Knaack Lake was investigated with emphasis on how the photosynthetic bacteria in the lake affect and are affected by these transformations. Sulfide in water samples was determined by the methylene blue method, which has a detection limit of 0.05 mg/liter. Oxygen, dissolved inorganic carbon, and bacteriochlorophyll were also determined. Knaack Lake has a surface area of 1.1 ha, a maximum depth of 22 m, and a mean depth of 7 m. It is located in central Wisconsin farmland. Sulfate concentrations were very low all year. In spring and summer, sulfate concentrations in the epilimnion ranged from 0.5 to 0.7 mg/liter and in the hypolimnion from 0.1 to 0.2 mg of SO4(-2) per liter. Elemental sulfur was found only during the partial mixing period in November, when 20-30 microgram S/liter was present throughout the water column. During the day, H2S was absent at the level of the green sulfur bacteria, but H2S built up at night. Carbon dioxide studies indicated that the green bacteria were photosynthetically active in the light and oxidized the H2S. (Small-FRC)
W82-01831

THE CONTRIBUTIONS OF TEMPERATURE AND THE INPUT OF ORGANIC MATTER IN CONTROLLING RATES OF SEDIMENT METHANOGENESIS,
Michigan Univ., Ann Arbor. Dept. of Environmental and Industrial Health.
C. A. Kelly, and D. P. Chynoweth.

Limnology and Oceanography, Vol 26, No 5, p 891-897, September, 1981. 3 Fig, 4 Tab, 15 Ref.

Descriptors: *Lake sediments, *Methane, *Temperature effects, Organic matter, Decomposing organic matter, Sediments, Lakes, Fluctuations.

The effects of temperature and of the supply of organic matter on rates of methanogenesis were studied in two freshwater lakes with different organic inputs and sediment temperatures. As was seen in earlier experiments, the natural cold-temperature methanolgenic rate in a particular sediment could be increased readily by increasing the temperature. When temperature was fairly constant for long periods such as during summer stratification, the rate of methane flux was directly proportional to and maximally adjusted to the rate of carbon input. Methane flux averaged 47% of organic input. Thus, when temperature changes rapidly, its effect will be predictably superimposed upon the effect of organic input. (Small-FRC)
W82-01832

RESONANT OSCILLATION IN DULUTH-SUPERIOR HARBOR,
Minnesota Univ., Duluth. Dept. of Physics.
T. F. Jordan, K. R. Stortz, and M. Sydor.
Limnology and Oceanography, Vol 26, No 1, p 186-190, January, 1981. 4 Fig, 3 Tab, 8 Ref.

Descriptors: *Resonance, *Harbors, *Oscillatory waves, Mathematical studies, Mathematical equations, *Lake Superior, Duluth, Minnesota, Water level fluctuations, Lakes, Flow characteristics.

The Duluth-Superior Harbor has two inlets to Lake Superior and a constriction separating the inner and the outer harbor. The masses of water moving in and out of the inlet channels can act as oscillators, coupled by the water level in the harbor and excited by oscillations of the lake level. Such oscillations at inlets to harbors, called Helmholtz resonances, can contribute significantly to mass movement and the flushing rate of a harbor. The dimensions of the Duluth-Superior Harbor and its inlets produce a Helmholtz resonance with a period comparable to the periods of free surface oscillations of Lake Superior, and the constriction may be considered as a possible third coupled oscillator. A Helmholtz resonance with a period of between 2.1 and 2.3 hours was calculated in the harbor. Some modes of oscillation of Lake Superior were found to have periods of about 2.0 and 2.3 hours. Spectral analysis of fluctuations of harbor water levels showed a mode of oscillation with a period of 2.1 hours. Analysis of water level oscillations in the harbor and currents in an inlet channel showed Helmholtz resonance periods of 2.1 hours, which seem to be excited by lake oscillations of nearly the same period. (Carroll-FRC)
W82-01837

FAYETTEVILLE, GREEN LAKE, NEW YORK: 3H-3HE WATER MASS AGES AND SECONDARY CHEMICAL STRUCTURE,
Australian National Univ., Canberra. Research School of Earth Sciences.
T. Torgersen, D. E. Hammond, W. B. Clarke, and T-H. Peng.
Limnology and Oceanography, Vol 26, No 1, p 110-122, January, 1981. 3 Fig, 8 Tab, 38 Ref.

Descriptors: *Meromictic lakes, *Chemocline, *Residence time, Chemical stratification, *Green Lake, *New York, Lakes, Isotope studies, Tritium, Helium, Limnology, Chemical analysis, Water analysis.

Green Lake, located near Fayetteville, New York is probably one of the most intensively studied meromictic lakes in the world. New chemical and isotopic measurements made in the lake in 1974 and 1975 are reported. The results of these measurements indicate the presence of an upper and a lower monimolimnion spearated by a secondary chemocline. The secondary chemocline, found at about 32.5 meters, is marked by distinct enrichments in S(2-), methane (CH4), total carbon dioxide N(+), and C1(-). Water mass ages were determined using tritium and tritiugenic helium. The upper monimolimion (16 to 32.5 meters) showed a mean annual age of 3.1 years, while the mean annual age of the lower monimolimnion was 5.8 years. The increased residence time of the S(2-) and CH4, which are produced in situ in the lower monimolimnion, causes enrichments of these substances at the secondary chemocline. A separate and probably diffuse groundwater input appears to be the most likely cause of Na(+), C1(-), He4, and sigma carbon dioxide enrichments and tritium depletions in the lower monimolimnion. The presence of a strong point source of groundwater to the upper monimolimnion at about 20 meters is suggested by the carbon 14, radon 222, and He3 profiles. New strontium 90 and cesium 137 measurements taken during this study are inconsistent with a previously published two-box model. (Carroll-FRC)
W82-01838

VOLTAMMETRIC STUDIES ON THE STABILITY OF THE ZN(II) CHELATES WITH NTA AND EDTA AND THE KINETICS OF THEIR FORMATION IN LAKE ONTARIO WATER,
Kernforschungsanlage Juelich, G.m.b.H. (Germany, F.R.). Inst. fuer Chemie.
B. Raspor, H. W. Nurnberg, P. Valenta, and M. Branica.
Limnology and Oceanography, Vol 26, No 1, p 54-66, January, 1981. 4 Fig, 6 Tab, 36 Ref.

Descriptors: *Zinc, *Chelating agents, *Organic matter, Lakes, Heavy metals, Chemical reactions, Kinetics, Voltammetry, Stability analysis, *Lake Ontario, Dissolved solids.

Voltammetric techniques were extended to the analysis of zinc NTA and zinc EDTA chelates in freshwater from Lake Ontario. Both of the ligands involved are more or less biologically nondegradable and reduce the toxicity of heavy trace metals by inhibiting their uptake by aquatic organisms through chelation. Differential pulse anodic stripping voltammetry was used to study the specific effects of ionic excess constituents, such as alkaline earth cations and chloride and hydroxide anions, on the stability and kinetics of formation of zinc (II) levels. Competition for the chelating ligands was found to have the most pronounced adverse specific effects on chelate stability. This was particularly true when the alkaline earth ions calcium (II) or magnesium (II) were present in substantial excess over the level of the heavy trace metals. While the results obtained in voltammetric studies of seawater are generally valid due to the rather constant macrocomponent composition and pH, inland waters have considerable diversity in composition, ionic strength, and pH. As a result, the concentrations of NTA and EDTA required to achieve a certain degree of chelation for a heavy trace metal in a certain type of water will give approximate information on the levels of the chelating components with chelator strength comparable to the dissolved organic matter required to attain a similar degree of chelation. It is also possible to develop estimates of the capacity of the dissolved organic matter for trace metal chelation and predictions of the significance of the particular kind of dissolved organic matter if the conditional stability constants of chelating components of the dissolved organic matter are known. (Carroll-FRC)
W82-01839

THE RELATIVE IMPORTANCE OF PROTOZOANS, ROTIFERS, AND CRUSTACEANS IN A FRESHWATER ZOOPLANKTON COMMUNITY,
Georgia Univ., Athens. Dept. of Zoology.
M. L. Pace, and J. D. Orcutt, Jr.
Limnology and Oceanography, Vol 26, No 5, p 822-830, September, 1981. 4 Fig, 2 Tab, 36 Ref.

Descriptors: *Zooplankton, *Protozoa, *Lakes, *Population density, Aquatic animals, Aquatic populations, Biological communities, Rotifiers, *Lake Oglethrope, Georgia.

The zooplankton community of Lake Oglethrope was sampled over a period of 13 months in this study of a macro- and microzooplankton association. Throughout the year, protozoans were numerically the most abundant organisms in the zooplankton, usually an order of magnitude greater than rotifers which were also abundant. Nauplii were abundant in winter. Macrozooplankton reached highest densities in May (Ceriodaphnia reticulata), October (Daphnia parvula and Diaptomus siciloides) and December (D. parvula and D. siciloides). Densities of protozoans were highest in the metalimnion, where scuticociliates bloomed in zones of intense bacterial activity. During these blooms, protozoa accounted for up to 62% of the zooplankton biomass. Protozoa are rarely included in studies of freshwater zooplankton communities, but since they make a significant contribution to rates of grazing, nutrient regeneration, and secondary productivity, they should not be ignored. (Small-FRC)
W82-01840

NITROUS OXIDE IN FRESHWATERS OF THE GREAT LAKES BASIN,
Cornell Univ., Ithaca, NY.
E. Lemon, and D. Lemon.
Limnology and Oceanography, Vol 26, No 5, p 867-879, September, 1981. 8 Fig, 4 Tab, 19 Ref.

Descriptors: *Nitrous oxide, *Great Lakes, *Seepage, Deep water, Surface effects, Diffusion models, Air-water interfaces.

The transport of nitrous oxide in the freshwaters of the Great Lakes Basin was investigated to determine the amount of seepage-water N20 from the land which enters streams, lakes, and the sea. Air and water samples were collected in the Great Lakes and Cayuga Lake. N20 was produced in a relatively 02-rich environment above the thermocline in deep water lakes and was reduced to N2 in the deeper, less oxic waters below the thermocline. Calcuation of N20 flux densities for the lakes indicated a wider range than has been reported for oceans. Two diffusion models were used to calculate exchange values of N20 between the atmosphere and the lakes. Groundwater under a large dairy farm was rich in N20, but once the N20 seeped into a headwaters tributary it was lost to the atmosphere. Generally, large amounts of N20 are dissolved in seepage or groundwater on the land, but once exposed to the open air, quickly disappeared into the atmosphere. (Small-FRC)
W82-01841

MORPHOLOGY, HYDROLOGY AND HYDROCHEMISTRY OF KARST IN PERMAFROST TERRAIN NEAR GREAT BEAR LAKE, NORTHWEST TERRITORIES,
National Hydrology Research Inst., Calgary (Alberta).
For primary bibliographic entry see Field 2F.
W82-01904

VARIANCE ESTIMATES FOR A DYNAMIC EUTROPHICATION MODEL OF SAGINAW BAY, LAKE HURON,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
D. Scavia, R. P. Canale, W. F. Powers, and J. L. Moody.
Water Resources Research, Vol 17, No 4, p 1115-1124, August, 1981. 2 Fig, 7 Tab, 56 Ref.

Descriptors: *Variation coefficients, *Error analysis, *Model studies, Mathematical models, Lakes, *Eutrophication, *Saginaw Bay, *Lake Huron, Algae, Nutrients, Phosphorus, Nitrogen, Zooplankton, Phytoplankton, Correlation coefficient.

First-order variance propagation was used to estimate variance in a eutrophication model output based on variable initial conditions, parameters, and external loads. This model is an eight-state-variable, nonlinear, time-dependent food chain model designed to simulate seasonal dynamics in Saginaw Bay, Lake Huron. The eight variables are phytoplanktons, herbivorous and carnivorous zooplankton, three chemical forms of N, and two chemical forms of P. Coefficients of variance during summer were similar to those measured.

Important parameters in terms of model sensitivity and variance propagation were identified for the variables for different times during the 350-day simulation. These included maximum phytoplankton specific growth rate, herbivorous zooplankton filter rate, carbon to chlorophyll ratio, and P to chlorophyll ratio. Parameter variance can be reduced in several ways: aggregating model state variables to reduce the number of uncertain parameters, acquiring additional laboratory and field data, limiting the range of true state variables aggregated as a single model state variable and characterized by assumed constant parameters, and reducing the variances associated with the most sensitive parameters. (Cassar-FRC)
W82-01917

CALCULATION OF BRACHIONUS RUBENS PRODUCTION BY THE DIRECT METHOD AND BY EDMONDSON'S METHOD,
Irkutskii Gosudarstvennyi Univ. (USSR). Biological and Geographical Research Inst.
G. L. Vasil'yeva, and N. P. Blokhina.
Hydrobiological Journal, Vol 16, No 3, p 22-26, 1980. 5 Fig, 1 Tab, 14 Ref.

Descriptors: *Rotifers, *Productivity, *Lakes, *Lake Baikal, Aquatic animals, Chlorella, Chlorophyta, Water analysis, Mathematical studies, Aquaculture, USSR.

A comparison was made between the calculation of the production of rotifers by Edmondson's method and direct calculations of the removed biomass, i.e., with direct calculations of production, with reference to the abundant rotifer species Brachionus rubens. Data was obtained in summers of 1973 and 1974 during the mass cultivation of the rotifer B. rubens as a fish feed at the Baikal Biological Station. The rotifers were reared in five concrete tanks in the open on the shore of Lake Baikal. Rotifers were fed on the alga Chlorella vulgaris. Poor development of the culture was noted in 1973, with an increase in the overall abundance of rotifers in 1974, especially an intensive increase in the number of juveniles. The effect of water temperature on the duration of the individual development of rotifers was manifested fairly clearly. The temporal variations in the production of rotifers as calculated by the Edmondson method are in full agreement with those obtained by calculating the biomass, with a few exceptions. Production calculated by Edmondson's method was compared with directly recorded production. In these findings, the recording of production by the direct removal of biomass is fairly accurate. All that is not allowed for is elimination. However, it is suggested that it might be possible that there was no elimination in the brief periods between removals of biomass. The figure for production yielded by Edmondson's method is fairly close to empirical data obtained by direct calculation. Thus the present method satisfactorily described the productivity of the rotifers. (Baker-FRC)
W82-01921

EFFECT OF THE LIMING OF INTENSIVELY EXPLOITED PONDS ON PHYTOPLANKTON DEVELOPMENT,
Akademiya Nauk URSR, Kiev. Inst. Hidobiologii.
N. N. Kharitonova, and L. V. Gorobets.
Hydrobiological Journal, Vol 16, No 4, p 35-39, 1980. 1 Fig, 2 Tab, 25 Ref.

Descriptors: *Reservoirs, *Phytoplankton, *Ponds, Aquaculture, Plankton, Nitrogen, Phosphorus, Fertilizers, Nutrients, *Lime, Ecological effects.

The effect of the liming of extensively exploited ponds on phytoplankton development was investigated during 1972-1973 in rearing ponds No. 13 and 14 of the 'Tsentral'nyy' unit of the Donets Fish Combine. The ponds had an area of 53.8 and 118 ha, respectively, a mean depth of 1.89 and 1.97 meters respectively, and were typified by weak water exchange, intensive development of phytoplankton, and the presence of a large amount of suspended organic matter, as a result of which the transparency of the water was low. Higher water plants were essentially absent. Stocking density ranged from 6100 to 8000 fish/ha. The ponds were treated with organic fertilizer in the early spring and with N-P fertilizers throughout the summer. Lime was applied manually from a boat at a rate of 71-147 kg/ha. Phytoplankton samples were taken before the addition of lime, and also on the 3rd, 6th, 9th, 12th and 15th days thereafter. The samples were taken and processed by the standard procedures. Liming caused a brief reduction in the abundance and biomass of algae. Cyanophyta and Protococcinea proved most sensitive to the application of lime, with Volvocineae, Conjugatae and Euglenophyta being less sensitive. The development of Bacillariophyta was not appreciably affected by liming, but on occassion their abundance and biomass increased after lime had been added. The application of lime led to a significant improvement in the hydrochemical regime of the ponds, for example increased oxygen content and reduced content of dissolved organic matter in the water. The N-P fertilizers must be used following liming at a rate of 100-200 kg/ha for more rapid and controlled development of the phytoplankton. (Baker-FRC)
W82-01923

THE HYDROFLORA OF URBAN PONDS AS AN INDEX OF THEIR SANITARY AND BIOLOGICAL STATE,
Kharkov Univ. (USSR).
A. M. Matviyenko, T. V. Dogadina, N. I. Il'chenko, R. I. Meshcheryakova, and O. V. Savvina.
Hydrobiological Journal, Vol 16, No 4, p 45-48, 1980. 1 Tab, 20 Ref.

Descriptors: *Ponds, *Water quality, *Algae, Acidity, Urban areas, Fungi, *Kharkov, USSR, Recreation facilities, Eutrophic lakes, Eutrophication, Taxonomy.

The hydroflora were investigated in six ponds over a period of 2 years in Kharkov. Pond 1 was produced by damming a ravine and is used for recreational purposes. Pond 2 is a river pond situated in a densely populated area of the city. Pond 3 developed in a sand quarry and is used as a pond park and sports center. Pond 4 was produced by damming gullies and ravines and is used for recreation. Pond 5 is an excavated pond located in a densely populated area and is used for recreation. Pond 6 is an excavated pond with a dam and embanked shores, used for recreation. In the investigation, 294 intraspecific algal taxa were found in the phytoplankton. The largest numbers of different species were found in ponds 1 and 6, 149 and 136, respectively; the largest numbers of species are from the Protococcophyceae and Cyanophyta. Protococcophyceae and Bacillariophyta predominate in the phytoplankton of the ponds studied. Some rare species were also found, such as Ilsteria lobata, never reported before in the USSR. Ponds 1 and 4 were classified as moderately eutrophic, ponds 2 and 6 as strongly eutrophic, and pond 5 as eutrophic-polytrophic. Pond 3 was shown to be oligotrophic. The distribution of aquatic fungi showed the number of species to be poor, with ponds 1, 5 and 6 containing 18, 19, and 19 species, respectively. The oxygen content of the ponds was satisfactory. Permanganate oxidizability varied considerably. The pH was almost always low, 4.8-6.3. The phosphate content of the water ranged from 0.1 to 0.3 mg/l. (Baker-FRC)
W82-01924

CONTOURITES IN LAKE SUPERIOR,
Minnesota Univ., Minneapolis. Dept. of Geology and Geophysics.
T. C. Johnson, T. W. Carlson, and J. E. Evans.
Geology, Vol 8, No 9, p 437-441, September, 1980. 6 Fig, 27 Ref.

Descriptors: *Contours, *Lakes, *Bottom currents, Lake sediments, Lake morphology, Water currents, Bottom sediments, *Lake Superior, Seismology.

Preliminary evidence is presented for the existence of contourites in Lake Superior. The lake floor underlying the Keweenaw Current was traversed with a 3.5 kHz seismic-reflection profiling system on five cruises. Sediment samples were also obtained. The seismic reflection profiles observed can be attributed to turbidity currents or to contour currents. The geometry of the acoustic bed forms gives strong support for contour currents, as there are distinct wavy reflectors in a scoured trough at a depth of 200 m at the base of the trough. Hyperbolic echoes are found adjacent to the trough, and overlapping echoes farther lakeward. Sediment cores contained what appeared to be contours. There were irregular, thin sand layers with sharp upper and lower contacts, interbedded with sandy clay. This is the first report of marine-like contours in a lacustrine environment. (Small-FRC)
W82-01935

ZOOPLANKTON SPECIES DIVERSITY IN LAKE ST. CLAIR, ONTARIO, CANADA,
Windsor Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-01937

PHYTOPLANKTON ACCUMULATION IN LANGMUIR CELLS,
British Columbia Univ., Vancouver. Dept. of Mathematics.
G. T. Evans, and F. J. R. Taylor.
Limnology and Oceanography, Vol 25, No 5, p 840-845, September, 1980. 3 Fig, 17 Ref.

Descriptors: *Phytoplankton, *Langmuir cells, *Water circulation, Lakes, *Red tide, Dinoflagellates, Eutrophication, Wind.

The distribution of phytoplankton in Langmuir circulations is examined. In this case downwind transport is ignored, and only movement in a vertical cross section perpendicular to the axis is considered. The cell is 10 meters wide, and has a surface speed of 1.5 cm per sec, typical of that occurring with a 5 meter per sec wind. The water movement appeared to be relatively unimportant compared with the phytoplankton movement. Stommel's model (1949) is not applicable when phytoplankton velocities are not constant. The accumulation of phytoplankton by Langmuir cells depends greatly on the starting position of the organisms and on their vertical movement patterns. In red tides, the bloom from organisms will be swept into rows if they are on the surface when the Langmuir circulation starts. If the algae are below the surface, they may either be swept to the surface or not enter the circulation, depending on their depth. Those organisms in the center of the cell may remain below the surface, where they are not evident. (Cassar-FRC)
W82-01946

EFFECTS OF THERMOCLINE DISPLACEMENT UPON SUBSURFACE CHLOROPHYLL MAXIMA IN LAKE MICHIGAN,
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
J. A. Bowers.
Journal of Great Lakes Research, Vol 6, No 4, p 367-370, 1980. 3 Fig, 15 Ref.

Descriptors: *Chlorophyll, *Thermocline, Lakes, *Lake Michigan, Thermal stratification, Wind.

Distinct subsurface maxima in the vertical distribution of chlorophyll have been observed in Lake Michigan during thermal stratification. This study determined that the depths of these maxima were significantly correlated with thermocline displacements from equilibrium in the nearshore areas. These water movements are a response to wind. During relatively calm periods in 1975 a distinct deep chlorophyll layer was present. In 1976 the periodic wind stress from the north and northeast created downwelling. The resulting deeper, less distinct thermocline decreased light intensity and increased turbulence, thus decreasing algal productivity and biomass. (Cassar-FRC)
W82-01957

SOUTHERN LAKE MICHIGAN SEDIMENTS: CHANGES IN ACCUMULATION RATE, MINERALOGY, AND ORGANIC CONTENT,
Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.

For primary bibliographic entry see Field 2J.
W82-01958

INORGANIC CHEMISTRY OF PARTICULATE MATTER FROM THE NEARSHORE ZONE OF LAKE MICHIGAN,
Michigan Univ., Ann Arbor. Great Lakes and Marine Waters Center.
R. Rossmann.
Journal of Great Lakes Research, Vol 6, No 4, p 348-352, 1980. 5 Tab, 16 Ref.

Descriptors: *Particulate matter, *Trace metals, *Sinks, Lakes, Chemical precipitation, *Lake Michigan, Suspended sediments, Sediments, Lake sediments, Phytoplankton, Zooplankton, Metals, Heavy metals, Hypolimnion, Epilimnion, Calcium carbonate, Manganese oxides, Dolomite.

Suspended particulate matter collected near the Donald C. Cook Nuclear Plant, Lake Michigan, during 1974 through 1976 contained major amounts of trace metals relative to the soluble fraction. This particulate matter serves as a sink and a conveyor of trace metals to the sediments. Fe, K, Mg, and Mn were always more concentrated in the hypolimnion than in the epilimnion, and Ca, Cr, Cu, Na, Sr, Zn, and total P were almost always more concentrated in the hypolimnion than in the epilimnion. Sediment resuspension was the cause of this hypolimnion enrichment. Plankton were not significantly involved in trace metal particulate chemistry. Ratios of metals concentrations in phytoplankton:particulates and zooplankton:particulates did not exceed 0.058, whereas metals ratios in particulates:solubles were as high as 16 (Mn). Although calcium carbonate precipitated during the summer months, peaking in September, it is not important in this nearshore region as a P or trace metal sink because resuspension occurs regularly and river output is continuous. The substances most strongly correlated with trace metals were dolomite and hydrated Mn oxides, and possibly an organic substance of unknown composition. (Cassar-FRC)
W82-01959

THE POPULATION ECOLOGY OF IRON BACTERIA (GENUS OCHROBIUM) IN A STRATIFIED EUTROPHIC LAKE,
Freshwater Biological Association, Cumbria (England). Windermere Lab.
J. G. Jones.
Journal of General Microbiology, Vol 125, No 3, p 85-93, 1981. 8 Fig, 2 Tab, 34 Ref.

Descriptors: *Bacteria, *Eutrophication, Lakes, Population dynamics, Stratification, Seasonal variation, Iron, *England, English Lake District.

The present study examined the population ecology of Ochrobium sp. to determine the depth at which the organism grew in a eutrophic lake. Samples were taken over the deepest point of Esthwaite Water, a eutrophic lake with a surface area of 1 square kilometer and a mean depth of 6.4 meters. The hypolimnion of the lake becomes deoxygenated during summer stratification. At the onset of summer stratification in Esthwaite Water the release and immediate oxidation of ferrous ions from the sediment increased the turbidity in the overlying water. Ochrobium sp. capsules and Leptothrix sp. filaments were found in the turbid zone; their presence suggested either growth in situ or an upward migration from the sediment. Within a month the zone of iron oxidation and the Ochrobium sp. and Leptothrix sp. populations had moved upward into the water column, and peaks were found at depths of 12 to 13 meters. Turbidity profiles indicate the depth at which ferrous ions are oxidized and thus the depth to which oxygen must penetrate periodically. Within a week the hypolimnion had become deoxygenated further, carbon dioxide concentrations had increased, and the zone of iron oxidation had developed a sharp peak. The Leptothrix sp. and Ochrobium sp. had increased by an order of magnitude and were now separated into two distinct zones, the former above and the latter just below the peak of oxidized iron. During the period of most rapid growth it appeared that the generation time for Ochrobium sp. was 29 hr, but this did not allow for losses due to grazing and population migration. Later in the season wind-induced turbulence dispersed the zone of iron oxidation and the population of Ochrobium sp. The population overwintered in the sediment. (Baker-FRC)
W82-01997

ABUNDANCE DYNAMICS OF MICROORGANISMS IN THE DECOMPOSITION OF MACROPHYTES,
Akademiya Nauk SSSR, Borok. Inst. Biologii Vnutrennykh Vod.
V. M. Kudryavtsev, and Yu. V. Yeshov.
Hydrobiological Journal, Vol 16, No 4, p 14-18, 1980. 4 Tab, 7 Ref.

Descriptors: *Decomposition, *Macrophytes, *Microorganisms, *Bacteria, Organic matter, Nutrients, Temperature effects, Acidity, Aquatic plant, Banks, Vegetation, Water quality, Fungi, Reservoirs, Decomposing organic matter, Rybinsk Reservoir, USSR.

The dynamics of the development of microorganisms were observed during the death and decomposition of higher water plants under laboratory conditions. Experiments were conducted in 10-liter capacity glass aquaria filled with water from the bank areas of Rybinsk reservoir, which are overgrown with water plants. Also added were 10 g of wet biomass of water-lily, pondweed and bulrush. The plants were collected at periods of intensive growth. Samples were taken at fixed intervals from these containers for determination of the total number of bacteria on Synpor membrane filters by Razumov's method. During the observation period the temperature of the water varied only slightly, and the pH varied in the range of 7.35-8.25. Oxygen saturation of the water was 75-90%. The observations revealed that the total quantity of bacteria fluctuates appreciably in the decomposition of higher water plants. The abundance of bacteria in the experimental aquaria was 1.5-2.5 times greater than in the control. Intensive reproduction of bacteria was noted at the start of the experiment. Their highest abundance was recorded on day 3. Subsequently the rate of reproduction was affected by a number of factors, including temperature, illumination, and nutrient concentration. The abundance of bacteria was not the same in the decomposition of different species of macrophytes. The largest quantity was recorded in the decomposition of pondweed and water-lily, the least in the decomposition of bulrush. The readily decomposable part of the organic matter was oxidized by the saprophytic microflora. The bacteria noted were mainly nonsporulating. Consequently, the bacteria that decompose starch and cellulose are involved in utilization of organic matter of macrophytes along with microscopic fungi, the abundance of which ranged between a few tens and hundreds of thousands of cells milliliter. (Baker-FRC)
W82-01999

QUANTIFICATION OF THE LAKE TROPHIC TYPOLOGIES OF NAUMANN (SURFACE QUALITY) AND THIENEMANN (OXYGEN) WITH SPECIAL REFERENCE TO THE GREAT LAKES,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
S. C. Chapra, and H. F. H. Dobson.
Journal of Great Lakes Research, Vol 7, No 2, p 182-193, 1981. 4 Fig, 6 Tab, 38 Ref.

Descriptors: *Trophic level, *Lakes, *Oxygen depletion, Water quality, Mathematical studies, *Great Lakes.

Oxygen deficit of the Great Lakes is studied as a fundamental measure of the lake trophic state. Naumann's concept focuses on visual symptoms of eutrophication related to plant production in the lake's surface area. Thienemann's concept focuses on the oxygen concentration in deep waters. An attempt is made to express these two concepts on a common dimensionless scale in order to allow comparison of their relative importance in different parts of the lakes. Separate trophic scales and indices were developed; the scales are comparable, as they are expressed in a dimensionless form with a lower bound of zero and a mesotrophic range of 5 to 10. Using these scales, Lakes Superior, Huron, and Michigan were classified as oligotrophic. In terms of surface water quality, central and eastern Lake Erie and Lake Ontario were classified as mesotrophic, but on the oxygen scale they ranged from eutrophic in central Lake Erie to oligotrophic in Lake Ontario. For lakes of similar primary production, areal oxygen depletion is directly proportional to hypolimnion thickness. (Small-FRC)
W82-02004

COMPARATIVE LIMNOLOGY OF INNER LONG POINT BAY, LAKE ERIE, AND ADJACENT WATERS OF THE OUTER BAY,
Ontario Ministry of Natural Resources, Wheatley. Lake Erie Fisheries Research Station.
For primary bibliographic entry see Field 5B.
W82-02005

NITRATE ACCUMULATION IN AEROBIC HYPOLIMNIA: RELATIVE IMPORTANCE OF BENTHIC AND PLANKTONIC NITRIFIERS IN AN OLIGOTROPHIC LAKE,
Scientific and Industrial Research, Taupo (New Zealand). Freshwater Section.
W. F. Vincent, and M. T. Downes.
Applied and Environmental Microbiology, Vol 42, No 4, p 565-573, October, 1981. 6 Fig, 4 Tab, 35 Ref.

Descriptors: *Oligotrophic lakes, *Nitrates, Accumulation, Lakes, Benthos, Plankton, *Nitrification, Hypolimnion, Thermal stratification, Stratification, *Lake Taupo, *New Zealand.

The rate of accumulation of nitrate-nitrogen and the nitrification intermediate, nitrous oxide, was determined in the well-oxygenated hypolimnion of the largest oligotrophic lake in New Zealand. An examination of the vertical distribution of nitrifying bacteria was made by short-term radioisotopic assay to establish the relative contribution of benthic and planktonic species to the observed deepwater accumulation of oxidized nitrogen. The lake under study was Lake Taupo, a moderately large, deep, oligotrophic lake in the central volcanic plateau of North Island, New Zealand. Both nitrate and nitrous oxide accumulated in the hypolimnion of the lake throughout stratification. The two forms of oxidized nitrogen increased in concentration with increasing depth toward the sediments, where the concentrations of dissolved reduced nitrogen were two orders of magnitude higher than concentrations in the overlying water. Nitrification rates were measured by dark C-14 labeled carbon dioxide assays with and without the inhibitor nitrapyrin. The fastest rates were recorded for planktonic nitrifiers in the epilimnion and benthic species in the surficial 2.5 mm of the sediments. Nitrifying bacteria were least active in the deep hypolimnion. Deepwater accumulation of nitrate in Lake Taupo must therefore be a product of benthic rather than planktonic nitrification. (Baker-FRC)
W82-02023

EFFECT OF DIFFERENT WATER SALINITY LEVELS AND ORGANIC MATTER APPLICATION ON THE COMPOSITION OF WATER SOLUBLE AND EXCHANGEABLE BASES IN A BRACKISHWATER FISH POND SOIL,
Central Inland Fisheries Research Inst., Barrackpore (India).
G. N. Chattopadhyay, and L. N. Mandal.
Hydrobiologia, Vol 74, No 1, p 33-37, September, 1980. 3 Fig, 13 Ref.

Descriptors: *Fish ponds, *Organic matter, *Salinity, *Brackish water, ponds, Bases, Manure, Aquaculture, *Water pollution effects, Sodium, Potassium, Calcium, Magnesium, Soils, Nutrients.

Behavior of different water soluble and exchangeable bases in brackish water fish pond soil under different water salinity levels (0 to 30 ppt) in the presence and absence of added organic matter

were studied. Results indicated that the higher water salinity levels could adversely affect biological production of the ponds by increasing the amount of water soluble and exchangeable Na(+) (1.6 milliequivalent (me) per 100 g at trace salinity to 3.9-5.5 me per 100 g at 30 ppt salinity) and decreasing Ca(2+) (15.8-16.9 me per 100 g at trace salinity to 10.6 me per 100 g at 30 ppt salinity). Mg(2+) levels did not show a distinct relationship with water salinity without added organic matter. However, with organic matter, the Mg(2+) content increased from 11.7 me per 100 g at trace salinity to 14.6 me per 100 g at 30 ppt salinity. Application of organic manures was beneficial, increasing the exchangeable Ca(2+) and decreasing the exchangeable Na(+) in the soil. K(+) content was unaffected by organic matter treatment. SAR values of waters increased with increases in water salinity and decreased slightly on organic matter treatment. (Cassar-FRC)
W82-02027

A CONTROL MECHANISM OF THE PHYTOPLANKTON RESPIRATION IN A EUTROPHIC RESERVOIR,
Technische Univ., Dresden (German D.R.). Bereich Hydrobiologie.
J. Benndorf.
Hydrobiologia, Vol 72, No 1/2, p 125-129, July, 1980. 3 Fig, 2 Tab, 14 Ref.

Descriptors: *Respiration, *Photosynthesis, *Phytoplankton, *Carbon dioxide, Lakes, Reservoirs, *Eutrophic lakes, Bautzen Reservoir, Light intensity, Compensation light intensity, Bautzen Reservoir, Germany.

Water samples taken in the eutrophic Bautzen Reservoir, German Democratic Republic, between June 1976 and December 1978 had very low or non-existent free carbon dioxide on several sampling occasions when water temperatures were above 15 C, the incident light exceeded 500 J per sq cm per day, and there was no wind-induced agitation. The compensation light intensities (where photosynthesis equals respiration of the phytoplankton) were also very low, less than 0.2 J per sq cm per day, in the absence of CO2. The compensation light intensity increased with increasing concentrations of CO2. This result is interpreted as a minimizing of cell respiration at a low CO2 supply. Consequences of this control mechanism are high phytoplankton growth rates even at CO2 limitation during the light hours, storage of polyphosphates and possibly a high dark CO2 assimilation during the night. This shows possible errors inherent in the measurement of gross photosynthesis by the light-dark bottle technique and the calculation of the gross and net photosynthesis from the direct, continuous measurement of oxygen at low CO2 supply. (Cassar-FRC)
W82-02030

SEASONAL AND DIURNAL CHANGES OF CHLOROPHYLL IN A TROPICAL FRESH WATER IMPOUNDMENT,
Kamaraj Univ., Madurai (India). School of Biological Sciences.
V. Kannan, and S. V. Job.
Hydrobiologia, Vol 69, No 3, p 267-271, March, 1980. 1 Fig, 3 Tab, 21 Ref.

Descriptors: *Eutrophic lakes, *Phytoplankton, *Chlorophyll, Nutrients, Lakes, Seasonal variation, Diurnal distribution, Algae, Sathiar Reservoir, *India, Reservoirs.

The highly eutrophic Sathiar Reservoir, India, had a higher maximum production of chlorophyll a (37.16 + or - 3.93 micrograms per liter in July 1977) than any previously recorded in Indian waters. Minimum chlorophyll a was 2.2 + or - 0.61 micrograms per liter in September 1977, following the rains which caused dilution, outflow, and sedimentation with silt. Chlorophyll b fluctuated from 1.32 to 18.91 micrograms per liter. Daily chlorophyll levels were highest at 12 noon (occasionally at 3 p.m.) and minimum at 6 a.m. (Cassar-FRC)
W82-02052

EXPERIENCE WITH LAKE AND RESERVOIR RESTORATION TECHNIQUES IN THE GERMAN DEMOCRATIC REPUBLIC,
Institut fuer Wasserwirtschaft, Berlin (German D.R.).
H. Klapper.
Hydrobiologia, Vol 72, No 1/2, p 31-41, July, 1980. 4 Fig, 2 Tab, 34 Ref.

Descriptors: Lake rehabilitation, *Eutrophic lakes, *Water resources management, Lakes, *Lake restoration, Water quality control, Water pollution prevention, *German Democratic Republic, Rehabilitation, Regulations, Fertilizers, Wastewater treatment, Nutrients, Hypolimnion, Aeration, Nitrogen compounds, Phosphorus compounds, Economic aspects, Social aspects, Phosphates, Reservoirs.

The intensive use of land and water resources has accelerated eutrophication of lakes in the German Democratic Republic. As of 1978, the total of 524 lakes have been classified as follows: 3.4% oligotrophic and mesotrophic, dimictic; 59.4% eutrophic; 29.6% polytrophic; and 9.6% hypertrophic. Several rehabilitation methods have been used in this country to prevent pollution and restore affected ecosystems. Government regulations control water use, establish protective zones, and specify fertilizer type and timing of applications. Sewage sludge and manures are extensively used as soil treatments, storage basins being provided for the winter months. Wastewater treatment removes nutrients by phosphate precipitation and denitrification. The water bodies themselves may be treated in situ by nutrient precipitation with aluminum sulfate, hypolimnetic depletion (withdrawing the nutrient-rich water for irrigation or drinking water), encouragement of desirable species of fish, increasing lake depth by damming, protection from light, covering sediments with inert material, changing flow patterns, desilting, aeration of surface or hypolimnion, addition of sodium nitrate to inhibit hydrogen sulfide formation, and controlling undesirable aquatic plants and animals. Improvements in both economic and social aspects resulted from these rehabilitation measures. (Cassars-FRC)
W82-02054

DISSOLVED OXYGEN DEPENDENT PHOSPHORUS RELEASE FROM PROFUNDAL SEDIMENTS OF LAKE CONSTANCE (OBERSEE),
Bayreuth Univ. (Germany, F.R.).
T. Frevert.
Hydrobiologia, Vol 74, No 1, p 17-28, September, 1980. 5 Fig, 2 Tab, 19 Ref.

Descriptors: *Phosphorus, *Dissolved oxygen, *Lake sediments, Sediments, Nutrients, Lake Constance, Path of pollutants.

Profundal sediments of Lake Constance did not release significant phosphorus as long as dissolved oxygen remained above 1 ppm and pH ranged between 7 and 8 in the overlying water. Experiments in perspex tubes using sediment-water systems from the lake also determined that the presence of a diatom sludge and carbonate-phosphate coprecipitate (CaCO3 + CaHPO4) increased the P release up to 0.5 mg per sq meters per day, an amount not significant to the P balance in this lake. The annual late summer increase of total P in profundal Lake Constance cannot be explained by P release from the sediment. It is more probable that P is accumulated from sinking of P-bound detritus of biogenic and/or tributary origin. (Cassar-FRC)
W82-02055

ENVIRONMENTAL STUDIES: THEIR IMPLICATIONS AND THE SPECIAL CASE OF EGYPT,
For primary bibliographic entry see Field 6G.
W82-02062

PHOSPHORUS CYCLING IN A DENSE POTAMOGETON PECTINATUS L. BED,
Rhodes Univ., Grahamstown (South Africa). Inst. for Freshwater Studies.
C. Howard-Williams, and B. R. Allanson.
Oecologia, Vol 49, No 1, p 56-66, 1981. 9 Fig, 6 Tab, 50 Ref.

Descriptors: *Cycling nutrients, *Lakes, *Phosphorus, Natural waters, Seasonal variation, Sago pondweed, Sediments, Benthic environment, Benthos, Nutrients, Aquatic plants, *Swartvlei Lake, *South Africa, Brackish water, Ogliotrophic lakes.

The dynamics of phosphorus concentration was studied in the littoral zone of Swartvlei, a southern African coastal lake. The implications of the nutrient pathways were examined in the regulation of phosphorus concentrations in the water. This brackish lake is oligotrophic and unpolluted, with an ionic composition the same as that of diluted sea water. Surface and bottom water samples were collected from two depth zones in the Potamogeton beds, at two-weekly or monthly intervals from 1975 to the end of 1978. The highest levels of phosphorus concentration were found in the sediment samples, with phosphorus concentration decreasing through above ground macrophytes, detritus, benthic invertebrates, below ground macrophyte tissue, epiphytic algae, water soluble phosphorus, and waterborne particulate phosphorus. The annual growth and decomposition patterns of Potamogeton were seen to control the seasonal variations in phosphorus concentrations in various groups. When the fate of a given input of phosphorus to the water was measured, 32% of it was found to be taken up by the large epiphtyic algae, 17% by the Potamogeton, 16% by the benthic fauna, 28% by the sediments and 7% by microorganisms associated with detritus. A closed cycle of phosphorus movement was evident. When any phosphorus was released from decaying macrophytes, reabsorption rapidly occurred through the epiphytic algae. Once phosphorus has entered the cycling of the macrophyte community, it seems unlikely that it would ever enter into open circulation in the lake. (Baker-FRC)
W82-02070

ESTIMATION OF THE PRODUCTION OF PLANKTONIC INFUSORIANS IN CONNECTION WITH FLUCTUATIONS IN THEIR ABUNDANCE,
Gorkii State Univ. (USSR).
M. A. Kuznetsova, and T. P. Arslanova.
Hydrobiological Journal, Vol 16, No 3, p 15-21, 1980. 6 Fig, 4 Tab, 5 Ref.

Descriptors: *Plankton, *Productivity, *Ponds, *Population dynamics, Gorky Region, Lakes, Populations, Aquatic populations, Aquatic life, Biomass, Seasonal variation, *USSR.

The object of this study was to calculate the production of planktonic infusorians on the basis of daily observations of 5 and 10 days. In two separate water bodies daily measurements were taken of water temperature, the abundance of planktonic infusorians, their rate of reproduction, and the rate of their consumption. A small urban pond and Lake Velikoye were studied. The pond is in a forest park, and has an area of about 2 ha and a maximum depth of 1.5 meters. It is fed by springs and ground water. The planktonic infusorians of the pond are six species of Spirotricha: Halteria grandinella, Tintinndium fluviatile, Strombidium viride, Codonella cratera, Strombidium sp. and Strombilidium sp. The population quality of all species is characterized by a sudden increase and decrease within a period of several days. The duration of reproduction periods for all species of infusoria was comparable to the duration of the latent periods for which populations of a specific species either disappeared completely or were severely depressed in quantity. The temperature of the water was one of the major factors regulating infusoria quantity fluctuations. The production of infusoria obtained as a result of daily observations was about twice as low as the production found in ten-day intervals. (Baker-FRC)
W82-02072

EFFECT OF FERTILIZERS ON THE PRIMARY AND BACTERIAL PRODUCTION OF REARING PONDS IN THE VOLGA DELTA,

Kaspiiskii Nauchno-Issledovatelskii Inst. Rybnogo Khozyaistva, Astrakhan (USSR).
V. I. Vorob'yev, and A. F. Sokol'skiy.
Hydrobiological Journal, Vol 16, No 3, p 27-31, 1980. 5 Tab, 11 Ref.

Descriptors: *Fertilizers, *Ponds, *Aquatic life, *Aquaculture, Nitrogen, Phosphorus, Nutrients, Minerals, Fish, *Fish farming, *Volga Delta, USSR.

Model experiments were carried out at the Volga experimental plant of the Caspian Fisheries Research Institute to determine the effect of organo-mineral micronutrient fertilizers on the productivity of the ponds of this group. These experiments enabled an assessment to be made of the effectiveness of the different types of fertilizers on primary and bacterial production, and also on the chemical composition of the water of these ponds. Five experimental rearing ponds were used, each having an area of 0.65-2.0 ha and a mean depth of about one meter. Ammonium nitrate and superphosphate were added to pond No. 21 at a rate of 12 kg/ha. Reeds cut and prepared 2 years earlier were added to pond No. 22. The reeds had already spent one season in the water as fertilizer, but because they had been only 40-50% mineralized in that season, they had been left for another year. N and P mineral fertilizers were also added to this pond, each at a rate of 12 kg/ha. Superphosphate and ammonium nitrate were added to pond No. 23 at 12 kg/ha, and cobalt chloride was also added at a rate of 2 kg/ha over the season. Only superphosphate at 12 kg/ha was added to ponds No. 15 and 40, along with cobalt chloride at 2 and 5 kg/ha, respectively, over the season. The findings yielded the conclusion that the use of cobalt in the rearing ponds and elsewhere in the case of cobalt deficits makes it possible to create more favorable abiotic conditions in the water, to practically double the rate of bioproductive processes, and to involve other trace elements in the biological cycle. (Baker-FRC)
W82-02077

PHYTOPLANKTON DISTRIBUTION IN THE SOUTHERN AND MIDDLE PARTS OF LAKE BAIKAL,
Akademiya Nauk SSSR, Novosibirsk. Inst. Fiziki.
N. A. Frank, L. A. Shchur, A. D. Aponasenko, and F. Ya. Sid'ko.
Hydrobiological Journal, Vol 16, No 3, p 13-15, 1980. 2 Fig, 7 Ref.

Descriptors: *Lakes, *Phytoplankton, Distribution, Vertical distribution, Spatial distribution, *Lake Baikal, Chlorophyll, Biomass, USSR, Chlorophyll a.

Hydrobiological and hydrooptical research was carried out in July of 1974 in the southern and middle parts of Lake Baikal between Slyudyanka settlement and the Ol'khonskiye Vorota strait with the objective of determining the abundance and biomass of the phytoplankton, its chlorophyll a content, the characteristics of the attenuation of the water and other hydrooptical characteristics. A total of 44 sampling sites were chosen. Chlorophyll content in the surface zone of the water at a depth of 1 meter in the southern part of Lake Baikal as far as Cape Kadil'nyy ranged between 0.1 mg/cubic meter and 0.3 mg/cubic meter, and the abundance and biomass of the phytoplankton were respectively 3000 to 40000 cells/liter and 12-40 mg/cubic meter. Chlorophyll content 1 km from the shore of the lake is on the average 1 to 1/5 times the content in the central part of the lake. The vertical distribution of chlorophyll has a clear maximum at a depth of 5 to 10 meters. Investigations around the mouth of the Solzan River did not reveal appreciable differences in the vertical and horizontal distribution of chlorophyll a from the values characteristic for the southern part of Lake Baikal. The drift of the Selenga River had an appreciable effect on phytoplankton distribution in the middle part of Lake Baikal. (Baker-FRC)
W82-02078

FINDS OF RELICT INFUSORIA IN KIEV RESERVOIR,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
A. A. Koval'chuk.
Hydrobiological Journal, Vol 16, No 4, p 27-31, 1980. 7 Fig, 17 Ref.

Descriptors: *Reservoirs, *Plankton, Benthos, Infusoria, Protozoa, Aquatic life, *Halophytes, *Kiev Reservoir, Salt tolerance, Reservoir stages, USSR.

A number of halophilous forms which were discovered during an investigation of the benthic Infusoria of Kiev reservoir in 1977-1978 are described. Forms found included: Prorodon marinus, Lacrymaria caudata, Lagynurus pumilio, Frontonia aberrans, Cyclidium helgolandicum, Cristigera minuta, Lohmanniella elegans, Metopus vestitus, and Condylostoma remanei. All the relict forms of Infusoria were found in a small area round the village of Strakholes'ye above Teterev Bay, where marshes in which conditions are favorable to the existence of these infusorians existed before the filling of the reservoir. The species composition of the relict forms was most varied in the autumn in the psammon, and also in bulrushes, apparently in connection with the resistance of individual populations of this plant to salinification. The fact that there is a predominance of the boreal element in the relicts suggests an incursion of waters from the Baltic into the Black Sea during one of the transgressions. During the period of their existence in isolation, the relict infusorians of Kiev Reservoir have changed relatively little, and it is therefore concluded that the isolation has not been lengthy. (Baker-FRC)
W82-02079

THE PREDICTED CONTENT OF ORGANIC AND BIOGENIC MATTER IN THE WATER OF VILYUY RESERVOIR AND THE EXTENT TO WHICH IT HAS BEEN CONFIRMED,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
T. M. Labutina, and A. I. Denisova.
Hydrobiological Journal, Vol 16, No 4, p 77-80, 1980. 2 Tab, 6 Ref.

Descriptors: *Reservoirs, *Organic matter, *Permafrost, Prediction, Decomposing organic matter, *Vilyuy Reservoir, Vegetation, Water quality, Water pollution sources, USSR.

The Vilyuy reservoir lies in the northeast of the country in a permafrost region. The reservoir was formed in southwestern Yakutia by the damming of the Vilyuy River 21 km below the mouth of the Akhtaranda River. When the reservoir was filled, 30,000,000 cubic meters of forest were inundated. For several years the submerged tree trunks were the source of various chemicals that found their way into the water. The submerged vegetation and soils have appreciably influenced water quality in the reservoir and the content of organic and biogenic matter. Long-term records on the seasonal content of organic and biogenic matter in the water of Vilyuy River and its affluents were used to analyze and predict the expected concentrations of organic and biogenic matter during the period of 1969-1975 in the waters of the reservoir. When the predicted and the actual concentrations were compared, it was found that the deviations of the former from the latter did not exceed plus or minus 8%. River discharge was the main factor in the formation of the hydrochemical regime of the reservoir. Arboreal vegetation took second place, and soils took third. (Baker-FRC)
W82-02080

BACTERIOPLANKTON AND PHYTOPLANKTON IN THE KIEV SECTOR OF KANEV RESERVOIR DURING THE PERIOD OF ITS FORMATION,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
N. A. Gavrishova, and L. N. Chernitskaya.
Hydrobiological Journal, Vol 16, No 4, p 6-14, 1980. 3 Fig, 4 Tab, 13 Ref.

Descriptors: *Reservoirs, *Phytoplankton, *Bacteria, Water quality, Self-purification, Algae, Plankton, *Kanev Reservoir, Reservoir stages, Water pollution sources, USSR.

The hydrobiological regime of the Kiev sector of Kanev reservoir was investigated during the period of its creation via microbiological indices and phytoplankton. In 1975, which was the fourth year of filling, the highest bacteriological indices occurred. This year was characterized by extreme temperature and hydrologic features. From 1975-1977, the bacteriological indices increased relative to the data obtained in 1972-1974. This is in agreement with the trend toward an increase in the abundance of bacterioplankton during the first years of the creation of a reservoir. During this period of time a gradual increase was noted in algal biomass, and an increase was also seen in the number of algal species, due to the conversion of the sector to a reservoir. In spite of alterations in the ratio and abundance of the algae, the dominant composition of the main groups was maintained. Using data from an analysis of the distribution of the abundance of bacterioplankton and phytoplankton at different points in the Kiev sector of the reservoir, a rank estimate was prepared of water quality. The rank indices of the water at the beginning, in the middle and at the end of the sector ranged between 4 and 6 in the classification of Zhukinskiy. This finding suggests that the capacity of the water in the Kiev sector of the reservoir to undergo self-purification declined slightly after the filling of the Kanev reservoir. (Baker-FRC)
W82-02081

PLANKTONIC INFUSORIA OF KIEV AND KREMENCHUG RESERVOIRS,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
A. A. Nebrat.
Hydrobiological Journal, Vol 16, No 4, p 23-27, 1980. 16 Ref.

Descriptors: *Reservoirs, *Plankton, *Protozoa, Productivity, Lake ice, Infusoria, Ukraine, Seasonal variation, Temperature effects, Stagnant water, *Kiev Reservoir, *Kremenchug Reservoir, USSR.

The study of planktonic infusoria of Kiev and Kremenchug reservoirs began in the spring of 1972 and continued until autumn of 1975. A total of 110 species of infusoria were identified in the plankton from these two reservoirs, of which 85 were new for the Dnieper and its reservoirs, and 29 for the Ukraine. Holotricha were the most richly represented in the reservoirs investigated with 60 species or 54.5%, followed by Spirotricha with 40 species or 35.7%, and Peritricha for 11 species or 9.8%. The species were identified during seasonal excursions and showed wide variations with the seasons. In terms of abundance, T. fluviatile took first place among the dominant species of Infusoria in the pelagic zone of Kremenchug reservoir at 41.8% of total abundance. The highest population density of this species was recorded in the lower part of the reservoir at 50.3%. Small Spirotricha typical of stagnant and bog waters were dominant during the spring months in the shallow upper parts of the Kremenchug reservoir. A total of 45 species were found in the reservoirs in the autumn. The number of species of infusoria remaining below the ice in water bodies was very small and their abundance at this time of the year is low. (Baker-FRC)
W82-02082

INVESTIGATION OF TURBULENCE AND LANGMUIR CIRCULATION IN LAKE LADOGA,
Akademiya Nauk SSSR, Leningrad. Inst. of Lake Studies.
N. N. Filatov, S. V. Rjanzhin, and L. V. Zaycev.
Journal of Great Lakes Research, Vol 7, No 1, p 1-6, 1981. 5 Fig, 19 Ref.

Descriptors: *Water circulation, *Lakes, *Russia, Turbulence, Water currents, *Ladoga Lake.

Experimental measurements were taken of currents in the gulf of the northeast part of the nearshore zone of Lake Ladoga, USSR. Horizontal measurements were carried out at a 5 meter depth for 3 months. Measurements were also made of current fluctuations, both horizontal and vertical. Kinetic

energy spectra and the corresponding linear invariant spectra of currents calculated from measurements at a 10 meter depth in the offshore zone of the lake for a wide range of frequencies showed several maxima which corresponded to the following events: synoptic oscillations of currents with time scales of about 2 to 4 days, inertial oscillations of 13 to 14 hr periods, Langmuir circulation with time scales of 5 to 10 minutes, micrometeorological oscillations with a time scale of 1 minute, and oscillation with the periods of surface waves in the upper layer. From the measurements of vertical fluctuations, horizontal fluctuations, and gradients of mean speed of currents, coefficients of vertical turbulent exchange were determined. The dependencies of mean vertical current speed and depths of penetration of Langmuir circulations as a function of wind speed and stratification were calculated. The calculated relations were not linear. (Baker-FRC)
W82-02100

2I. Water In Plants

EFFECT OF PERIODS OF MOISTURE AVAILABILITY ON GROUNDNUT CROP IN THE SAURASHTRA REGION OF GUJARAT,
Bansilal Amritlal Coll. of Agriculture, Anand (India).
For primary bibliographic entry see Field 2G.
W82-01708

SOIL WATER STUDIES ON SMALL LUCERNE PLOTS,
Department of Agriculture and Fisheries, Stellenbosch (South Africa).
D. J. Beukes, and H. W. Weber.
Water SA, Vol 7, No 3, p 166-174, July, 1981. 4 Fig, 4 Tab, 18 Ref.

Descriptors: *Hay, *Soil water, *Soil-water-plant relationships, Irrigation effects, Crop yield, Crop production, Water use efficiency, Agriculture, Alfalfa, *South Africa.

Lucerne was grown in the field under four soil water depletion (SWD) levels; 15%, 35%, 55%, and 75%. The primary objective of this investigation was to determine the finer details of methods and instruments for measuring soil water, but the present paper discussed the secondary objectives: to determine the changes in soil water content and soil water pressure as well as the water use characteristics of lucerne. Irrigation requirements were established of 1100 mm for a 15% SWD and 700 mm for a 75% SWD. There was a direct relationship between the soil water regime and the amount of water consumed. With a 15% SWD level the rate of evapotranspiration equaled that of pan evaporation. Changes in soil water content and soil water pressure occurred on a much shallower level with a 15% than with a 75% SWD. When there was a decrease in the SWD level, there was an increase in the growth rate of lucerne, a decrease in the water use efficiency, and an increase in hay production. (Small-FRC)
W82-01713

ECOLOGICAL AND PHYSIOLOGICAL FEATURES OF THE ROOT SYSTEM OF INSHORE HYDROPHYTES,
Ukrainian Academy of Sciences, Kiev (USSR). Institute of Hydrobiology.
For primary bibliographic entry see Field 5B.
W82-01715

THE EFFECT OF DIFFERENT WATER REGIMES ON PLANT GROWTH AND NODULE STRUCTURE OF GREENHOUSE-GROWN WINGED BEAN (PSOPHOCARPUS TETRAGONOLOBUS),
University of West Indies, Kingston (Jamaica). Dept. of Botany.
E. L. Rathfelder.
Annals of Applied Biology, Vol 98, No 1, p 143-148, May, 1981. 4 Fig, 23 Ref.

Descriptors: *Soil-water-plant relationships, *Water stress, *Root development, Beans, Waterlogging, Nodules, Greenhouses.

Three water regimes were applied to the potted seedlings of winged beans (Psophocarpus tetragonolobus cv. Chimbu Illinois) in a greenhouse: control (field capacity, 20% water by weight added each morning), stress (half of field capacity, 10% water by weight added each morning), and wet (pots standing in water to produce waterlogging in the bottom 1 cm). Root nodules did not form in the stressed plants until 4 weeks, compared with 3 weeks in the other treatments. Nodules were 54% smaller than those in control plants and 39% smaller than in waterlogged plants. These differences decreased with time. (Cassar-FRC)
W82-01723

NOTE ON THE ROLE OF IRRIGATION FREQUENCIES ON THE REGROWTH OF BERSEEM,
Govind Ballabh Pant Univ. of Agriculture and Technology, Pantnagar (India).
A. Kumar, and S. D. Rai.
Indian Journal of Agricultural Sciences, Vol 51, No 3, p 194-196, March, 1981. 1 Fig, 1 Tab.

Descriptors: *Irrigation effects, *Crop production, *Soil water, Vegetation regrowth, Plant growth, Crop yield, Forages, *India.

The effect of soil moisture on the regeneration of berseem (Trifolium alexandrinum Juslen) was evaluated in a 1976-77 field study. Irrigation of the crop at a ten day interval was ideal for favorable growth and high yield of green fodder. Frequent watering may have helped the crop hydrolyze and mobilize the root carbohydrates. When irrigation frequency was reduced, the rate of regrowth was reduced. The rate of dry matter accumulation in the first ten days after cutting increased with the advancement of cuts. This effect was more conspicuous when irrigation frequencies were reduced. Thus, with frequent irrigation and a sufficiently high water table, berseem can continuously supply forage. The crop accumulated the highest dry matter/day during the first 10 days after cutting, regardless of the irrigation scheme used. (Small-FRC)
W82-01745

SIMULATION OF SOIL WATER WITHIN THE ROOT ZONE OF A CORN CROP,
Kentucky Univ., Lexington. Dept. of Agronomy.
For primary bibliographic entry see Field 2G.
W82-01834

EFFECT OF SOIL MOISTURE STRESS ON LEGUME-RHIZOBIUM SYMBIOSIS IN SOYBEANS,
Govind Ballabh Pant Univ. of Agriculture and Technology, Pantnagar (India). Dept. of Soil Science.
T. R. Rathore, P. K. Chhonkar, R. S. Sachan, and B. P. Ghildyal.
Plant and Soil, Vol 60, No 3, p 445-450, 1981. 3 Tab, 9 Ref.

Descriptors: *Water stress, *Soybeans, *Symbiosis, Soil-water-plant relationships, Legumes, Soil moisture deficiency.

Soybeans, cv. Hark, in pots were subjected to water stress (temporary wilting for 3 days) at each of several stages: nodule initiation (NIS), early flowering (EFS), midbloom (MBS), early flowering and midbloom (EFS + MBS), rapid pod filling, (RPS), and midbloom and rapid pod filling (MBS + RPS). Moisture stress did not affect nitrogen status of roots or number of bacteroids. However, leghemoglobin content, number and weight of pods per pot, number and weight of seeds per pot, and seed protein content were all affected to varying degrees by moisture stress at different stages. In general, moisture stress reduced leghemoglobin content of root nodules, N uptake, yield and seed protein content, and delayed flower initiation and plant maturity. Stress at the early stages only (NIS or EFS) allowed plants to recover and produce normal yields, but stress at later stages halved the yield. Stress at EFS + MBS and MBS + RPS was less harmful than either EFS or MBS deprivation alone, indicating an increased adaptability. (Cassar-FRC)
W82-01846

DOUBLE AND MONOCROPPED WHEAT AND GRAIN SORGHUM UNDER DIFFERENT TILLAGE AND ROW SPACINGS,
Oklahoma State Univ., Stillwater. Dept. of Agronomy.
R. J. Crabtree, and G. A. Makonnen.
Soil Science, Vol 132, No 3, p 213-219, September, 1981. 3 Fig, 4 Tab, 8 Ref.

Descriptors: Available water, *Agricultural engineering, Farming, Soil water, Resources management, Soil-water-plant relationships, Water resources development, *Wheat, *Sorghum, Crop yield, *Experimental farms, Oklahoma.

A field study was conducted on wheat double-cropped with grain sorghum under rain-fed conditions at the Oklahoma Vegetable Research Station at Bixby. The soil was a Wynona silt loam with 0 to 1% slope. The experiment ran from December 1975 to November 1979. The effects of tillage and row spacings on soil water content and yields of monocropped (MC) and double-cropped (DC) wheat and grain sorghum were studied. When planted at the same time and over a 4-year period, DC wheat yielded 2260 kg per ha, compared with 2890 for monocropped wheat. Drought produced a failure in the grain sorghum as the second crop for 1 of the 4 years. For the 3 years of successfully double-cropped grain sorghum with conventional tillage, the yield in 50 cm rows was 4080 kg/ha, compared with 3810 kg/ha in 75 cm rows. No-tillage, DC grain sorghum in 50 cm rows yielded 3830 compared with 3590 kg/ha in 75 cm rows. When planted at the same time as the DC grain sorghum with conventional tillage, MC grain sorghum in 50 cm rows yielded 4150 kg/ha, compared to 3760 kg/ha in 75 cm rows. For the DC treatments, water content in 120 cm of soil profile was not significantly affected by tillage and row spacings during the grain sorghum growing period. However, tillage and planting operations must be timely to prevent loss of water in the soil-seed environment when attempting to establish a stand for the double crop. On the average only 12% of the precipitation that fell from mid-June to early October for the 3 years of successful DC was detected as stored water in the MC wheat plots. More grain production and more effective use of annual precipitation and soil water were achieved in 3 out of the 4 years when wheat and grain sorghum were DC. (Baker-FRC)
W82-01862

CONTROL OF PEACH TREE GROWTH AND PRODUCTIVITY BY REGULATED WATER SUPPLY, TREE DENSITY, AND SUMMER PRUNING,
Victoria Dept. of Agriculture, Tatura (Australia). Irrigation Research Inst.
D. J. Chalmers, P. D. Mitchell, and L. van Heek.
Journal of the American Society for Horticultural Science, Vol 106, No 3, p 307-312, May, 1981. 7 Tab, 19 Ref.

Descriptors: *Irrigation practices, *Crop yield, *Fruit crops, Irrigation, Water supply, Trickle irrigation, *Peaches, Irrigation efficiency, Growth rates.

Various methods were used to determine if they could be productive in controlling tree vigor and fruit production in ultra-dense peach orchards. Root competition, summer pruning, and regulated irrigation all inhibited tree growth, but regulated irrigation combined with root competition generated from high tree density was the most effective. Yields of fruit and growth of fruit were significantly increased up to 30% by high tree density combined with low rate of water application, when water stress limited shoot growth but stimulated subsequent fruit growth. The production of increased fruit yield while simultaneously reducing vegetative growth indicates that irrigation can be

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used as a powerful management strategy to manipulate plant growth for greater fruitfulness in much the same manner as dwarfing rootstocks. These data do show that the effects intensified as root competition intensified at the closer spacing and also as the root system grew. Management treatments that concentrate the root system, such as controlled wetted zones as in trickle irrigation, natural barriers as in shallow soils, or even artificial barriers could be expected to increase the effectiveness of regulated irrigation. Increased yields with reduced irrigation will only be obtainable, however, for as long as the tree has excess vegetative vigor that can be suppressed in favor of fruit growth. As trees become older and lose their potential for vegetative growth, there will be less need to control them, and the harvest index will increase naturally. The irrigation strategy will be determined according to the natural vigor of the trees, the age of the planting, the soil type, the fruit growth, and the crop load. (Baker-FRC)
W82-01883

RESPONSES OF GRAIN SORGHUM TO VARIABLE WATER SUPPLY UNDER TWO IRRIGATION FREQUENCIES,
California Univ., Davis. Dept. of Land, Air, and Water Resources.
For primary bibliographic entry see Field 3F.
W82-01944

CORN AND ALFALFA PRODUCTION AS INFLUENCED BY LIMITED IRRIGATION,
Utah State Univ., Logan. Dept. of Soil Science and Biometeorology.
For primary bibliographic entry see Field 3F.
W82-01945

INFLUENCE OF TRICKLE AND SPRINKLE IRRIGATION ON GOLDEN DELICIOUS APPLE QUALITY,
Irrigated Agriculture Research and Extension Center, Prosser, WA.
For primary bibliographic entry see Field 3F.
W82-02001

EFFECT OF PROFILE SOIL MOISTURE AND PHOSPHORUS LEVELS ON THE GROWTH AND YIELD OF ANONUTRIENT UPTAKE BY CHICKPEA,
Haryana Agricultural Univ., Hissar (India).
S. Singh, and H. C. Sharma.
Indian Journal of Agricultural Sciences, Vol 50, No 12, p 943-947, December, 1980. 3 Tab, 7 Ref.

Descriptors: *Crop production, *Soil water, Crop yield, Chickpea, Nutrients, Nitrogen, Phosphorus, Water stress, Soil-water-plant relationships.

A field experiment was conducted in 1975-76 and 1976-77 with all combinations of three profile soil-moisture levels, 125, 160 and 200 mm/m, with and without 50 mm of additional irrigation water, allocated to main plots and four doses of phosphorus, 0, 4.5, 9.0, and 13.5 kg P/ha, in the subplots. A split plot design was used. Soils were sandy loam, low in organic carbon and available nitrogen, medium in phosphorus, and high in potassium. The pH of the soil was 7.8; maximum water retention capacity of the soil profile was 225 mm/m. In the 3rd, 4th, and 5th weeks of January the amount of rainfall received was 3.5, 2.6, and 10.0 mm, and in the 2nd and 3rd weeks of February it was 2.6 and 16.2 mm, respectively. Significant increases in dry matter accumulation owing to higher initial soil-moisture levels were recorded at all the stages of crop growth, although the yield increment became smaller with successive increases in soil profile moisture. The additional irrigation of 50 mm given 60 days after sowing further increased the dry matter, and to a greater extent at lower levels of soil profile moisture than at higher levels. Phosphorus application increased dry matter accumulation significantly at all growth stages. Higher moisture supply by building 200 mm of initial profile soil moisture supplemented with 50 mm of protective irrigation 60 days after planting the crop resulted in 71.5 and 51.3% increase in N and P uptake by chickpea crop over the lower level (125 mm) of soil moisture. (Baker-FRC)
W82-02042

EFFECT OF SOIL-MOISTURE TENSIONS AND PRECEDING WINTER CROPS ON THE YIELD AND WATER-USE EFFICIENCY OF SUCCEEDING CROP OF TOSSA JUTE,
Bidham Chandra Krishi Vishwa Vidyalaya, Kalyani (India).
H. Sen, P. K. Jana, and S. P. Maity.
Indian Journal of Agricultural Sciences, Vol 50, No 12, p 948-951, December, 1980. 1 Fig, 6 Tab, 5 Ref.

Descriptors: *Crop production, *Soil water, Water stress, Crop yield, Wheat, Potatoes, Mustard, Soil-water-plant relationships.

The influence of soil-moisture tension was investigated in sandy-loam soil on the fiber yield of tossa jute. In 1973 and 1974 the experiment was conducted with three soil-moisture tensions for each of the three winter crops, wheat at 0.3, 0.5, and 1.0 atm, mustard at 0.5, 1.5, and 2.5 atm, and potato at 0.3, 0.6, and 0.9 atm, and three soil moisture tensions at 0.3, 0.6, and 0.9 atm for jute. The higher yield of jute was associated with decreases in soil-moisture tension. The preceding winter crops and the maintenance of different soil-moisture tensions for each of these winter crops had no significant effect on fiber yield, stick yield, and height of the plant. The water use efficiency increased with an increase in soil-moisture tension. The yield and water use efficiency demonstrated that a maintenance of 0.6 atm tension was useful. (Baker-FRC)
W82-02045

TURNOVER OF TRITIATED WATER IN CALAMONDIN PLANTS,
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel).
For primary bibliographic entry see Field 5A.
W82-02048

2J. Erosion and Sedimentation

SEDIMENT-CONTAMINANT TRANSPORT MODEL,
Battelle Pacific Northwest Lab., Richland, WA.
For primary bibliographic entry see Field 5B.
W82-01614

TEMPORAL AND SPATIAL VARIATIONS OF MERCURY, LEAD, ZINC, AND COPPER IN SEDIMENTS OF THE SAGUENAY FJORD,
Laval Univ. (Quebec). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W82-01639

NOTE ON TWO LIMIT DISTRIBUTIONS OF BEDLOAD MOVEMENT,
Waikato Univ., Hamilton (New Zealand). Dept. of Earth Sciences.
W. E. Bardsley.
Journal of Hydrology, Vol 52, No 1-2, p 165-169, June, 1981. 9 Ref.

Descriptors: *Sediment transport, *Model studies, *Mathematical studies, *Bed load, Sediment load, Statistical methods, Channel erosion, Channel flow, Analysis of variance, Mathematical equations, Sediment erosion.

Many models of bedload transport described channel-floor particle movement in terms of a one-dimensional unidirectional random walk. The transported particles are assumed to experience a rest period, prior to each step, which is large in relation to the time spent in the next phase of movement. A case of bedload transport was considered where the step length and rest periods are identically distributed, yet independent random variables. In the model described, as time approaches infinity, the distance an arbitrary particle is transported is shown to be a normally distributed random variable. The mean and variance of this limit distribution may be obtained as simple functions of the mean and variance of the step lengths and rest periods. As the distance an arbitrary particle is transported approaches infinity, similar results are observed for the time it takes for the transport. (Geiger-FRC)
W82-01643

SPATIAL AND TEMPORAL VARIATIONS IN CESIUM-137 AND CARBON IN SEDIMENTS OF SAGUENAY FJORD (VARIATIONS SPATIALES ET TEMPORELLES DU CESIUM-137 ET DU CARBONE DANS DES SEDIMENTS DU FJORD DU SAGUENAY),
Laval Univ. (Quebec). Dept. of Chemistry.
C. Barbeau, R. Bougie, and J-E. Cote.
Canadian Journal of Earth Sciences, Vol 18, No 6, p 1004-1011, June, 1981. 4 Fig, 2 Tab, 15 Ref.

Descriptors: *Sedimentation rates, *Fjords, Cesium, *Cesium radioisotopes, Radioisotopes, Cores, Canada, Erosion, Sedimentation, Sediments, *Saguenay Fjord, Quebec.

Measurements were made of the rate of accumulation of sediments in the Saguenay Fjord, Quebec, Canada. The measurements were made from cesium-137 activity in 19 cores. The data varied between sediment rates of greater than 1.0 cm/year upstream and 0.2 cm per year downstream. In cores from the northern basin, the cesium-137 profiles indicate that they follow the pattern of fallouts on the ground, reflecting the impact of a sudden inflow of clay from a major mudslide. In large basins indications are that the rate of sedimentation is less influenced by external happenings. At upstream locations the carbon content and the C/N ratio are higher. Based on cesium-137 dating, core sections show carbon contents that reflect changes caused by the forest industry over the years. (Baker-FRC)
W82-01644

FIELD OBSERVATIONS OF THE ISOTOPIC COMPOSITION OF PARTICULATE ORGANIC CARBON IN THE SOUTHERN NORTH SEA AND ADJACENT ESTUARIES,
Institute for Soil Fertility, Groningen (Netherlands). Delft Hydraulic Lab.
W. Salomons, and W. G. Mook.
Marine Geology, Vol 41, No 3-4, p M11-M20, June, 1981. 3 Fig, 7 Tab, 14 Ref.

Descriptors: *Organic carbon, *Sediment transport, *Fluvial sediments, *Isotope studies, Organic matter, Sediment distribution, Soil erosion, Peat soils, Organic soils, Peat, Suspended sediments, Sediments, Mixing, Sedimentation, *Estuaries, North Sea.

The isotopic composition of the organic carbon in a large number of sediments from the southern North Sea and in fluvial and estuarine deposits was determined field tests. Organic matter in fluvial sediments and suspended matter was found to contain carbon isotopes in a range characteristic of continental organic matter (-25 to -28 o/oo). In sediments of marine sedimentation sites and in marine suspended matter, delta C13 values fluctuated between -20 and -25 o/oo. The low mean values of -13.2 o/oo for the deposited sediments indicated a high content of continental organic matter deposited from present-day rivers or from the erosion of peat layers from the terrestrial or marine environment. The source of detrital continental organic matter could not be ascertained by stable isotope studies. In the estuarines examined, the content of organic matter decreased and the delta C13 values increased in the seaward direction, probably as a result of the mixing of fluvial and marine sediments. (Geiger-FRC).
W82-01714

DISTRIBUTION, MORPHOLOGY, AND ORIGIN OF SEDIMENTARY FURROWS IN COHESIVE SEDIMENTS, SOUTHAMPTON WATER,
Institute of Oceanographic Sciences, Taunton (United Kingdom).
For primary bibliographic entry see Field 2L.
W82-01720

SEDIMENT TRANSPORT AND A RESERVOIR SITUATION FORMULA FOR ZIMBABWE-RHODESIA,
Rhodesia Univ., Salisbury. Dept. of Civil Engineering.
P. R. B. Ward.
Civil Engineer in South Africa, Vol 22, No 1, p 9-15, January, 1980. 11 Fig, 5 Tab, 21 Ref.

Descriptors: *Sediment transport, *Reservoir silting, *Rhodesia, Silt, Silting, Sedimentation, Suspended load, Rivers.

A three year experimental program to determine the amount of sediment transported by Rhodesian rivers is described. The findings are based on river measurements of sediment transported past hydrological gauging stations and not on measurements of reservoir siltation rates. The sediment yield depends on several factors, including rainfall, geology, land tenure and catchment slope. Measurements of suspended sediment concentrations in water samples were made by a turbidity method. Four or five samples from each sampling site, taken during flood flows, were analyzed for size distributions. A representative value for losses of suspended sediments from large catchments in Rhodesia is 38 t/sq km/year. Allowing an extra 10% loss by transport of dissolved solids, and the total loss from catchments is 42 t/sq km. This figure was in agreement with previously determined findings which had been based on reservoir siltation rates. However, this figure was several times smaller than data for small catchments under heavy human occupation in Tanzania.
W82-01736

CROP RESIDUE REMOVAL AND TILLAGE; EFFECTS ON SOIL EROSION AND NUTRIENT LOSS IN THE CORN BELT,
Science and Education Administration, Morris, MN. North Central Soil Conservation Research Lab.
M. J. Lindstrom, S. C. Gupta, C. A. Onstad, R. F. Holt, and W. E. Larson.
Agricultural Research Service, Agriculture Information Bulletin Number 442, October 1981. 35 p, 1 Fig, 13 Tab, 13 Ref.

Descriptors: *Cropland, *Nutrient removal, *Soil erosion, *Cultivation, Soil conservation, Biomass, Fuel, Corn belt, Crop yield, Productivity, Farm management.

Soil erosion is already a serious problem in the U. S., and if large amounts of crop residues are removed for use as biomass for fuels, soil erosion would be accelerated. The Universal Soil Loss Equation (USLE) was used to predict soil erosion for five residue and tillage management systems, and the amounts of residue that could be removed without undue damage to the soil. Crop acreage and yield data for 6 years were compiled by counties in 10 states in the corn belt. The tillage systems were: conventional tillage, all residue removed; conservation tillage, with either 1,500 or 3,500 lb of residue remaining; and no till, with 1,500 or 3,500 lb of residue remaining. Calculated soil losses for each residue and tillage management system combination with assigned crop rotations were compared with the soil loss tolerances defined as the maximum soil loss that is considered safe for continued long-term, maximum productivity of the soil. As the residue and tillage systems become more conservative the soil-loss values decrease, but even with the most conservative, situations arose where the soil loss exceeded acceptable levels. Areas are identified where crop residues may be used for alternate uses, and where they should not be, under any particular tillage regime. When residues are removed the nutrients they would return to the soil must be replaced. (Brambley-SRC)
W82-01770

SEDIMENT ANALYSES FOR SELECTED SITES IN THE SOUTH PLATTE RIVER IN COLORADO AND NEBRASKA, AND THE NORTH PLATTE AND PLATTE RIVERS IN NEBRASKA--SUSPENDED SEDIMENT, BED-LOAD, AND BED MATERIAL,
Geological Survey, Denver, CO. Water Resources Div.
J. E. Kircher.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Price $6.75 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-207, 1981. 48 p, 27 Fig, 8 Tab, 4 Ref.

Descriptors: *Data collections, *Suspended sediment, *Bed load, *Watershed management, Sampling, Sites, *Sediment transport, Discharge measurement, Particle size, *Colorado, *Nebraska, South Platte River, North Platte River, Platte River.

Sediment samples were collected on the South Platte, North Platte, and Platte Rivers in Colorado and Nebraska during the 1979 and 1980 runoff seasons. Suspended-sediment concentrations ranged from 62 to 3,705 milligrams per liter and the maximum load was 45,547 metric tons per day. The percentage of suspended sediment samller than sand (less than 0.062 millimeter) was as follows: 23 to 78 percent for the South Platte River, 9 to 30 percent for the North Platte River, and 2 to 89 percent for the Platte River. Bedload-transport rates ranged from 0.0085 to 0.67 kilogram per second per meter of channel width for the entire study area. The median grain size of bedload ranged from 0.6 to 2.6 millimeters for the South Platte River, 0.5 to 0.8 millimeter for the North Platte River, and 0.6 to 1.2 millimeters for th Platte River. The median grain size of bed material for the South Platte River ranged from 0.3 to 2.4 millimeters, compared to 0.5 to 0.9 millimeter for the North Platte River, and 0.4 to 3.1 millimeters for the Platte River. (USGS)
W82-01776

SEDIMENT DATA FOR STREAMS NEAR MOUNT ST. HELENS, WASHINGTON--VOLUME 1, 1980 WATER-YEAR DATA,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-01792

DIFFUSION OF SEDIMENT ON THE LEE OF DUNE-LIKE BEDFORMS: THEORETICAL AND NUMERICAL ANALYSIS,
Louisiana State Univ., Baton Rouge. Dept. of Geology.
C. Chakrabarti, and D. R. Lowe.
Sedimentology, Vol 28, No 4, p 531-545, August, 1981. 10 Fig, 1 Tab, 28 Ref.

Descriptors: *Sediment deposition, *Bed load, *Dunes, Sediment transport, Model studies, Numerical analysis, Sediment sorting, Particle size, Deposition.

The diffusion and deposition on the leeside of dune-like bedforms is describing semiquantitatively by theoretical and empirical analysis of flow structure, sediment transport, and sediment size characteristics of the dune crest. Simulation analysis shows that flow velocity, flow depth, and sediment size strongly influence deposition rate and texture of leeside sediment before avalanching. Sorting of this bed material strongly controls grain size and deposition rate gradients. This model can promote understanding of mechanisms of sediment transport and of palaeoflow properties determined from sediment texture analysis. (Cassar-FRC)
W82-01842

ESTIMATING EROSION AND SEDIMENT YIELD ON FIELD-SIZED AREAS,
Purdue Univ., Lafayette, IN. Dept. of Agricultural Engineering.
G. R. Foster, L. J. Lane, J. D. Nowlin, J. M. Laflen, and R. A. Young.
Transactions of the ASAE, Vol 24, No 5, p 1253-1262, 1981. 4 Fig, 4 Tab, 32 Ref.

Descriptors: *Erosion, *Model studies, Sedimentation, Mathematical models, Soil management, Management practices, Erosion control, *Sediment yield.

A model is described which, while simply constructed and usable over a broad range of situations at reasonable cost, embodies the latest knowledge on the fundamentals of erosion mechanics. The model may be used without calibration or collection of data to determine parameter values. It can be linked to hydrologic and chemical transport models and was developed for that specific purpose as a component of CREAMS, a field scale model for Chemicals, Runoff, and Erosion from Agricultural Management Systems. The basis of this model is the assumption that the Universal Soil Loss Equation (USLE) storm erosivity and the peak runoff rate at the watershed outlet can be used to characterize a storm's rainfall, runoff, and sediment yield. A quasi-steady state is assumed. Hydrologically and hydraulically a typical watershed may be divided into areas or elements of overland flow, channel flow, or impounded runoff. Each type of flow is treated in the model with a specific set of equations for that type of flow from an overland flow or channel segment, the model computes a potential sediment load which is the sum of the sediment load from the immediate upslope segment plus that added by lateral inflow within the segment. The model gave reasonable results when compared with data from concave plots under simulated rainfall, single terrace watersheds, small watersheds with impoundment terraces, and a small watershed under conservation tillage. This model may be a useful tool for analyzing the influence of alternate management practices on erosion and sediment yield from field-sized areas. (Baker-FRC)
W82-01849

RESOURCE INVENTORY--SHEET, RILL AND WIND EROSION,
Soil Conservation Service, Washington, DC.
R. I. Dideriksen.
Transactions of the ASAE, Vol 24, No 5, p 1246-1252, September-October, 1981. 4 Fig, 11 Tab, 14 Ref.

Descriptors: *Erosion, *Statistics, Wind erosion, Sheet erosion, Gully erosion, Channels, Rill erosion.

The most up-to-date statistical data available on natural resources was supplied in 1977 by the National Resource Inventories findings. Sheet, rill, and wind erosion continue to be a major national problem. Cropland loss of soil by sheet and rill erosion is estimated to be 1.7 billion tons annually. In 19 states the average cropland erosion rate exceeded 11.2 tons/ha. Fifty percent of all sheet and rill erosion occurs on cropland. Cropland without adequate conservation treatment has an average annual soil loss of 1.5 billion tons, more than eight times the amount on adequately protected land. Pastureland, rangeland, and forest land account for another 1.7 billion tons of soil lost by sheet and rill erosion. The annual erosion rate on pastureland in four states exceeded 11.2 tons/ha. Very steep areas make up one fourth of the total pastureland, but account for 62% of the pastureland erosion. The rangeland sheet and rill erosion rate in four states is more than 11.2 tons/ha. Areas with limiting soil conditions make up one third of the total rangeland acreage, but account for two thirds of the rangeland erosion. About 17% of the nonfederal forest land is grazed and erodes at six times the rate of ungrazed forest land. Wind erosion in the 1976-77 winter blowing season damaged 3.2 million ha of land in the Greater Plain States. The average annual loss due to wind erosion exceeded 11.2 tons/ha on cropland in 3 states and rangeland in 4 states. (Baker-FRC)
W82-01850

THE APPLICATION OF RADIOACTIVE TRACERS FOR DETERMINATION OF BED-LOAD TRANSPORT IN ALLUVIAL RIVERS,
Copenhagen Univ. (Denmark). Dept. of Geography.
T. Thomsen.
Nordic Hydrology, Vol 11, No 3/4, p 133-144, 1980. 4 Fig, 4 Tab, 17 Ref.

Descriptors: *Bed load, *Radioactive tracers, *Alluvial rivers, *Sediment transport, Rivers, Ansager

River, Denmark, Centroid velocity, Mixing, Ripple marks, Tracers.

Bed load transport rate in an alluvial river was determined by a radioactive isotope tracer method. There was a difference of 25% between the results obtained from tracer studies and the values computed by the Engelund and Fredsoe (1976) model on sediment transport. Natural sand (704 g) from the Ansager River, labeled with Cr-51 (activity level 515 mCi) was injected into the river and radioactivity surveyed on 4 occasions. The centroid velocities (in meters per day) were 3.1, 4.9, 1.3, and 1.5 at 6 days, 13 days, 41 days, and 71 days after injection. The higher rates on days 6 and 13 show a higher transport rate of sediment particles in the surface of the mobile layer prior to complete mixing between active and inactive sediment particles. The mixing depth or mobile layer was about 15 cm deep. Activity in the uppermost 4.5 cm was more than twice as high as in the underlying 10 cm. This indicated a maximum ripple form height of 4.5 cm. The material transporting width was about 5.4 cm, range 3.05-9.90. Bed load transport rates were 3.19 tons per day for the 13-41 day period and 3.65 tons per day for the 42-71 day period. (Cassar-FRC)
W82-01893

HYDRAULIC GEOMETRY AND MINIMUM RATE OF ENERGY DISSIPATION,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
C. T. Yang, C. C. S. Song, and M. J. Woldenberg.
Water Resources Research, Vol 17, No 4, p 1014-1018, August, 1981. 2 Fig, 2 Tab, 30 Ref.

Descriptors: *Energy dissipation, *Channel morphology, *Hydraulic geometry, Rivers, *Sediment transport, Morphology, Equilibrium, Erosion.

The theory of minimum rate of energy dissipation was applied in conjunction with the Manning-Strickler equation and the dimensionless unit stream power equation for sediment transport (Yang, 1973) to a theoretical river with self-formed channels of approximately rectangular shape. The theory states that a system is in equilibrium when its rate of energy dissipation is at a minimum. When a system, such as a river, is subjected to constraints, it adjusts itself until it approaches the equilibrium conditions. The calculated exponents (width, 9/22; depth, 9/22; and slope, -1/6) of the hydraulic geometry relationships proposed by Leopold and Maddock (1953) agreed very well with those measured in the laboratory by Barr et al. (1980). The theoretically derived hydraulic geometry exponents also agreed with observed values from natural river gaging stations. Channel depth can be readily adjusted in accordance with the minimum rate of energy dissipation theory, but width adjustment may depend not only on discharge and sediment load, but also on past history of the river, erodibility of the bank, valley width, vegetation, and man-made structures and improvements. (Cassar-FRC)
W82-01918

SOUTHERN LAKE MICHIGAN SEDIMENTS: CHANGES IN ACCUMULATION RATE, MINERALOGY, AND ORGANIC CONTENT,
Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
D. K. Rea, R. A. Bourbonniere, and P. A. Meyers.
Journal of Great Lakes Research, Vol 6, No 4, p 321-330, 1980. 4 Fig, 1 Tab, 28 Ref.

Descriptors: *Lake sediments, *Sedimentation rates, Chemical reactions, *Lake Michigan, Sediment deposition, Water-sediment interfaces, Organic matter, Carbonates, Organic carbon, Fulvic acid, Cores, Particle size.

The last 3550 years of sedimentation in southeast Lake Michigan were reconstructed, using data obtained from three 1-meter gravity cores. At a depth of 50-60 cm (3300 years ago) an abrupt decrease in sedimentation rate and changes in sediment character are evident. These are associated with the lowering of water levels shortly after the end of the Nipissing high lake levels 4000 years ago. Sediment accumulation rates are about 50 g per sq m per year through the upper core section and 900 g per sq m per year in the lower section. Median grain sizes are 6.4 phi units at the core surface, 7.3 phi units at 45 cm, and 7-8 phi units for the lower section. In the lower core section (rapid accumulation rate) sediments are finer and contain a higher proportion of carbonates, inorganic C, and humin, and a lower proportion of organic carbon and fulvic acid. The differences in carbonates and organic fractions depend on the residence time in the oxidized surface layer. Rapidly accumulating material has tens of years for carbonate dissolution and organic C decomposition, whereas slowly sedimenting material may be exposed to chemical attack for hundreds of years. (Cassar-FRC)
W82-01958

R-FACTORS FOR SOIL LOSS IMPACT PREDICTION,
Construction Engineering Research Lab., Champaign, IL.
R. E. Riggins, and J. T. Bandy.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE4, p 851-857, August, 1981. 3 Fig, 8 Ref.

Descriptors: *Soil erosion, *Rainfall impact, *Prediction, Mathematical equations, *Cropland, Risks, Precipitation.

Soil loss is an important consideration in many environmental impact analysis situations. The universal soil loss equation, described in Agriculture Handbook No. 537 (HB537), can be used to predict soil loss from agricultural lands. However, while agricultural soil loss has generally been predicted on an average annual basis, there is a growing need for consideration of other time intervals. Incorporation of risk into impact analysis also permits the design of erosion control relative to the costs associated with failure. In addition, effective impact analysis requires a source of readily-available, inexpensive data. A procedure has been developed for determining design rainfall erosion indices for given storm periods for use in soil-loss impact analysis. The procedure brings together a new, simpler method of calculating rainfall erosion values, the concept of risk, and readily available precipitation data. Design rainfall erosion values can be selected on the basis of return interval or simple risk. Any time interval up to 1 year can be considered. Application of the technique to precipitation data from stations in Texas and Georgia showed that rainfall erosion values followed a log-normal probability distribution and could be adjusted to be comparable with values published in the HB 537. (Carroll-FRC)
W82-01963

ACCURACY OF SUSPENDED SEDIMENT MEASUREMENTS IN NATURAL STREAMFLOWS,
Institute of Civil and Construction Engineering, Split (Yugoslavia). Faculty of Civil Engineering.
O. Bonacci.
Journal of Hydraulic Research, Vol 19, No 3, p 195-209, 1981. 3 Fig, 6 Tab, 4 Ref.

Descriptors: *Suspended sediments, *Streamflow, *Mathematical models, Analysis of variance, Mathematical studies, Experimental design, Rivers, Drava River, Monte Carolo method, Case studies, Yugoslavia, *Sediment transport.

A simulation model was developed to investigate the influence of individual factors on the pulsation of the suspended sediment transport in the cross-section of an open streamflow. These results, combined with analysis of variance and experimental planning, made it clear that the selection and number of measurement verticals were important and that measurements should be carried out quickly. Satisfactory accuracy can be obtained when 4 to 7 measurement verticals are used. As the concentration of sediment increases, the number of verticals should increase. The position of the sample points on the vertical did not affect the accuracy of suspended sediment measurements. These conclusions were validated by measurements carried out on the profile of the Drava River near Botovo, Yugoslavia. The relative measurement error ranged from 10 to 60%. (Small-FRC)
W82-02002

2K. Chemical Processes

KINETICS FOR THE AQUATIC ENVIRONMENT,
Oregon Graduate Center, Beaverton.
J. F. Pankow, and J. J. Morgan.
Environmental Science and Technology, Vol 15, No 10, p 1155-1164, October, 1981. 7 Fig, 35 Ref.

Descriptors: *Chemical reactions, *Kinetics, *Mathematical studies, *Model studies, *Aquatic environment, Chemical properties, Phosphates, Metal complexes, Differential equations, Mathematical equations, Metals, Iron, Equilibrium, Adsorption, Oxidation, Hydrogen ion concentration.

Many natural water systems never reach complete equilibrium and are governed by the chemical kinetics of the system. In this, the first part of a two-part article, the kinetics of tripolyphosphate hydrolysis and Fe(II) oxidation are discussed. For tripolyphosphate, the most effective condensed phosphate detergent builder, hydrolysis occurs in two steps and obeys a first-order rate law. Equations were formulated to describe changes in orthophosphate concentration as a function of time. Conversion of half of the tripolyphosphate to orthophosphate took about 10 days. If rate constants are increased by a factor of 10, the conversion time is reduced to two days. When anoxic groundwaters surface, when hypolimnetic waters undergo spring and fall overturns, and when acid mine drainage is discharged to a river, the oxidation by oxygen of Fe(II) to Fe(III) takes place. The effects of pH, concentration, and various ligands on the oxidation kinetics are discussed. These findings plus future research on the catalytic oxidation of Mn(II) in the presence and absence of ligand and the adsorption of a metal ion onto the surfaces of suspended particles in the presence of ligand will be used to draw certain conclusions about the appropriateness of kinetics or equilibrium modeling as applied to natural water chemistry phenomena. (Geiger-FRC)
W82-01631

COPPER(II)- AND CADMIUM(II)-BINDING ABILITIES OF SOME NEW HAMPSHIRE FRESHWATERS DETERMINED BY DIALYSIS TITRATION,
New Hampshire Univ., Durham. Dept. of Chemistry.
For primary bibliographic entry see Field 5F.
W82-01632

THE USE OF SPECIFIC CONDUCTANCE IN STUDIES OF NATURAL WATERS AND SOIL SOLUTIONS,
Lanchester Polytechnic, Conventry (England). Dept. of Geography.
For primary bibliographic entry see Field 7A.
W82-01646

WATERSHED CONSTITUENT LOADING ANALYSIS UTILIZING EMPIRICAL HYDROCHEMICAL MODELING TECHNIQUES,
Utah State Univ., Logan.
For primary bibliographic entry see Field 5B.
W82-01676

NON-EQUILIBRIUM WATER/ROCK INTERACTIONS,
Stanford Univ., CA. Dept. of Geology.
For primary bibliographic entry see Field 1A.
W82-01684

THE RELATIONSHIP BETWEEN MACRO-TOPOGRAPHY AND THE GROUNDWATER QUALITY IN THE GREAT FISH RIVER BASIN, EASTERN CAPE PROVINCE,

Orange Free State Univ., Bloemfontein (South Africa). Dept. of Geology.
For primary bibliographic entry see Field 2F.
W82-01718

GROUNDWATER DISCHARGE THROUGH SPRINGS WITH WELL-DEFINED OUTLETS--A CASE STUDY FROM JELOYA-MOSS, S. NORWAY,
Norges Landbrukshoegskole, Vollebekk. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W82-01748

WATER QUALITY STUDY -- SOUTHWEST MINNESOTA PUBLIC WATER SUPPLIES,
Minnesota Univ., Minneapolis. School of Public Health.
C. P. Straub, V. M. Goppers, and R. D. Singer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-147497, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Center, University of Minnesota, Report, March, 1981. 24 p, 7 Fig, 2 Tab, 7 Ref. OWRT-A-038-MINN(1).

Descriptors: *Water quality, *Water resources, *Water supply, *Groundwater, *Surface water, *Public health, *Municipal water, Rock River watershed, Wells, Sampling locations, Glacial aquifers, Bedrock aquifers, Geohydrology, Precipitation, Southwest Minnesota, Minnesota.

Municipal water supplies in the Rock River watershed in Southeastern Minnesota were tested on a monthly basis for two years for the anions nitrate-nitrogen, sulfate, chloride, and bicarbonate alkalinity as CaCO3; and for total dissolved solids, conductivity, and pH. Ratios of the various anions were used to identify changes in water quality not associated with dilution. Seasonal changes in water qualtiy were not necessarily reflcted in changes of ratios; concentrations of nitrate-nitrogen increased in many cases, exceeding permissible concentrations specified in the Interim Primary Drinking Water Standards. High dissolved solids concentrations generally exceeded levels specified in the Secondary Drinking Water Standards. Groundwater concentrations were compared with surface water samples from the several streams, springs, and lakes in the area, and some correlations were made between land use and groundwater quality and precipitation. Data from the study were used to call attention to deficiencies in water quality to water consumers in the communities concerned. (Mullen-IPA)
W82-01795

KINETICS FOR THE AQUATIC ENVIRONMENT,
Oregon Graduate Center, Beaverton.
J. R. Pankow, and J. J. Morgan.
Environmental Science and Technology, Vol 15, No 11, p 1306-1313, November, 1981. 8 Fig, 6 Ref.

Descriptors: *Aquatic environment, *Kinetics, *Equilibrium, *Chemical reactions, Oxidation, Model studies, Chelation, Adsorption, Metals, Manganese, Iron.

A previous paper on kinetic concerned overall reaction rates and the degree to which a pair of opposing reactions within an overall system is maintained at equilibrium. This paper extends the discussion of kinetics in natural water systems to three examples: the autocatalytic oxidation of Mn(2+) in both presence and absence of ligand, and the adsorption of a metal ion on the surface of suspended particulates in the presence of a ligand. The suitabilities of equilibrium and kinetic calculations for inclusion in models are compared for several situations. Equilibrium models are useful when reactions occur very quickly or extremely slowly with respect to the period of interest, for example the conversion of Fe(2+) to Fe(3+) during a rapid autumnal lake turnover. In the absence of equilibrium, kinetics can be used. This requires inclusion of appropriate input or sink terms in the differential equations as well as running mass balance equations. Cases of this type could include algae blooms, sediment remineralization, and antropogenic inputs, although the equilibrium approach may be applicable under certain conditions. (Cassar-FRC)
W82-01806

THE SIGNIFICANCE OF WET AND DRY SYNOPTIC REGIONS ON LONG-RANGE TRANSPORT OF POLLUTION AND ITS DEPOSITION,
British Meteorological Office, Bracknell (England).
For primary bibliographic entry see Field 5B.
W82-01877

THE GEOCHEMICAL CONTROL OF SEAWATER (SILLEN REVISITED),
Massachusetts Inst. of Tech., Cambridge.
R. E. McDuff, and F. M. M. Morel.
Environmental Science and Technology, Vol 14, No 10, p 1182-1186, October, 1980. 3 Fig, 3 Tab, 24 Ref.

Descriptors: *Geochemistry, Alkalinity, *Seawater, Ions, Chemical precipitation, Chemical properties, *Chemical reactions, Geophysics.

The dominant sources and sinks in the oceanic balance of seawater ions are discussed in this consideration of Sillen's classic work on ocean chemistry. The Sillenian concept of a heterogeneous chemical control of seawater alkalinity is reconciled with modern ideas of the processes actually controlling the major ion concentrations in the ocean. An alkalinity loss by calcium carbonate precipitation can balance the alkalinity input from rivers. Alkalinity is also controlled indirectly by carbonate metamorphism, which buffers the CO2 content of the atmosphere. The ocean composition seems to be dominated by geophysical rather than geochemical processes. The acid-base chemistry is fundamentally controlled by heterogeneous chemical processes. (Small-FRC)
W82-01936

GROUNDWATER CHEMISTRY OF SOME SELECTED AREAS IN SOUTHEASTER NORWAY,
Norges Landbrukshoegskole, Vollebekk.
J-O. Englund, and J. A. Myhrstad.
Nordic Hydrology, Vol 11, No 1, p 33-54, 1980. 12 Fig, 2 Tab, 26 Ref.

Descriptors: *Water quality, *Rocks, *Chemical properties, *Groundwater, Aquifers, Groundwater movement, Seawater, Minerals, Brackish water, *Geochemistry, *Norway.

Groundwater in 3 areas of southeast Norway, the Lake Mjosa district, As, and Moss-Jeloy, were characterized by chemical analysis of 98 wells drilled 15 to 110 meters deep in bedrock. Since the groundwater surface in bedrock is usually present well below the overlying morainic or glacifluvial material, the water must penetrate this material. Therefore, weathering of minerals in the unsaturated zone is an important factor in determining the chemical composition of groundwater. The movement of groundwater is so slow that water quality is dependent on the solution of reservoir rocks below the groundwater surface. The highest specific electrical conductances, 550 microS per cm, were in dark calcareous shales, and the lowest, 300 microS per cm, in sandstone and gneisses. In the As and Moss-Jeloy regions, which are below the Late-postglacial marine limit, groundwater is influenced by ancient sea salts and fossil sea water. Groundwater from Late Precambrian rocks contains mainly calcium, bicarbonate, and sulfate; from Cambro-Ordovician rocks, magnesium, sodium, potassium, and bicarbonate. Above the Late-Postglacial marine limit groundwater in gneisses and gabbroes is dominated by calcium and bicarbonate; below this limit, by sodium, chloride, and bicarbonate. The composition of groundwater is largely governed by mineral-water equilibria. Most water samples in this study have not yet reached equilibrium with their surrounding minerals. (Cassar-FRC)
W82-02020

PHYTOBENTHOS OF THE RIVER TEES AND ITS TRIBUTARIES,
Durham Univ. (England). Dept. of Botany.
N. T. H. Holmes, and B. A. Whitton.
Freshwater Biology, Vol 11, No 2, p 139-168, April, 1981. 5 Fig, 4 Tab, 57 Ref.

Descriptors: Measurement techniques, *Benthos, *Phytoplankton, Rivers, Plant populations, Population density, Population dynamics, Algae, Seasonal variation, *Tees River, *Great Britain.

No previous studies of plant communities in flowing water have combined detailed floristic and objective quantitative surveys for a whole stretch of river over an extended period of time, although several meet three of these four requirements. This paper presents a standard method for describing plant communities in fast-flowing streams and rivers which is based on the selection of a representative 10-meter length of the stream which can be relocated exactly. A semi-quantitative account is then developed based on a combination of estimates of the relative areas covered by different physiognomic forms and the relative proportions of species present. Application of this method to the River Tees system in Great Britain is reported. Comparison of semi-quantitative analyses developed for six sites on the river showed that the site located directly below the Cow Green retention reservoir, which site had markedly regulated flows, differed from the other five sites in various ways. Bryophytes were found to comprise a greater cover at this site than elsewhere on the river system throughout the year, and a conspicuous growth of Phormidium occurred in autumn. During late summer and early autumn, filamentous green algae of a variety of species were also abundant at this site. Similar seasonal growth was also found at the site located furthest downstream, where the species Cladophora glomerata was dominant. The two upstream sites experienced conspicuous spring diatom 'bursts', which also occurred about a month later at the two downstream sites. Data from this study indicate that if time permits only one sample to be taken from a particular stretch of river, a sample taken in late summer probably provides the most information on flora and life forms. Appendices provide detailed lists of the taxa and diatoms identified at each of the six sites. (Carroll-FRC)
W82-02065

2L. Estuaries

SALT DISPERSION IN THE HUDSON ESTUARY,
Lamont-Doherty Geological Observatory, Palisades, NY.
K. Hunkins.
Journal of Physical Oceanography, Vol 11, No 5, p 729-738, May, 1981. 4 Fig, 4 Tab, 21 Ref.

Descriptors: *Salinity currents, *Estuaries, *Water currents, *Tidal effects, Salt balance, Shear, Seasonal variation, Mixing, Salinity, Mathematical studies, Tidal currents, *Hudson River estuary, New York.

Salt transport through river estuaries to the sea is balanced by landward dispersion influenced by physical mixing processes. The currents and salinity levels of the lower Hudson estuary were studied to evaluate the relative importance of these dispersion processes. Weakly significant correlations existed between wind and currents. Three cross-sectional surveys provided estimates of salt dispersion by other practices. Current and salinity data were decomposed into various temporal and spatial means, and departures from these means and covariances between the various quantities were interpreted in terms of physical dispersion processes. The steady shear of gravitational circulation was the main cause of salt dispersion in the lower Hudson estuary. Between spring high-flow and summer low-flow conditions, steady shear salt dispersion varied by a factor of 5. Salt dispersion by tidally varying shear was lower in magnitude. The relations between sectionally averaged current and salinity yielded a negative dispersion, which was attributed to the tendency of bottom tidal

currents to lead upper layer currents in phase and the increased longitudinal salinity gradient near the surface. (Geiger-FRC)
W82-01615

NITRATE REDUCTION TO AMMONIUM AND ORGANIC NITROGEN IN AN ESTUARINE SEDIMENT,
Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.
For primary bibliographic entry see Field 5B.
W82-01625

COHERENCE BETWEEN WIND AND CURRENT EVENTS IN A NEARSHORE, SHALLOW WATER, WAVE DOMINATED ENVIRONMENT,
Old Dominion Univ. Norfolk, VA.
G. M. Hecker.
PhD Dissertation, 1980. 123 p, 41 Fig, 36 Ref, 3 Append, University Microfilms International, Ann Arbor, MI; Order No GAX81-11390.

Descriptors: Winds, *Current meters, *North Carolina, Currents, Waves, Tidal waters, Shallow water, *Wave action, Nearshore, *Wind-driven currents.

Five days of observation were made of the current at four depths in a water depth of eight meters, and accompanying record of local wind one-half kilometer from shore at the U.S. Army Corps of Engineers Coastal Engineering Research Center field facility at Duck, North Carolina beginning five May 1978. The current was measured with a state-of-the-art electromagnetic current meter having a 0.2-second response time and an accuracy of + or - 2 centimeters per second. At each depth a ten-minute record was made each hour with a sampling interval of one-eighth second. The frequency components of the record were analyzed and found to be essentially free from noise and bias. The record of one hundred and twenty (less five lost due to loss of amplifier power supply) ten-minute averages was also analyzed for frequency components. Semidiurnal and diurnal tidal components and quadratic curve trends were identified. Analyses by fast fourier transform revealed that the component of the wind perpendicular to the coast had significant coherence with the alongshore component of the current. (Sinha-OEIS)
W82-01674

NUMERICAL ANALYSIS OF TRANSIENT SALT/FRESH-WATER INTERFACE IN COASTAL AQUIFERS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W82-01693

HYDROLOGY OF OKARITO LAGOON AND THE INFERRED EFFECTS OF SELECTIVE LOGGING IN OKARITO FOREST,
Forest Research Inst., Christchurch (New Zealand).
For primary bibliographic entry see Field 4C.
W82-01703

FIELD OBSERVATIONS OF THE ISOTOPIC COMPOSITION OF PARTICULATE ORGANIC CARBON IN THE SOUTHERN NORTH SEA AND ADJACENT ESTUARIES,
Institute for Soil Fertility, Groningen (Netherlands). Delft Hydraulic Lab.
For primary bibliographic entry see Field 2J.
W82-01714

DISTRIBUTION, MORPHOLOGY, AND ORIGIN OF SEDIMENTARY FURROWS IN COHESIVE SEDIMENTS, SOUTHAMPTON WATER,
Institute of Oceanographic Sciences, Taunton (United Kingdom).
R. D. Flood.
Sedimentology, Vol 28, No 4, p 511-529, August, 1981. 18 Fig, 44 Ref.

Descriptors: *Estuaries, *Bottom sediments, *Water currents, Furrows, Cohesion, Erosion, Deposition, Sedimentology, Southampton Water, Drowning, *Sediments, Sediment distribution.

Furrow morphology, sediments, structure and associated water flow were observed during a year-long investigation of Southampton Water furrows. Studies included side-scan sonar/fathometer surveys, diver observation and sampling, temperature/salinity measurement, and current speed measurement. Furrows in six well-defined patches apparently resulted from short periods of erosion followed by long periods of deposition. All of the furrows are parallel, 0.5 to 15 m troughs aligned with the dominant current. Some furrows have different characteristics such as width. Narrow furrows accumulate sediment at greater than 3.6 cm/year. Coarse sediments such as shells fill the bottoms of furrows and act to widen the furrows when moved by currents. Large furrows may remain in the same place for 12 years, while small furrows may last a month. (Small-FRC)
W82-01720

GEOCHEMISTRY AND HYDRODYNAMICS IN THE HUTT AND LEEMAN EVAPORITIC LAGOONS, WESTERN AUSTRALIA: A COMPARATIVE STUDY,
Uranerz Australia Party, Ltd., Subiaco.
A. V. Arakel.
Marine Geology, Vol 41, No 1-2, p 1-35, May, 1981. 14 Fig, 4 Tab, 25 Ref.

Descriptors: *Hydrologic cycle, *Playas, Lake basins, Seawater, Ponds, Ponding, *Geochemistry, *Lagoons, Precipitation, Lake beds, Groundwater, Lake sediments, Lake evaporation, Minerals, Sedimentation, Brines, *Australia, Hydrodynamics.

The geochemical characteristics and hydrologic circulation of the Hutt and Leeman Lagoons, located in the northern part of the Perth Basin, Western Australia, are compared. These lagoons are shallow evaporative basins which resulted from ponding in a Pleistocene dune terrain. The present-day lagoons have playa surfaces in which sedimentation is related to the distribution and interaction of groundwaters, seawater, and lagoonal brines. Precipitation is limited to ephemeral halite in ponded waters along with the diagenetic emplacement of calcium carbonate and calcium sulfate in sediments. The lagoonal circulation is controlled predominantly by playa surfaces, which are mostly below sea level. A net influx of sea water, impelled by a hydrostatic head of up to 4 meters, is balanced each season by evaporative reflux. (Geiger-FRC)
W82-01746

SEASONAL AND SPRING-NEAP TIDAL DEPENDENCE OF AXIAL DISPERSION COEFFICIENTS IN THE SEVERN - A WIDE, VERTICALLY MIXED ESTUARY,
Institute for Marine Environmental Research, Plymouth (England).
R. J. Uncles, and P. J. Radford.
Journal of Fluid Mechanics, Vol 98, No 4, p 703-726, June, 1980. 7 Fig, 3 Tab, 25 Ref.

Descriptors: *Estuaries, *Diffusion coefficient, *Salinity, *Tidal effects, Seasonal variation, Runoff, Saline-freshwater interfaces, *Severn estuary, *United Kingdom.

Results are presented for the seasonal and spring-neap tidal dependence of the dispersion coefficient in the Severn Estuary based on observations of the axial salinity distributions during 1971-1976. Results are also given for the seasonal dependence of residence times expressed as functions of axial distance along the estuary. The coefficients were derived from salt budget calculations based on 29 sets of observations, and regression analysis was used to determine simple linear and logarithmic relationships for the dispersion coefficients in terms of tidal range and the total rate of input of fresh water. Generally, the coefficients increased with increasing runoff and usually depended upon tidal range. There was a small decrease with increasing tidal range in the seaward part of the estuary and a large increase with increasing tidal range towards the head. Yearly averaged coefficients ranged from 1000 to 10,000 sq m/sec. When dispersion coefficients were applied to calculations of residence times, the residence time of the whole estuary varied from about 100 days during the winter to 200 days during the summer. (Small-FRC)
W82-01749

ESTUARINE DREDGE AND FILL ACTIVITIES: A REVIEW OF IMPACTS,
Florida State Dept. of Environmental Regulation, Tallahassee,
S. A. Johnston, Jr.
Environmental Management, Vol 5, No 5, p 427-440, September, 1981. 6 Fig, 33 Ref.

Descriptors: *Dredging, *Estuaries, *Silting, Suspended load, Turbidity, *Ecological effects, Suspended solids, Environmental effects, Fish, Aquatic life.

The effects and impacts of dredge and fill activities on estuaries are discussed with emphasis on biological and water quality impacts. Recommendations are made for improving and mitigating deleterious effects. The biological effects of turbidity may cause reduced visibility and reductions in the availability of food for fish. High levels of suspended solids can reduce oyster growth and may have toxic effects on various larvae. Dissolved oxygen concentrations are lower near some dredging and filling sites, and pH can be reduced. Siltation can have drastic effects, including the immediate removal of organisms through suffocation and the long-term elimination of many desirable species of flora and fauna. Resuspension of bottom materials can result in the release of nutrients as well as the possible release of toxicants. Where coastal wetlands can not be circumvented during construction projects, bridging should be used rather than filling and embankment. The turbidity caused by dredging and filling can be reduced through the use of a turbidity diaper. (Small-FRC)
W82-01805

A SENSITIVITY ANALYSIS OF AN ECOSYSTEM MODEL OF ESTUARINE CARBON FLOW,
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology.
J. K. Summers, and H. N. McKellar, Jr.
Ecological Modelling, Vol 13, No 4, p 283-301, September, 1981. 3 Fig, 5 Tab, 36 Ref.

Descriptors: *Estuaries, *Ecosystems, Dynamics, Organic matter, *Model studies, Sensitivity analysis, North Inlet, Sedimentation, Coastal waters, *Carbon cycle.

An estuarine carbon exchange model is examined using some techniques from systems theory, principally sensitivity analysis. The use of such techniques is demonstrated, and suggestions are made for their application to large ecosystem research projects. The model employed in the analysis has recently been used to estimate the annual net exchange rates of carbon between the North Inlet estuary, South Carolina, and the ocean as well as to elucidate the sources and storages of this carbon flow. The model is a 19-compartment real time deterministic formulation of the four major subsystems which comprise the North Inlet estuary: marsh, water column, oyster reef and subtidal benthos. To estimate parameter performance for the model, sensitivity analysis was performed on the 122 parameters over long periods of 5 years to ensure that long-term effects would be visible. Statistical relationships between perturbations of component interactions and system behaviors were investigated using these analyses. The major conclusion from a study of this model is that much more research is needed in the North Inlet system before a more precise structural framework for the North Inlet model can be attempted. Primary areas for continued research include characterization of the interaction between marsh grasses and algae; the extent of microbial recycling of dissolved organic carbon in the water column; and the community energetics of the North Inlet nekton and avian fauna. Concerning total organic exchange with the sea, specific research is needed into the variability

and controls of particulate organic matter in coastal waters, photosynthesis, planktonic microbial respiration, dissolved organic matter utilization by microbes, tidal washout from the marsh surface, and sedimentation from the water column to the subtidal sediments. (Baker-FRC)
W82-01875

GULF OF MEXICO WETLANDS: VALUE, STATE OF KNOWLEDGE AND RESEARCH NEEDS,
National Marine Fisheries Service, Beaufort, NC. Southeast Fisheries Center.
G. W. Thayer, and J. F. Ustach.
In: Proceedings of a Symposium on Environmental Research Needs in the Gulf of Mexico (GOMEX), Key Biscayne, Florida, 30 September - 5 October 1979, Volume IIB, May, 1981. p 1-30, 3 Fig, 3 Tab, 73 Ref. National Oceanic and Atmospheric Administration, Miami, Florida.

Descriptors: *Wetlands, *Estuaries, *Habitats, *Ecosystems, *Fisheries, Aquatic habitats, Spatial distribution, Detritus, Spawning, Vegetation, Fauna, Growth, Coastal marshes, *Gulf of Mexico.

Approximately 50% of the commercial and recreational fishes in the Gulf of Mexico and 80-90% of the fishery landings are estuarine-dependent. Coastal wetlands provide habitats and food resources that make estuarine-nearshore zones vital spawning, nursery and feeding areas for aquatic species. Although there is a great deal of information on plant species in Gulf wetlands, little quantitative data exist on mixed species communities and submergent species and on the factors regulating growth and production of most wetland plants. There is a paucity of quantitative data on the abundance and distribution of faunal components, including forage species and meiofauna, and on growth and mortality rates of juvenile fishes, age-specific utilization, and resource partitioning within wetland habitats. One of the most important, yet poorly understood, aspects of wetland ecology is the production, decomposition, utilization, and export of detrital material from Gulf wetlands. When one considers that about 75% of the total plant production in Gulf estuarine-wetland areas is derived from macrophytes, the importance of developing a sound information base on the decomposition process is obvious. Intensive long-term studies on a few systems and extensive short-term studies on many systems on a regional basis within the Gulf are needed to understand natural variability among organisms and their habitats, as well as the range of conditions and variability of wetland ecosystems. (Moore-SRC)
W82-01902

APPARATUS TO PRODUCE TIDAL FLUCTUATIONS IN A SIMULATED SALT MARSH SYSTEM,
University of West Florida, Pensacola.
C. R. Cripe.
Progressive Fish Culturist, Vol 42, No 1, p 32-33, January, 1980. 3 Fig, 3 Ref.

Descriptors: *Salt marshes, *Tides, *Laboratory equipment, Tidal marshes, Water level fluctuations, Estuarine environment, Simulators, *Pesticide kinetics.

An apparatus was designed to aid in studying pesticide dynamics in simulated salt marsh systems by producing tidal fluctuations in tanks. Water entered the test tanks (3 m in diameter and 0.6 m deep) at 3 liters/min through a siphon and headbox arrangement and discharged through a constant-level excurrent siphon that could be raised and lowered by a motor and gear assembly. During each revolution of the motor, the apparatus raised and lowered the water level in the tank about 10 cm, which simulated a sinusoidal tidal cycle. The motor and gear apparatus control timing and can be changed to vary the tidal cycle. (Small-FRC)
W82-01930

PHYTOPLANKTON DISTRIBUTIONS OBSERVED DURING A 3 1/2 DAYS FIXED-STATION IN THE LOWER ST. LAWRENCE ESTUARY,
Quebec Univ., Rimouski. Dept. of Oceanography.
M. Sinclair, J. P. Chanut, and M. El-Sabh.
Hydrobiologia, Vol 75, No 2, p 129-147, October, 1980. 11 Fig, 4 Tab, 35 Ref.

Descriptors: *Phytoplankton, *Species diversity, *Turbulent flow, Estuaries, Chlorophyll, *St. Lawrence estuary, Thalassiosira, Species composition, Niches, Productivity, Variability, Diatoms, Flagellates, Biomass.

Phytoplankton biomass, species composition, and variability in physiological state were investigated from July 31 to August 4, 1975, during a fixed station cruise off Rimouski, Wuebec, in the St. Lawrence Estuary. The temperature-salinity data and current data suggest that a single water mass on the order of tens of kilometers was present during this study. The surface composition of phytoplankton was relatively constant. In areas of high chlorophyll, Thalassiosira were dominant. Pennate diatoms and flagellates dominated at a surface discontinuity in salinity. The biomass distributions appeared to be a function of physical (turbulence, etc.) rather than biological processes in this small-scale study. On the scale of hours and kilometers, the biomass and primary productivity varied widely. The ratios of productivity/biomass and carbon/chlorophyll were associated with species composition differences. Niche diversity (as indicated by the relative constancy in species composition) was low despite the physical heterogeneity of the surface water. This is a result of the high turbulence associated with estuarine environments. (Cassar-FRC)
W82-01938

WATER QUALITY IMPACTS EXCHANGING WATER BETWEEN SEA AND A CLOSED ESTUARY,
Ministry of Transport and Public Works, Middelburg (Netherlands). Environmental Research Div.
For primary bibliographic entry see Field 5G.
W82-01991

TIDE-INDUCED RESIDUAL FLOW IN SHALLOW BAYS,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
J. Van De Kreeke, and A. A. Chiu.
Journal of Hydraulic Research, Vol 19, No 3, p 231-249, 1981. 5 Fig, 23 Ref.

Descriptors: *Flow patterns, *Tidal effects, *Bights, Bays, Shallow water, Eddies, Mathematical studies, Flow velocity, Residual flow.

Residual flow patterns were computed in a square bight and a semi-enclosed basin using a finite difference technique. The computations for the square bight suggested that the differences between the Lagrangian mean velocity and the residual flow divided by the mean depth are small. The tidally averaged equations demonstrated the dynamics of the tide-induced residuals. These equations' source terms were interpreted as residual stresses associated with the first order tidal motion. When restricted to the interior of the square bight, good agreement was found between numerically and semi-analytically computed residual flows. Numerically computed residual flow patterns for the semi-enclosed basin showed large eddies. Eddies are not present in the tidal flow. The present difference formulation of the advective terms may need modification. (Small-FRC)
W82-02003

ON SOME CHYTRIDS FOUND IN ESTUARINE HABITATS,
Institut fuer Meeresforschung, Bremerhaven (Germany, F.R.). Dept. of Botany.
A. Ulken.
Botanica Marina, Vol 23, No 6, p 343-352, June, 1980. 11 Fig, 1 Tab, 13 Ref.

Descriptors: *Fungi, *Aquatic fungi, *Estuaries, Bottom sampling, Brackish water, Water pollution effects, Rivers, Weser River, Federal Republic of Germany, River Tay, Great Britain, Comparison studies.

The occurrence of chytrids and thraustochytrids at seven stations between Bremerhaven and Bremen-Lesum on the river Weser were observed from 1976 to the present. Bottom samples which included small amounts of mud were taken monthly, and fungi from the samples were grown for two to four weeks. Nine species of fungi were isolated, all of which were able to live and propagate in brackish waters. Sporulation mechanisms were observed, and physiological abilities were investigated, including the destruction of keratin and chitin materials. Results from the river Weser fungi were compared with results obtained in an investigation of fungal occurrence in the river Tay in the United Kingdom, between Dundee and Perth. The Tay is unpolluted, while the Weser contains industrial salts from the Kali mines. River Tay results were similar to those of the river Weser. (Small-FRC)
W82-02038

PCB AND HCB IN THE SEDIMENTS AND WATERS OF THE TIBER ESTUARY,
Rome Univ. (Italy). Ist. d'Igiene.
G. Puccetti, and V. Leoni.
Marine Pollution Bulletin, Vol 11, No 1, p 22-25, January, 1980. 1 Fig, 6 Tab, 30 Ref.

Descriptors: *Marine sediments, *Estuaries, *Pollutants, *Tiber River, Italy, *Sediments, Polychlorinated biphenyls, Benzenes, Chlorinated hydrocarbons, Toxicity, Water pollution, Hexachlorobenzene.

Environmental pollution by polychlorinated biphenyls (PCB) has received considerable attention since the substance was discovered in animal tissues in 1966. Various studies have established its presence in aquatic sediments, wastewaters, organisms, and food. Previous research has demonstrated the presence of PCB in the catchment area of the Tiber River in Italy. This study investigated the range of PCB and of hexachlorobenzene (HCB) in the coastal seawaters and sediments of the mouth of the Tiber. Although HCB has limited and controlled applications in agriculture in Italy, the substance is diffused throughout the environment. Water analyses showed that PCB was present in 85 of 86 samples taken over a two year period in concentrations ranging from 0.009 to 1,000 parts per billion (ppb), with a mean value of 0.297 ppb. The four sediment samples all contained PCB, in concentrations ranging from 28 to 770 ppb. Only 16 percent of the water samples contained HCB, with concentrations ranging from 0.002 to 0.01 ppb, and none of the sediment samples contained HCB. These findings with respect to HCB indicate that the substance is not stable in the marine environment or that it is diluted there. Sampling sites closer to the coast contained less PCB than ones further out, suggesting that the water from the Tiber River acts as a microbiological decontaminating agent or that pollution of the marine environment further from the coast occurs through the atmosphere. The PCB concentrations found in this study are 100 to 300 times higher than the concentration considered acceptable on the basis of toxicity experiments with aquatic organisms. It is recommended that Italy develop standards for the concentrations of PCB in urban and industrial effluents. (Carroll-FRC)
W82-02057

ECONOMIC INSTRUMENTS FOR CONTROLLING EFFLUENT DISCHARGES TO THE RIVER TEES ESTUARY,
Newcastle upon Tyne Univ. (England). Dept. of Economics.
B. Beavis, and C. K. Rowley.
Marine Pollution Bulletin, Vol 11, No 5, p 120-124, May, 1980. 1 Fig, 6 Ref.

Descriptors: *Effluents, *Water pollution control, *Economic aspects, Industrial wastewater, *Great Britain, Mathematical models, Estuaries, Feasibility studies, Water quality standards, Taxes, Costs, Cost-benefit analysis, *Tees River.

For many years England and Wales have applied statutory controls of effluent discharges less strictly in the case of tidal rivers and estuaries than in the case of non-tidal rivers. Following a recom-

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mendation in 1972 that all industrial discharges to tidal waters and estuaries be brought under statutory control, alternative control mechanisms, and particularly the feasibility of using a system of charges instead of consents for controlling effluent discharges, were investigated. A one-dimensional water quality model of the River Tees, in which parameters vary only with respect to distance along the river, was combined with a cost abatement model to permit estimation of the pattern of abatement which would achieve specific water quality standards within specific time periods at the minimum aggregated private costs to all major dischargers. A multi-period approach permitted evaluation of the costs of introducing a variety of abatement procedures at different specific time periods at two year intervals over a 10-year period. Least cost solutions were found to be sensitive to both the level of water quality achieved and the date by which the water quality standard was required to be achieved. The solutions were generaly insensitive to the choice of discount rate. The study results indicate that a tax-price solution based on some knowledge of spatial water quality considerations and erring on the side of harshness in order to guarantee the satisfaction of the water quality standard on the basis of the initial tax-price vector may provide a less costly alternative than consents. The tax-price solution is shown to be an economically feasible approach in the case of the River Tees. (Carroll-FRC)
W82-02060

AMERICIUM IN INTERTIDAL SEDIMENTS FROM THE COASTAL ENVIRONS OF WINDSCALE,
Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W82-02098

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

CYCLING ZONE ADSORPTION APPLIED TO PURIFICATION OF BRACKISH WATER WITH THERMALLY REGENERABLE ION-EXCHANGE RESINS,
Delaware Univ., Newark. Dept. of Chemical Engineering.
K. S. Knaebel.
PhD Dissertation, 1980. 195 p, 46 Fig, 19 Tab, 104 Ref, 2 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-19939.
NSF-ENG 77-19951.

Descriptors: *Desalination, *Ion exchange, *Separation techniques, Water treatment, Brackish water, Mathematical models, Resins, Cycling zone adsorption, Deionization.

Cyclic variation of the temperature of a dilute aqueous NaCl feed to a fixed bed of thermally regenerable ion-exchange resin leads to alternate purification and enrichment of the product. The effects of operating conditions and staging of zones in series on separation are examined experimentally. The resins considered are Amberlite XD-2 and XD-5; the latter exhibits superior exchange capacity. A mathematical model that accounts for dissipative processes is proposed, and agrees with experimental results at high flow rates and cycling frequencies. A second model, which incorporates the Langmuir isotherm but assumes local equilibrium, is developed and agrees with experimental results at low flow rates and low cycling frequencies. An economic feasibility study indicates that the process is competitive with reverse osmosis and other deionization processes. (Sinha-OEIS)
W82-01696

MULTI-SALINE SAMPLE DISTILLATION APPARATUS FOR HYDROGEN ISOTOPE ANALYSES: DESIGN AND ACCURACY,
Geological Survey, Reston, VA. Water Resources Div.
A. A. Hassan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-115460, Price codes A02 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-25, 1981. 4 p, 1 Fig, 2 Ref.

Descriptors: *Water sampling, *Distillation, *Salinity, Dehydration, Hydrogen, Isotope studies, Temperature, Stable isotopes.

A distillation apparatus for saline water samples was designed and tested. Six samples may be distilled simultaneously. The temperature was maintained at 400 C to ensure complete dehydration of the precipitating salts. Consequently, the error in the measured ratio of stable hydrogen isotopes resulting from incomplete dehydration of hydrated salts during distillation was eliminated. (USGS)
W82-01789

3C. Use Of Water Of Impaired Quality

COMPOSITION OF FRUIT AND VEGETABLE PROCESSING WASTES,
Orange Free State Univ., Bloemfontein (South Africa). Dept. of Microbiology.
For primary bibliographic entry see Field 5D.
W82-01601

RIVER BASIN SEQUENTIAL WATER USE AND SALINITY EFFECTS ON CROP YIELD ECONOMICS,
Utah State Univ., Logan.
For primary bibliographic entry see Field 3F.
W82-01671

FOOD AND ENERGY PRODUCTION: CONJUNCTIVE WATER PLANNING,
Wright Water Engineers, Inc., Denver, CO.
W. L. Lorah, and K. R. Wright.
Journal of Hydrology, Vol 51, No 1-4, p 89-96, May, 1981. 1 Fig, 1 Tab, 1 Ref.

Descriptors: *Conjunctive use, *Water reuse, *Semiarid lands, Land reclamation, Irrigable land, Oil fields, Saline soils, Cropland, Leaching, Salts, Suspended solids, Dissolved solids, Injection, Multiobjective planning.

As competition for water between energy and agricultural interests increases, it is ever more necessary to find innovative approaches to water management which optimize limited water resources. A plan is presented which could meet the needs of both a large-scale waterflooding scheme for increased oil production and irrigation for a cropland reclamation project. Oil production and agricultural lands are frequently found in the same area in much of the Persian Gulf region. Modern irrigation techniques can be used to reclaim much of the cropland in this region, which has become saline and less productive, through the process of leaching. The proposed conjunctive water supply and treatment plan calls for river water to be diverted onto the saline lands for treatment to remove suspended solids. At the same time, this treatment process would leach salts from the soil. The treated water and the salts would then be captured by an underground drainage system for delivery to the oil field for subsequent injection around the oil reservoir. Use of the leachate from the agricultural sector as an acceptable raw supply for the oil industry would eliminate the need to construct a costly mechanical water treatment plant. Expenses eliminated by the plan could be used to assist a land development program, which might otherwise be economically impractical. The primary consideration for the oil industry in developing such a conjunctive use plan would be economic water treatment. The agricultural sector would need to evaluate both costs and benefits and would need to experiment with various crops. Factors which could make land treatment infeasible are identified, and field and laboratory work that must be undertaken to determine feasibility is described. (Caroll-FRC)
W82-01856

REARING PACIFIC SALMON IN SALTWATER PONDS FERTILIZED WITH DOMESTIC WASTEWATER, DATA REPORT, JUNE 1979 - MAY 1980,
Humboldt State Univ., Arcata, CA. Dept. of Fisheries.
G. H. Allen, J. Hedgepeth, J. Pandozzi, and M. Jennings.
August, 1980. 73 p, 10 Fig, 28 Tab, 27 Ref, Append.

Descriptors: *Wastewater renovation, *Fish physiology, *Fish populations, *Salmon, Trout, Municipal wastewater, Fish stocking, Fisheries, Wastewater treatment, Oncorhynchus, Fish, *Arcata, California.

Two experiments concerned with raising juvenile salmonids in two 0.15-hectare wastewater-seawater fish ponds were conducted at the City of Arcata, CA, sewage treatment facility on the north arm of Humboldt Bay. Rainbow trout (Salmo gairdneri) were reared in one pond during the summer of 1978, and rainbow trout and coho (silver) salmon (Oncorhynchus kisutch) were reared together in both ponds from fall 1979 to spring 1980. Survival of trout in summer was less than 10 percent for both vibriosis-vaccinated and unvaccinated trout. It is suggested that the probable causes of low survival were periods of high water temperature (24-25 degrees centigrade), especially when combined with salinities of approximately 20 ppt. Survival of coho salmon and trout in winter rearing was high in ponds--at least 60 percent, and perhaps as high as 90 percent in South Pond. Rainbow trout survival was good but lower than for coho. Coho salmon and steelhead rainbow trout reared in four-meter square pens all showed high survival in the 60- to 96-percent range. Trout grew to a larger size than coho over a shorter rearing period and provided a net production of fish from the ponds. Coho growth was mainly in late winter and spring months prior to smolting, with slightly less weight of coho biomass in the ponds at the end of the rearing period than at the beginning. Density-dependent relationships between number of fish per unit area, length attained by surviving fish, and percent of smolting were established, using both pen-reared and pond-reared fish. As currently managed, natural flood production would allow at least 10,000 25-gram smolts to be produced in one of the 0.15-hectare ponds. (Garrison-Omniplan)
W82-01906

A PROPOSAL FOR RECLAMATION BY DILUTION OF IRRIGATION WATER,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
W. A. Jury, G. Sinai, and L. H. Stolzy.
Irrigation Science, Vol 1, No 3, p 161-168, 1980. 5 Fig, 3 Tab, 12 Ref.

Descriptors: *Soil reclamation, *Irrigation water, *Saline water, *Saline soils, Water quality control, Solute transport, Reclamation, Salts, Agricultural hydrology, Cooling water, Drainage water, Controlled drainage, Leaching, Root zone, Model studies, Reclaimed water.

Reclamation of a soil salinized from irrigation with saline water was explored using a salt transport-chemical equilibrium model. The procedure involves a saline irrigation water derived from power plant cooling water residual (EC = 4.2 mmho per cm) diluted with well water (EC = 0.5 mmho per cm) to produce a mixture (EC = 1.4 mmho per cm) which is alternated with the saline water in 2-year cycles. This method allows continued use of the land and minimizes the discharge of salt below the root zone. During the saline irrigation year some salt is precipitated, and some if redissolved during the diluted irrigation year, for a net precipitation of 18% for the complete cycles. This compares with a net precipitation of zero for traditional methods. Although traditional leaching methods reduce salinity and sodicity of the root zone faster than the dilute irrigation method, they

allow more salt to be carried below the root zone and hence to the groundwater or other receiving waters. (Cassar-FRC)
W82-01943

3E. Conservation In Industry

MANAGING WATER AT HELICOPTER PLANT,
For primary bibliographic entry see Field 5D.
W82-01974

3F. Conservation In Agriculture

FURROW ADVANCE RATES UNDER SURGE FLOW SYSTEMS,
Utah State Univ., Logan. Dept. of Agriculture and Irrigation Engineering.
A. A. Bishop, W. R. Walker, N. L. Allen, and G. J. Poole.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR3, p 257-264, September, 1981. 6 Fig, 6 Ref.

Descriptors: *Irrigation efficiency, *Furrow irrigation, *Infiltration rate, *Surges, Water conservation, Compacted soils, Soil compaction.

A study of furrow irrigation proved that the advance phase was accomplished with less water using surge flows than with continuous flows. In a field planted to corn with 30 inch row spacing, 600 ft long furrows, and 1.46% average slope, two types of furrows alternated: wheel furrows (compacted by tractor wheels) and non-wheel furrows (unaffected by tractor wheels). Differences between advance rates in surge flow and continuous flow were very pronounced in the first water application to newly formed non-wheel furrows. The time required for the water to advance to the end of the 600 ft row was less than 500 min for surge flows (10 min cycles--1/3 on and 2/3 off, 1/2 on and 1/2 off, and 2/3 on and 1/3 off) and 3500 min for continuous flow. In non-wheel furrows on the second irrigation, advance times for the 600 ft row were 650 min for continuous flow and 100 to 350 min for the three surge flow regimes. Changing the cycle time to 20 min increased the advance time in surge flow to 80 min, compared with 40 min for a 10 min cycle and 240 min for continuous flow in the same trial. There was no significant difference between 5, 10, and 20 min cycles in newly formed non-wheel furrows. Apparently, surge flow altered the characteristics of the furrow, accelerating the development of thin surface seals in the bottom of the furrows and decreasing permeability. This research indicates that surge flow can reduce the volume of water needed for the advance phase, equalize water distribution, and eliminate runoff. (Cassar-FRC)
W82-01612

CASE STUDIES OF AGRICULTURAL WATER CONSERVATION,
Sonnen (M. B.) Co., Inc., Walnut Creek, CA.
M. B. Sonnen, B. B. Dendy, and K. P. Lindstrom.
Water Resources Bulletin, Vol 17, No 3, p 394-398, June, 1981. 2 Tab, 5 Ref. OWRT-C-90134-C(9428)(2), 14-34-0001-9428.

Descriptors: *Agriculture, *Surveys, *Economic aspects, *Water conservation, Farming, Irrigation practices, Loans, Land leveling, Conjunctive use, Water reuse, Public opinion, Planning.

A survey of 13 farmers in four irrigation districts located in California and Texas revealed that a majority was in favor of changing their water delivery systems to closed conduits, removing phreatophytes, reusing irrigation tail water, and avoiding salinity problems. Farmers responded negatively to proposals for collecting local runoff for irrigation, altering land to capture excess rainfall, locating an additional surface water source, developing soil salinity problems with their current irrigation methods, and installing drains. The most widespread methods of water conservation in use were land leveling, especially with laser controlled equipment; adjusting crops to water short periods; and reuse of irrigation tail waters. Conjunctive use of ground and surface waters is almost universally practiced. Water conservation is practiced because of its economic benefits, not for altruistic or ethical purposes. Farmers would respond to incentives for further water conservation practice. Although greater government incentive mechanisms would not be likely to reduce water use much more than 15%, training and education programs and increased loan programs for installation of water conservation equipment are recommended. (Cassar-FRC)
W82-01667

RIVER BASIN SEQUENTIAL WATER USE AND SALINITY EFFECTS ON CROP YIELD ECONOMICS,
Utah State Univ., Logan.
H. O. Fapohunda.
PhD Dissertation, 1980. 319 p, 32 Fig, 44 Tab, 70 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-19243.

Descriptors: Water resources, *Model studies, *River basins, Resources development, *Salinity, Crops, Economics, Agriculture, *Crop yield, Economic aspects, Impaired water use, Water use, Sequential Use Model, *Nigeria, Resources management, Crop yield economics.

An economic simulation model is combined with an existing hydrologic and salinity model (BSAMS) in order to predict management effects of sequential water use in a river basin. The hydrologic, salinity and economic systems are closely interrelated in any water resource project. Comprehensive planning is difficult if the three systems are analyzed independently; hence, it is advantageous to incorporate all three systems into a single working model, now called the Sequential Use Model. This model uses functions which relate seasonal crop evapotranspiration and soil solution salt concentration to yields. In essence, the output from the hydrologic (seasonal evapotranspiration) and salinity (soil solution salt concentration) models become inputs into the economic model, which predicts the net return to the given hydrologic and salinity conditions. The model provides a means of determining the relative efficiency of water use with respect to production or net returns for several management alternatives. The marginal values of water can be evaluated for all alternative uses or cropping schemes and the most profitable can then be selected. The sequential use model is applied to an actual hydrologic unit, the Madejia-River Basin in Nigeria to demonstrate its applicability to management and planning problems. (Sinha-OEIS)
W82-01671

EXPLOITING THE WATERS OF LAKE CHAD.
For primary bibliographic entry see Field 8A.
W82-01726

IMPRESSIONS OF SOIL AND WATER CONSERVATION IN CHINA,
Soil Conservation Service, Washington, DC.
For primary bibliographic entry see Field 4D.
W82-01730

THE CHAMBAL PROJECT: PROBLEMS AND SOLUTIONS,
Madhya Pradesh Irrigation Dept., Bhopal (India).
For primary bibliographic entry see Field 4A.
W82-01739

IRRIGATION FOR BRAZIL'S POLIGONO DAS SECAS,
Themag Engenharia Ltda., Sao Paolo (Brazil).
F. M. G. Budweg.
International Water Power and Dam Construction, Vol 33, No 8, p 20-22, August, 1981. 1 Fig, 3 Ref.

Descriptors: *Irrigation programs, *Civil engineering, Water resources development, *Semiarid lands, Resources development, Irrigation, Drought, Flood control, Sao Francisco River, *Brazil.

A regional plan to divert wet season runoff of the Sao Francisco river over long distances for irrigation to mitigate the problems of drought in Brazil is described. Not only is the lack of water a problem, there is also the problem of catastrophic flooding when rain does occur in this area of Brazil. In spite of these difficulties, large tracts of the region's land are used for raising livestock and farming. The Sao Francisco is the only river flowing through the semi-arid northeast which carries large volumes of water from the southeastern region of the country where rainfall is much more regular and more abundant. Two large reservoirs contribute considerably to the regulation of the river's flow, the Tres Marias and the Sobradinho. Watershed management plans will be combined with plans to store excess runoff of the flood seasons to transform many of the rivers of the northern half of the polygon of drought from seasonal to perennial rivers and thus provide the basis for large scale irrigation projects. Two basic plans are currently being considered. The first plan calls for diversion of part of the wet season runoff from the Sao Francisco to the north. According to estimates, about 780,000 ha in the semi-arid region north of the Sao Francisco would be suitable for farming by irrigation if water were available without limitation. Roughly 140,000 ha could be irrigated from locally existing sources. The overall development would take decades and be one of the largest single irrigation projects ever completed. (Baker-FRC)
W82-01744

LOW ENERGY PRECISION APPLICATION (LEPA) IRRIGATION SYSTEM,
Texas Agricultural Experimental Station, Lubbock.
W. M. Lyle, and J. P. Bordovsky.
Transactions of the ASAE Vol 24, No 5, p 1241-1245, September-October, 1981. 6 Fig, 1 Tab, 11 Ref.

Descriptors: *Irrigation practices, Design criteria, Rainfall, Runoff, *Irrigation design, Rainfall-runoff relationships, *Furrow irrigation.

A new concept in irrigation system design is introduced, along with a report of preliminary results. The system is characterized by and has been labeled as a low energy precision application (LEPA) system, which rather than spraying water into the air at moderate to high pressures, distributes it directly to the furrow at very low pressure through drop tubes and orfice controlled emitters. The system continuously moves through the field in a linear fashion. It is used in conjunction with micro-basin land preparation, which also optimizes the utilization of rainfall by minimizing runoff. The combined system was designed to minimize the effect of soil and climatic variables which adversely influence furrow and sprinkler irrigation efficiencies. From the results of testing thus far completed, it appears that significant savings in both water and energy resources are indicated. The system has been evaluated in terms of irrigation efficiency, water use efficiency (yield per gross unit of water delivered to the field), and energy conservation. (Baker-FRC)
W82-01859

DRIP IRRIGATION UNIFORMITY CONSIDERING EMITTER PLUGGING,
Michigan State Univ., East Lansing. Dept. of Agricultural Engineering.
V. F. Bralts, I. P. Wu, and H. M. Gitlin.
Transactions of the ASAE, Vol 24, No 5, p 1234-1240, September-October, 1981. 6 Fig, 1 Tab, 16 Ref.

Descriptors: *Drip irrigation, Irrigation practices, Mathematical studies, Statistical analysis.

The present research is an attempt to statistically include emitter plugging in the calculations for uniformity of single and dual chamber drip irrigation lateral lines. The theoretical development of orifice type emitter flow variation due to partial and/or complete plugging is discussed. Through the examples provided the study showed that emitter plugging can be statistically included in the

calculations of uniformity of emitter flow of single and dual chamber drip irrigation lateral lines. In addition, the number of emitters per plant has been shown to be important when calculating uniformity of emitter flow, including emitter plugging. The inclusion of emitter plugging in drip irrigation design enables the design engineer to assess the ramifications of potential plugging on uniformity of emitter flow and ultimately on crop yields. The various system design requirements such as irrigation water filters, lateral line chemical treatment and lateral line flushing can be balanced with acceptable levels of emitter plugging and uniformity. Furthermore, remedial measures such as increased irrigation time or lateral line replacement could be made when uniformity decreases below acceptable limits. Design curves and nomographs have been developed which simplify the inclusion of emitter plugging in design of drip irrigation lateral lines. These design charts are based upon the statistical uniformity coefficient. Similar charts can be easily developed for other uniformity measures. (Baker-FRC)
W82-01860

EFFECT OF IRRIGATION PRACTICES AND METHODS OF SOWING-CUM-IRRIGATION ON THE PERFORMANCE OF SAFFLOWER,
Central Soil Salinity Research Inst., Karnal (India).
R. K. Rajput, S. N. Singh, J. S. Yadav, and B. M. Sharma.
Indian Journal of Agricultural Sciences, Vol 51, No 5, p 316-320, May, 1981. 4 Tab, 8 Ref.

Descriptors: *Crop yield, *Irrigation effects, *Furrow irrigation, Irrigation practices, Crop production, Agriculture, Statistical analysis, India, *Safflower.

A field experiment was conducted to determine the most sensitive growth stage of safflower for moisture stress and to determine the best method of sowing vis-a-vis irrigation for good seed yield and water economy. Treatments included combinations of eight post-sowing irrigation schedules based on crop growth stages and four methods of sowing-cum-irrigation. The relationship between post-sowing irrigation schedules and methods of sowing-cum-irrigation was not statistically significant during both seasons of the experiment as well as in the pooled analysis. Irrigation at any growth stage was beneficial, and the effect was pronounced when irrigation was applied at the flowering stage followed by irrigation at the milk stage. At the test site where the soils are deep, highly moisture retentive, and medium textured, safflower can successfully be grown with row spacing of 50 cm and alternate furrow irrigation. Irrigations applied at the flowering stage and the milk stage will ensure a yield of about 2700 kg/ha. (Small-FRC)
W82-01878

CONTROL OF PEACH TREE GROWTH AND PRODUCTIVITY BY REGULATED WATER SUPPLY, TREE DENSITY, AND SUMMER PRUNING,
Victoria Dept. of Agriculture, Tatura (Australia). Irrigation Research Inst.
For primary bibliographic entry see Field 2I.
W82-01883

INTRASEASONAL WATER ALLOCATION IN DEFICIT IRRIGATION,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
R. L. Bras, and J. R. Cordova.
Water Resources Research, Vol 17, No 4, p 866-874, August, 1981. 6 Fig, 3 Tab, 18 Ref.

Descriptors: *Water requirements, *Irrigation requirements, *Crop yield, *Water allocation, Model studies, Stochastic process, Soil moisture deficiency, Cost-benefit analysis, Economic aspects, Profit, Evapotranspiration.

An optimal irrigation policy is derived by applying a model which considers the intraseasonal stochastic variance in crop water requirements and the dynamics of the soil moisture depletion process. The goal of the simulation is maximum profits. General expressions are derived analytically for computing the first two moments of the soil moisture content and of total actual evapotranspiration. The conditional probability distribution of soil moisture content at the end of each decision stage and the associated first moment of the total actual evapotranspiration are used within a stochastic control algorithm, using dynamic programming, to obtain the solution. Among the assumptions required are: lumped soil system, deterministic potential evapotranspiration and irrigation water supply, one crop, simplistic rainfall model, soil moisture averaged through depth, and unquantified farmers' risk aversion. A case study of corn growing on Nunn clay loam soil in Colorado in 1974 is used to test the model. The 120-day growing season is divided into 15 eight-day decision stages and the optimal water allocation solved for limited and unlimited water cases. Results are depicted in graphs plotting net benefits (Dollars per acre) vs. available irrigation water at the root zone (mm) when the cost of irrigation water is $0.16 per mm. (Cassar-FRC)
W82-01916

RESPONSES OF GRAIN SORGHUM TO VARIABLE WATER SUPPLY UNDER TWO IRRIGATION FREQUENCIES,
California Univ., Davis. Dept. of Land, Air, and Water Resources.
J. M. Faci, and E. Fereres.
Irrigation Science, Vol 1, No 3, p 149-159, 1980. 6 Fig, 2 Tab, 19 Ref.

Descriptors: *Sorghum, *Irrigation efficiency, *Water stress, Sprinkler irrigation, Basin irrigation, Soil-water-plant relationships, Evapotranspiration, Crop yield, Grain crops.

Sorghum bicolor L. Moench Cv. Pioneer 846 was grown during 1977 in deep loam soil under different irrigation regimes. Treatments were: Experiment I--sprinkler irrigation; initial soil condition, dry; water application at 2 day intervals or at 10-14 day intervals; Experiment II--basin irrigation; initial soil conditions, fully wetted; water applications at 1 week intervals or nonirrigated. Seasonal amounts of water applied were between 5.1 and 77.0 cm. Linear relationships were found of both total dry matter production and grain yield to seasonal evapotranspiration in both variations of Experiment I. Grain yield and dry matter production were the same with both irrigation frequencies when the evapotranspiration values were near potential. At low evapotranspiration values the Experiment I low frequency irrigation yielded more grain and dry matter than did the Experiment I high frequency irrigation. Higher frequency irrigation allowed more water evaporation from the soil and less recovery from water stress. Grain yields were higher for a similar evapotranspiration in Experiment II weekly irrigation than for Experiment I. (Cassar-FRC)
W82-01944

CORN AND ALFALFA PRODUCTION AS INFLUENCED BY LIMITED IRRIGATION,
Utah State Univ., Logan. Dept. of Soil Science and Biometeorology.
A. Retta, and R. J. Hanks.
Irrigation Science, Vol 1, No 3, p 135-147, 1980. 9 Fig, 7 Tab, 10 Ref.

Descriptors: *Grain crops, *Irrigation practices, *Evapotranspiration, Model studies, Corn, Alfalfa, Crop yield, Water stress, Varieties, Hanks model, Irrigation efficiency, Logan, *Utah.

Six varieties of corn and three varieties of alfalfa were grown under varying degrees of irrigation in two seasons (1976 and 1977) at Logan, Utah. Dry matter yields and, in most cases, grain yields, showed a linear relationship to evapotranspiration. There was little difference in yields among the varieties. The slopes of the regression lines (relative dry matter and grain yields:relative evapotranspiration) varied considerably between the 2 years but not among varieties. The slope in alfalfa changed less than in corn, partly as a result of the lesser degree of soil evaporation in alfalfa. Yields predicted by Hanks' (1974) water balance computer model to estimate dry matter and grain yields of field crops from inputs of standard soils, weather, and plant data agreed well with measured yields for both grains. (Cassar-FRC)
W82-01945

DEVELOPMENT OF SOLUTIONS FOR LEVEL-BASIN DESIGN,
Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
A. J. Clemmens, T. Strelkoff, and A. R. Dedrick.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR3, p 265-279, September, 1981. 3 Fig, 3 Tab, 22 Ref.

Descriptors: *Irrigation efficiency, *Distribution, *Basin irrigation, Irrigation design, Spatial distribution, Infiltration, Level basin design, Water conservation.

This paper discusses methods of estimating distribution uniformities for a wide variety of flow rates, run lengths, infiltration characteristics, and flow resistances for the design and management of irrigation in level basins. An example illustrates the use of the method in applying a given depth of water (4 inches) everywhere in a field at a desired uniformity (80%). It was seen that halving the run length can almost triple the basin area without sacrificing any uniformity. If the run length is decreased for a given basin area, distribution uniformity is greatly improved and the amount of applied water decreased. For a shorter basin, the distribution uniformity does not respond as drastically to changes in flow rate. (Cassar-FRC)
W82-01976

OPTIMAL DESIGN OF BORDER IRRIGATION SYSTEMS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
J. M. Reddy, and W. Clyma.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR3, p 289-306, September, 1981. 3 Fig, 4 Tab, 13 Ref.

Descriptors: *Border irrigation, *Irrigation requirements, *Crop yield, Profit, Water conservation, Optimization, Surface irrigation, Economic aspects, Water requirements, Model studies, Basin irrigation, Cost-benefit analysis.

An optimal border irrigation system design was developed to obtain maximum profits within the system constraints and variables. A two-step process established the relationship between yield and design variables. First, a hydraulic model determined the relationship between water requirement efficiency and the design variables. Second, a crop production model and the hydraulic model determined the relationship between crop yield and water requirement efficiency. These two relationships were combined with a mathematical programming technique. The model considered produce values and the costs of labor, water, ditch construction, and crop production, but not the negative effects of runoff and deep percolation. Design variables included were inflow rate, time of inflow, length of run, number of lengths of run, border width, and number of border widths. Graded borders and level basins were considered separately. This technique provides both the optimum management techniques for given field conditions and optimum design for new systems. (Cassar-FRC)
W82-01977

INFLUENCE OF TRICKLE AND SPRINKLE IRRIGATION ON GOLDEN DELICIOUS APPLE QUALITY,
Irrigated Agriculture Research and Extension Center, Prosser, WA.
S. R. Drake, E. L. Proebsting, Jr., M. O. Mahan, and J. B. Thompson.
Journal of the American Society for Horticultural Science, Vol 106, No 3, p 255-258, May, 1981. 4 Tab, 12 Ref.

Descriptors: *Apples, *Sprinkle irrigation, *Trickle irrigation, Irrigation practices, Fruit crops, Trees, Soil-water-plant relationship, Water use efficiency, Crop yield, *Irrigation efficiency.

Trickle irrigation of Golden Delicious apples (Malus domestica Borkh.) resulted in a generally higher quality product than did sprinkle irrigation in studies conducted in Washington during 1978 and 1979. Comparisons in growing regimes of trickle and sprinkle plots, respectively, were as follows: total water applied, 38 and 71 cm in 1978, 46 and 91 cm in 1979; leaf water potentials, -14 and -12 bars in 1978, -12 and -11 bars in 1979. In the trickle plots the soil remained moist in a 1.5 meter diameter circle around each tree, but reached the permanent wilting point in June. Differences in crop yields were not significant. Trickle-irrigated apples matured earlier, produced applesauce of better consistency, showed less weep of thawed frozen slices, and were higher in yellow color, soluble solids, and pH. Sprinkle-irrigated apples after 5 months storage were of higher eating quality (juicier and with lower soluble solids/titratable acidity ratio). Frozen apple slices from sprinkle irrigation plots were firmer. (Cassar-FRC)
W82-02001

AGRICULTURAL CONSERVATION PROGRAM: AN EVALUATION,
Agricultural Stabilization and Conservation Service, Washington, DC.
J. R. Henry.
Water Resources Bulletin, Vol 17, No 3, p 438-442, June, 1981. 1 Tab.

Descriptors: *Cost sharing, *Agricultural conservation Program, *Conservation, Economic aspects, Water policy, Water conservation, *Soil conservation, *Irrigation, Ponds, Erosion control, Forestry, Agriculture, Farms.

The Agricultural Conservation Program (ACP) authorizes cost sharing with land owners for projects to conserve water, soil, and wildlife and for agriculture-related pollution prevention and control. This paper summarizes Phase I of the appraisal of this program, concentrating on soil and water conservation, and excludes wind erosion, water quality, changes in productive capacity, wildlife habitats, and offsite impacts. Information was collected from 171 counties in 46 states, 5% of all counties, for a total of 60,836 cases. Overall results show that the ACP is doing a very good job in meeting its stated purposes, but effectiveness can be improved with planning and greater use of scientific tools such as soil maps and the Universal Soil Loss Equation. More than 52% of shared cost erosion control projects were installed on land with low erosion rates, less than 5 tons per acre per year; only 27% on land eroding at high rates, 5-14 tons per acre per year. Almost 63% of irrigation water practices were applied to lands receiving 4 ft or less per acre per year; 34% to lands receiving 4-8 ft per acre per year; and 4% to lands receiving 8 ft per acre per year or more. The 4% accounted for over 33% of total volume of water conserved. As the capacity of impoundments increased, costs per acre foot of storage capacity declined and costs per acre increased. (Cassar-FRC)
W82-02019

WATER USE, YIELD AND QUALITY OF RAPESEED AS INFLUENCED BY SPACING, IRRIGATION AND TIME OF HARVEST WHEN RAISED IN A MULTIPLE-CROPPING SYSTEM,
Chandra Shekhar Azad Univ. of Agriculture and Technology, Kanpur (India).
S. Bhan, M. Balaraju, and V. Ram.
Indian Journal of Agricultural Sciences, Vol 50, No 10, p 760-763, October, 1980. 2 Tab, 7 Ref.

Descriptors: *Irrigation requirements, *Rapeseed, *Water requirements, Water conservation, Agriculture, *India, Irrigation efficiency.

Water use efficiency of a rapeseed crop was greatest (4.60 kg grain per mm water in 1976-77 and 6.85 kg per mm in 1977-78) using two irrigations, at flower initiation and at pod development. Water use for this regime was 206.3 mm in 1976-77 and 212.2 mm in 1977-78. In 1976-77 and 1977-78 unirrigated fields produced 3.6 and 4.24 kg grain per mm water, respectively, using 134.2 and 127.6 mm of water, respectively. Water use efficiency for one irrigation at flower initiation was 4.46 kg per mm in 1976-77 and 5.73 kg per mm in 1977-78; for one irrigation at pod development, 3.53 kg per mm in 1976-77 and 5.14 kg per mm in 1977-78. Harvest of rapeseed at physiological maturity did not adversely affect yield, although the 1000 grain weight and percent oil were very slightly higher for the more mature crop. The two-week earlier rapeseed harvest facilitated sowing of a late wheat crop. (Cassar-FRC)
W82-02031

SHORTENING THE IRRIGATION INTERVAL AS A MEANS OF SAVING WATER IN A BANANA PLANTATION,
Volcani Inst. of Agricultural Research, Bet-Dagan Israel). Div. of Subtropical Horticulture.
E. Lahav, and D. Kalmar.
Australian Journal of Agricultural Research, Vol 32, No 3, p 465-477, 1981. 7 Fig, 8 Tab, 9 Ref.

Descriptors: *Irrigation practices, *Water conservation, Agricultural engineering, Farming, *Bananas, Arid climates, *Israel, Soil-water-plant relationships.

Information was sought on the effect of irrigation intervals and water amounts on the water and salt distribution in the soil profile and on the nutrient concentration in the leaf lamina and petiole of the banana sucker. The experimental site was located in the northern coastal plain of Israel. The soil was a brown low-lime grummusol. Organic matter was 1.0% and the nitrate level was 25 ppm. Wetting cycle treatments were irrigation at 3-day intervals and pulsed irrigation. The different treatments considerably affected the wetted soil volumes, with the effect of the water quantity being greater than that of the irrigation interval. The relationship between the wetted soil volumes and the yield showed that the lowest yield was obtained from suckers irrigated with a reduced water amount once in 3 days. Irrigation with the same water amount but by pulses increased the wetted soil volume, shortened the period of water stress, and therefore increased yields. The regular water amount applied at 3-day intervals resulted in the largest wetted soil volume, but the water stress period was considerably longer than that with the same water amount given by pulses, thus lowering the average yield. An increase in water tension at the lower layer in treatments by irrigated pulses showed that no water excess reached this layer. However, the increase in tension in the lower soil layer did not result in any negative effect on the sucker development, its roots, or its yields. During the 3-day interval between irrigation treatments, the upper soil layer was drying out and, due to the water consumption of the sucker increasing during the season, the water tension before irrigation increased. In cases of wide spacing, water loss was due to evaporation. With narrow planting distances, water loss was due to plant uptake. It was concluded that shortening the interval between periods of irrigation may be a good means of saving water. (Baker-FRC)
W82-02093

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

PARISH IS NOT LIABLE FOR SUBSIDENCE.
For primary bibliographic entry see Field 6E.
W82-01603

RECENT CHANGES IN LEVEL OF LAKE VICTORIA,
Hydrometeorological Survey of the Catchments of Lakes Victoria, Kyoga and Mobutu Sese Seko, Entebbe (Uganda).
G. W. Kite.
Hydrological Sciences Bulletin, Vol 26, No 3, p 233-243, September, 1981. 5 Fig, 3 Tab, 9 Ref.

Descriptors: *Lakes, *Dams, *Water level, Rivers, Streamflow, *Lake Victoria, Precipication, Evaporation, Water level fluctuations.

Under natural conditions, the outflow from Lake Victoria was controlled by the Ripon Falls in the Victoria Nile at Jinja. Following construction of the Owen Falls Dam, these falls have become partially submerged. The center portion of the falls was removed, so that today there is subcritical flow in the center of the river and supercritical flow on each side over the remains of the rapids. The excesses and shortages are volumes of water and, when divided by the areas of Lake Victoria corresponding to the appropriate levels, can be converted to depths over the lake, thus apparently establishing the effects of the Owen Falls dam on the level of Lake Victoria. The components of the water balance of Lake Victoria are, in order of decreasing importance, rainfall over the lake, evaporation from the lake, outflow from the lake, and runoff from the surrounding land areas. During the period from 1961 to 1964, the level of Lake Victoria rose by about 2.5 meters; over the period 1977 to 1980 it rose by around 1.5 meters. These rises are unusual, given the normal small variation of such a large lake. Use of a lake routing model has shown that the most recent rise in lake level can be simulated very closely if the observed precipitation volumes are increased by between 25 and 30%, suggesting that the observed data may be underestimates of the true precipitation. Rapid changes in lake levels and river flows such as those described here render the use of long term average statistics unreliable for design purposes. (Baker-FRC)
W82-01711

THE CHAMBAL PROJECT: PROBLEMS AND SOLUTIONS,
Madhya Pradesh Irrigation Dept., Bhopal (India).
D. S. Sinha.
International Water Power and Dam Construction, Vol 33, No 8, p 25-28, August, 1981. 3 Fig.

Descriptors: *Irrigation programs, *Flood control, *Drainage, *Chambal Project, *India, Civil engineering, Madhya Pradesh, Engineering, Soil water, Weed control, Waterlogging, Construction, Canal construction.

The Chambal Project serving Madhya Pradesh, India, is described. Three dams and 350 km of major canals supply this irrigation project. The purpose of the project was to offer protection from heavy flooding in the area. It became obvious that a large flood reserve would have to be maintained in the reservoir, with a corresponding loss of useful capacity, if proper utilization of the monsoon waters was to be achieved. Breaches in the Chambal canal also created problems for the area. Weed growth in the canal compounded the breaching problem, reducing the canal's carrying capacity. With the advent of irrigation and constant flow of the canal water, large areas became water-logged. Where irrigation is introduced for the first time, a rise in the groundwater table is expected. If surface and subsurface drainage are lacking, when water oozes out from the canal embankment or leaks through the subsoil, the waterlogging problem becomes enormous. The Chambal project was visualized in the early 1950s and planned an irrigation intensity of 70% of the cultivable area. However, factors made the amount of water this was able to supply inadequate to the need. Farmers started growing high yielding wheat instead of the normal variety. The higher yielding crop required significantly greater amounts of water. When they farmed all the area available, instead of the predicted 70% of it, again demand exceeded supply. Night irrigation was not being carried out, and during these hours water was allowed to go to waste into the drains. Problems have been somewhat overcome by ending canal weed problems, strengthening the canal embankments, and land levelling and land shaping. (Baker-FRC)
W82-01739

USING THE BAMBOO (BAMBUSA VULGARIS) AS FIELD DRAINAGE MATERIAL,
Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Agricultural Engineering.
E. U. Nwa.
Transactions of the ASAE, Vol 24, No 4, p 974-976, July/August, 1981. 3 Fig, 1 Tab, 11 Ref.

Descriptors: *Drainage, *Irrigation practices, *Nigeria, *Bamboo, Water table, Rainfall, Runoff, Waterlogging, Salinity, Subsurface drainage, Surface drainage.

The bamboo was tested as an inexpensive material for making field drains. A set of uniform bamboo pipes was cut into 4 meter lengths. The septum at the nodes was removed by boring through. Holes were drilled evenly spaced around each pipe. Two parallel drains, 20 meters long (i.e., 5 pipes each), were installed across the slope of a sloping test field at a spacing of 15 meters. The depth of the drain was one meter and the slope was 0.2%. Crushed stones, about 6.5 mm in diameter, were used as envelope material. The depth of the water table below the ground surface was measured in the ground water tubes a day or two after each rainfall and at weekly intervals during long rainless periods. At the peak of the rains the stream water at the lower end of the slope backed into the evacuation ditch up to the position of the lower drain, rendering it less effective. In general, the two drains proved fairly effective. The outflow rate naturally increased with the amount of rainfall. It also responded to the rainfall intervals, increasing, decreasing or remaining constant depending on the intervals. The maximum drain outflow rate of 32 liters/minutes was obtained between the end of July and the end of September. Rainfall was very regular during this period. It was concluded that bamboo can be used effectively for field drainage. (Baker-FRC)
W82-01743

STAGE-DISCHARGE RELATIONS AT DAMS ON THE ILLINOIS AND DES PLAINES RIVERS IN ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
D. M. Mades.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Price: $8.25 in paper copy, $4.00 in microfiche. Geological Survey Open-File Report 81-1009, 1981. 56 p, 19 Fig, 23 Tab, 11 Ref.

Descriptors: *Stage-discharge relations, *Dams, *Streamflow, *Regulated flow, Concrete dams, Movable dams, Slide, Radial gates, Locks, Outlets, Orifice flow, Model sutides, Discharge coefficients, Discharge measurement, Gaging station, *Illinois, Illinois River, Des Plaines River.

Stage-discharge relations were developed for the Brandon Road Dam on the Des Plainse River and the Dresden Island, Marseilles, Starved Rock, Peoria, and La Grange Dams on the Illinois River. At Brandon Road Dam, streamflow is regulated by the operation of tainter gates and headgates. Tainter gates are operated to regulate streamflow at the Dresden Island, Marseilles, and Starved Rock Dams. Peoria Dam and La Grange Dam comprise timber Chanoine wickets which are lowered to a horizontal position on the streambed when used for streamflow regulation. Both dams have concrete abutments housing butterfly valves that are also used for regulation. A total of 50 discharge measurements ranging from 49.0 to 2,450 cubic meter per second were used to determine discharge coefficients in equations expressing discharge as a function of headwater depth, tailwater depth, and gate opening. A stage-discharge relation for Chanoine wicket dams developed from a U.S. Army Corps of Engineers hydraulic model study in 1937 and 1938 was verified with discharge measurements made downstream from the Peoria and La Grange Dams. (USGS)
W82-01793

ECOLOGICAL CHARACTERISTICS OF THE RHIZOSPHERE MICROFLORA OF MYRIOPHYLLUM HETEROPHYLLUM,
Massachusetts Univ., Waltham. Department of Environmental Science.
J. R. Blotnick, J. Rho, and H. B. Gunner.
Journal of Environmental Quality, Vol 9, No 2, p 207-210, April/June, 1980. 1 Fig, 3 Tab, 26 Ref. OWRT-B-066-MASS(1), 14-34-0001-9075.

Descriptors: *Aquatic weed control, *Rhizosphere, *Nitrogen fixing bacteria, Weeds, Plant growth, Aquatic weeds, Aquatic plants, Nutrients, *Mesotrophic lakes, Aquatic bacteria, Aquatic productivity, Surface water, Species composition, Population density, Cycling nutrients.

There has been an increased interest in the growth patterns and nutrient requirements of vascular plants as problems associated with nuisance weed growth in aquatic environments increased. During periods of active plant growth, bacterial populations associated with the rhizosphere and rhizoplane of the water milfoil, Myriophyllum heterophyllum, were examined in the littoral zone of a softwater, mesotrophic lake of Massachusetts. Species composition of the rhizoplane bacteria differed markedly from that of adjacent sediments; however, the population density of heterotrophic bacteria in each of these sites was similar. In the rhizoplane, large populations of bacteria capable of reducing nitrate and performing ammonification were found. Nitrogen-fixing activity was significantly greater on root surfaces than in lake sediments. Intense rhizosphere activity was linked to the bimodal productivity cycle of M. heterophyllum. It was suggested that the large populations of rhizoplane bacteria involved in nutrient transformations may more readily supply aquatic plants with available nutrients than do the nonrhizosphere populations. (Geiger-FRC)
W82-01796

BIOLOGICAL CONSEQUENCES OF STREAM ROUTING THROUGH A FINAL-CUT STRIP MINE PIT: BENTHIC MACROINVERTEBRATES,
Argonne National Lab., IL.
W. S. Vinikour.
Hydrobiologia, Vol 75, No 1, p 33-43, October 4, 1980. 1 Fig, 7 Tab, 47 Ref.

Descriptors: *Macroinvertebrates, *Diversion, *Stream biota, Land reclamation, Lakes, *Goose Creek, *Wyoming, Benthic fauna, Streams, Mayflies, Midges, Tubificids, Coal mining, Aquatic life, Benthos, Strip mine lakes, Water quality.

Rerouting Goose Creek near Sheridan, Wyoming, through a final-cut strip mine pit (650 meters x 350 meters at the widest) to reach the coal reserves beneath the stream bed disrupted the normal riffle/pool sequence, forming a lake-type habitat. A study of the macrobenthos in the pit revealed a change from dominance by net-spinning hydropsychids and mayflies to dominance by tubificid worms (Limnodrilus hoffmeisteri) and midge larvae (Chironomus sp., Procladius sp., and Tanypus stellatus). A few other insects which drifted in from the creek were found in the upstream portion of the pit. None occurred in the downstream portion because of fish predation or unfavorable habitat. The pit, which receives sewage effluent and agricultural runoff, helps to improve water quality. The water leaving the pit has lower diurnal oxygen sags, ammonia-N concentrations, and fecal coliform levels than the entering water. (Cassar-FRC)
W82-01948

STREAMLINED REGULATIONS COULD HELP MAKE NEW STORMWATER MANAGEMENT CONCEPTS PART OF THE TRADITION,
C. R. Curtis, and R. C. Hinde.
Water and Pollution Control, Vol 119, No 8/9, p 22-23, 37, August/September, 1981. 2 Fig, 13 Ref.

Descriptors: *Storm water, *Water managment, Legal aspects, Regulations, Administrative regulations, Decision making, Computer models, Model studies, *Flood control, *Toronto.

Shortly after Hurricane Hazel reached the Metropolitan Toronto area in 1954 the Metropolitan Toronto and Region Conservation Authority was formed with the aim of acting as a strong, constructive force for flood control, to protect people and property from flooding. By 1971 an ambitious program of problem identification, analysis, and implementation had begun. Stormwater quality problems were identified and the basic data was gathered from observations at test catchments. Analytical numeric tools were developed to model both quality and quantity of stormwater. The most significant computer program resulting from this research was a version of the Storm Water Management Model, modified for Canadian conditions: CANSWMM. While the analytical techniques were being developed, training seminars for the people who would be involved in stormwater management modeling proceeded. Various computer models were explained. Some municipalities prepared Storm Drainage Criteria Manuals as guides for the development within their bounds. Local conservation implementation of stormwater management is often complicated by existing legislation and common law, as well as by government policy. The rights and obligations of municipalities and landowners must be considered in the design and implementation of any stormwater management scheme. Overlapping of jurisdictions is also a problem in legislation affecting stormwater management. It is hoped that the legal, procedural, and policy problems will soon be resolved so that stormwater management can move ahead. (Baker-FRC)
W82-02000

THE DAY THAT THE RAIN CAME DOWN,
For primary bibliographic entry see Field 2E.
W82-02064

4B. Groundwater Management

OPERATING POLICIES FOR A SURFACE/GROUND WATER SYSTEM,
Birmingham Univ. (England). Dept. of Civil Engineering.
K. R. Rushton, and L. M. Tomlinson.
Water Resources Bulletin, Vol 17, No 3, p 406-413, June, 1981. 5 Fig, 4 Tab, 20 Ref.

Descriptors: *Safe yield, *Conjunctive use, *Reservoir operation, *Groundwater management, Carbonate aquifers, Transmissivity, Groundwater recharge, Recharge, Springs, Simulation analysis, Lincolnshire Limestone aquifer, *England.

Conjunctive use of a hypothetical surface reservoir, storage volume 20,000 megaliters, and the Lincolnshire Limestone aquifer in eastern England was simulated. In this aquifer water enters in the outcrop region and flows toward the confined aquifer in which the wells are located. Storage coefficients and transmissivities vary widely in different sections. Fissures developed by solution permit excess water to flow from springs. Five alternative operating policies were considered for the period 1961-77. Greatest safe yield (or maximum constant yield) was 123 megaliters per day (22,600 gal per min), using combined control rules for reservoir and aquifer by a combined simulation. Other options produced safe yields of 84 to 118 megaliters per day. Extending the 17 year data to 100 years gave a maximum safe yield of 120 megaliters per day. Excluding the critical dry year, 1976, simulations showed a maximum yield of 162 megaliters per day. This illustrates that the method is very sensitive in input. (Cassar-FRC)
W82-01741

4C. Effects On Water Of Man's Non-Water Activities

LONG TERM RESPONSES OF STREAMFLOW FOLLOWING CLEARCUTTING AND REGROWTH,
Southeastern Forest Experiment Station, Asheville, NC. Coweeta Hydrologic Lab.
L. W. Swift, Jr., and W. T. Swank.

Hydrological Sciences Bulletin, Vol 26, No 3, p 245-256, September, 1981. 2 Fig, 4 Tab, 13 Ref.

Descriptors: *Stream discharge, *Forest management, *Clear-cutting, Cutting management, Forest watersheds, Forestry, Forests, Revegetation, Reforestation, Vegetation establishment, Runoff, Streamflow, North Carolina, Experimental basins.

Three experimental basins were maintained at Coweeta Hydrologic Lab in western North Carolina. Two basins were totally clearcut without removal of forest products - one of them twice, while the third was a forest management demonstration and received a mix of thinning, clearcutting, and noncutting. Changes in streamflow immediately after cutting and as the forest regrew are reported and related to variations in vegetation, climate and basin elevation. The results of the study clearly indicated that streamflow from mountain basins increases when the forest is cut, and that these increases decline as the vegetation regrows. The data from the study allow closer examination of the factors influencing the trend line equations fitted to streamflow increases. Vegetative regrowth is the dominant change occurring after the forest is cut on a basin and thus is the prime determinant of the trend lines for the Coweeta experiments. The most significant finding was that the slopes of the trend lines were essentially identical for all cases, despite the fact that these experiments involved different sets of years, different degrees of cutting, and basins with distinctly different physiography and elevation. Climatic variation was the most likely cause for departures of streamflow increases from the smooth trend line. The mixed hardwood forest of one basin was clearcut twice in the past 40 years. During the second regrowth period, streamflow increased after the first year at about one half the increases at the same points in time after the first treatment. Variability of flow seemed partly related to precipitation. (Baker-FRC)
W82-01610

HYDROLOGY OF OKARITO LAGOON AND THE INFERRED EFFECTS OF SELECTIVE LOGGING IN OKARITO FOREST,
Forest Research Inst., Christchurch (New Zealand).
J. M. Macpherson.
New Zealand Journal of Marine and Freshwater Research, Vol 15, No 1, p 25-39, 1981. 11 Fig, 14 Ref.

Descriptors: *Logging, *Suspended sediment, *Diversion, *Estuaries, Rivers, Lagoons, Ecological effects, Hydrology, Hydrologic budget, Okarito Lagoon, *New Zealand.

The relative impact of selective logging and the Waitangi-taona River diversion on Okarito Lagoon were assessed. The hydrology of the 20 sq km estuary was determined. The diversion of the Waitangi-taona River in 1967 may be responsible for the fact that the surface sediment was consistently muddier than the subsurface sediment. Most sediment is supplied by river or erosion of tidal channel margins. Freshwater inflows into the lagoon vary from less than 11 cu m/sec to more than 750 cu m/sec during storms. When the estimated yield and water inflow effects of the 1967 river diversion are compared with the short-term effects of selective logging, the effects of logging on sediment yield, water balance, and dissolved solids inputs should be small. If there are future studies of the ecological impact of physical changes in the lagoon and its catchment, the 1967 diversion should receive the most attention. (Small-FRC)
W82-01703

THE EFFECTS OF MAN ON BASIN RUNOFF, AND ON THE WATER BALANCE AND WATER STAGE OF THE CASPIAN SEA,
Gosudarstvennyi Gidrologicheskii Inst., Leningrad (USSR).
I. A. Shiklomanov.
Hydrological Science Bulletin, Vol 26, No 3, p 321-328, September, 1981. 4 Fig, 1 Tab, 3 Ref.

Descriptors: *Basin irrigation, *Hydrologic budget, Water demand, Water supply, Irrigation effects, Environmental effects, *Caspian Sea, Rivers, Runoff, *Water level fluctuations, *Sea level.

An assessment of the role of man's activities on governing the changes in inflows and sea stage was made to begin to ascertain the measures needed to solve the problems of the Caspian Sea. The main rivers flowing into the Sea are the Volga, Ural, Kura, Terek, Sulak, and Samur. The principal effects of man in the basins of these rivers from the point of view of runoff include construction and operation of reservoirs, irrigation, agrotechnical measures, and industrial and municipal water consumption. Investigations of long-term runoff fluctuations based on data from hydrometeorological sites were made, together with an analysis of changes in natural meteorological factors and the development of economic activity in the basins. Water balance estimations were also made, based on the study of water balance components in basin sub-areas where changes in evaporation and flow formation conditions occur due to man's activity. According to the data analyzed, the regime of surface inflow into the sea was practically natural until 1940, when a man-induced reduction of inflow occurred, amounting to 6.3 cubic kilometers/year, or 2.2% of the natural surface inflow. At present the inflow reduction is 38 cubic kilometers per year, or 13%. It appears in the future that this reduction will increase to 65-70 cubic kilometers per year, or 23% of the natural inflow. During 1955-1973 the construction and operation of reservoirs was the main problem. Now irrigation demands play the major role. By the end of this century, two-thirds of the reduction in total runoff to the sea will result from irrigation, due to the area of the basin being irrigated. If climatic conditions are average and if the effects of man's activities continue, the sea level is expected to decrease gradually to 29.5 meters above mean sea level by the end of this century. (Baker-FRC)
W82-01709

4D. Watershed Protection

RECONSTRUCTION OF A SMALL DAM FOR A RECREATIONAL LAKE.
Public Works, Vol 112, No 9, p 113-115, September, 1981. 5 Fig.

Descriptors: *Lakes, *Recreation facilities, Swamps, Erosion, Dams, Earth dams, Construction, Dam construction, Construction methods, Economic aspects, Management, *Erosion control, *Lake Lucerne, *New Jersey.

In Old Bridge Township, New Jersey, deterioration of a small dam on Lake Lucerne was resulting in increased sediment washing into the lake, and the resultant loss of the lake to the people for recreational purposes. Money was taken from a housing and community development grant to rehabilitate the dam and the surrounding 36.7 acres of woodland and marshland. Initially the design for the dam called for an elaborate concrete structure with a spillway. However, preliminary estimates indicated that the cost of such a structure would far exceed available monies. The final plan called for the establishment of a concrete wall of the dam and the placing of the outlet pipe in such a position as to allow increased fish and other aquatic life, which would then in turn take care of the mosquito problem. Local public works and recreation departments removed debris that had accumulated in parts of the lake over the years, including shopping carts, tires, boards and bottles. Several area residents were directed to clean up their properties which bordered the lake. The bottom of the lake was dredged to remove organic material and accumulated debris. The preconstruction meeting was held in April, 1980, and construction began in the latter part of the month. To reduce erosion, large riprap stone was placed on the sides of the spillway and on the downstream side at the pipe outlet. The stone was placed on top of a wire mesh and grouted. To provide access to the land around the lake the embankment over the outlet pipe was constructed 12 feet wide. Future work includes the construction of a foot bridge. The lake will remain a low-key recreational area open to area residents for nonpowered boating, fishing, hiking, bird-watching, and photography. (Baker-FRC)
W82-01604

HYDRAULIC TESTING OF PLASTIC FILTER FABRICS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8G.
W82-01613

KINEMATIC FLOW APPROXIMATION OF RUNOFF ON A PLANE: AN EXACT ANALYTICAL SOLUTION,
Griffith Univ., Brisbane, Queensland (Australia). School of Australian Environmental Studies.
For primary bibliographic entry see Field 2A.
W82-01617

EROSION AND SEDIMENT CONTROL IN CHINA'S YELLOW RIVER BASIN,
A. R. Robinson.
Journal of Soil and Water Conservation, Vol 36, No 3, p 125-127, May/June, 1981. 1 Tab, 6 Ref.

Descriptors: *Fluvial sediments, *China, *Erosion control, *Terracing, *Diversion structures, Sedimentation, Sluices, Erosion, Accelerated erosion, Slope degradation, Loess, Check dams, Penstocks, Gully erosion, Gullies, Irrigation water, *Yellow River basin.

The Yellow River of China carries the largest sediment load of any river in the world, causing a soil loss of 12 tons/acre/year over the river's entire watershed. The loess plateau which constitutes about 60% of the Yellow River watershed has become heavily populated and farmed. About one-third of the soil of this area had been destroyed or badly damaged by erosion. Large gullies have been cut in the loess plateau and in some areas annual soil loss averages 45 tons/acre. About 10 to 40% of the precipitation runs off the heavily gullied land. The Sanmen Gorge Dam built on the Yellow River in 1960 has been plagued by sedimentation problems. In 1962, the Chinese began sluicing through the dam to reduce sediment deposition within the reservoir. In 1965, diversion tunnels were opened, and penstocks were converted to sluiceways. In 1970, additional diversion outlets were opened, and power generation was reduced to a third of that originally planned. Terracing and vegetative coverings are used to reduce erosion in the loess areas. Check dams or gully plugs help to contain runoff and sediment in gullies. Diverted flows laden with sediment are used for irrigation, and warping, a process of improving sandy soil, is practiced to increase farmland acreage. Great sediment loads in the middle and lower Yellow River continue to create challenging problems for water storage and the maintenance of reservoirs. (Geiger-FRC)
W82-01729

IMPRESSIONS OF SOIL AND WATER CONSERVATION IN CHINA,
Soil Conservation Service, Washington, DC.
P. M. Howard.
Journal of Soil and Water Conservation, Vol 36, No 3, p 122-124, May/June, 1981.

Descriptors: *Soil erosion, *China, *Water resources development, *Water supply development, *Irrigation water, Natural resources, *Soil conservation, Soil stabilization, Water reuse, Water use, Fertilizers, Irrigation, Irrigation practices, Water management, Water conservation.

Soil and water conservation practice in the People's Republic of China is going through a transition. Part of this change stems from modernization of land and farm management practices which call for more irrigation water. China also gives high priority to the use of water for navigation and has stepped up measures to improve drainage and control flooding. Although China has vast water resources, many rivers are not located near irrigable land, and their high sediment contents often cause flooding. During the last 30 years, many physical

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structures have been built to help alleviate some of the problems. More work is needed on water reuse and spills. The rich sediment deposits of the Yellow River have been used for farmland. Until watershed erosion is controlled, the use of reservoirs for reducing flood peaks and trapping sediment will be limited. Mechanical parts are rapidly worn by the high sediment content of the water. Several critical sites along the Yellow River have been targeted for major erosion control programs. Revegetation has aided eroded areas that were destroyed by the rapid harvesting of forests. More collaboration between and research from national government, local government and academic organizations on erosion problems is needed. Human waste is often applied to vegetable crops grown near the cities; animal manure is composted with other organic materials and applied to mostly rice and cotton crops. Chemical fertilizers are being used increasingly where available. More progress in the better use of natural resources in China is expected through exchange of information with other countries. (Geiger-FRC)
W82-01730

CROP RESIDUE REMOVAL AND TILLAGE; EFFECTS ON SOIL EROSION AND NUTRIENT LOSS IN THE CORN BELT,
Science and Education Administration, Morris, MN. North Central Soil Conservation Research Lab.
For primary bibliographic entry see Field 2J.
W82-01770

THE LAKE TAHOE BASIN: A SYSTEMS ANALYSIS OF ITS CHARACTERISTICS AND HUMAN CARRYING CAPACITY,
Energy Policy Studies, Inc., Omaha.
For primary bibliographic entry see Field 6A.
W82-01807

EVALUATING SCOUR AT CULVERT OUTLETS,
Colorado State Univ., Fort Collins. Engineering Research Center.
J. F. Ruff, and S. R. Abt.
Transportation Research Record, No 785, p 37-40, 1980. 6 Fig, 3 Ref.

Descriptors: *Culverts, *Scour, *Erosion, Conduits, Sand, Gravel, Soil erosion, Energy dissipation, Channel scour, Conveyance structures, Design criteria, Erosion control.

The scour characteristics of uniform, noncohesive bed materials were studied in laboratory flumes. Two flume sizes were used: 6.1 m wide x 2.4 m deep x 30.5 m long and 1.2 m wide x 0.9 m deep x 4.6 m long. Test culverts were 100, 254, 356, and 457 mm in diameter. Scour holes in sand and gravel were similar in appearance. After 31 min the gravel scour hole was 85-90% of the full depth reached at 316 min and the sand scour hole was 80% of the depth reached at 316 min. The equations presented offer a refinement of existing methods for estimating the depth, length, width, and volume of scour holes. When culvert diameter, design discharge, and median diameter of the channel bed uniform material are known, the equations may be used to determine scour hole characteristics and to evaluate alternative scour protection methods and energy of dissipators. (Cassar-FRC)
W82-01934

AGRICULTURAL CONSERVATION PROGRAM: AN EVALUATION,
Agricultural Stabilization and Conservation Service, Washington, DC.
For primary bibliographic entry see Field 3F.
W82-02019

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

PLANNING WITH GREAT UNCERTAINTY: A REVIEW AND CASE STUDY OF THE SAFE DRINKING WATER CONTROVERSY,
Livingston Coll., New Brunswick, NJ. Dept. of Urban Studies.
M. R. Greenberg, and G. W. Page.
Socio-Economic Planning Sciences, Vol 15, No 2, p 65-74, 1981. 4 Tab, 59 Ref.

Descriptors: *Water pollution effects, *Public health, *Epidemiology, *Drinking water, New Jersey, Potable water, Chemical wastes, Organic compounds, Toxicity, Human population, Environmental policy, Future planning, Political aspects, Mortality, *Water treatment.

The monitoring of drinking water for toxic substances, especially organic pollutants, and the assessment of their risk to human health have become controversial environmental planning issues in the United States since 1974, when it was announced that people from Lousiana suffered high cancer risks from drinking Mississippi River water containing organic chemicals. A review is presented of the chemical contamination of potable water suppliesin the United States. The relation of polluted waters to the incidence of cancer is explored, and special attention is given to New Jersey, which has the highest rates of cancer mortality of any state in the country. When the US EPA carcinogenic potential coefficients were extrapolated to New Jersey potable water data, only 26 of 700 toxic chemicals found in United States water supplies were identified. Since relatively few suppliers provide most of the water supply of this state, the samples would have to be weighed by source and population in order to produce any significant relation to increased cancer risks. Improved monitoring of potable water supplies and more sophisticated epidemiological studies are needed to effectively solve environmental planning issues and decide on actions to safeguard public health. (Geiger-FRC)
W82-01606

RAPID, QUANTITATIVE SEPARATION OF CHLOROPHYLLS AND THEIR DEGRADATION PRODUCTS BY HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY,
Brookhaven National Lab., Upton, NY. Dept. of Energy and Environment.
P. G. Falkowski, and J. Sucher.
Journal of Chromatography, Vol 213, No 2, p 349-351, August, 1981. 2 Fig, 11 Ref.

Descriptors: *Water analysis, *Chlorophyll, Measuring instruments, Chromatography, Sediments, Chlorophyll a.

A high-pressure liquid chromatographic system is described for the determination of the major chlorophylls and their degradation products, including chlorophyll a, b, and c, chlorophyllide a, phaeophorbide a, and phaeophytins a and b. For extraction of field samples, 100 to 200 ml sea water were filtered on 25 mm glass-fiber filters. The filters were ground in a tissue grinder with 2 ml of absolute methanol and brie filtered through a glass-fiber filter into a graduated centrifuge tube. The ground glass filters were reextracted on the filter manifold with an additional 1 ml of methanol. A 25-microliter volume of pooled pigment extracts was applied to the HPLC column for analysis. A two-step solvent program was used to resolve chlorophyll c from chlorophyllide a and phaeophorbide a and at the same time allow phaeophytin a to elute in a reasonable time. Methanol-water (90:10) was applied until phaeophorbide a was eluted, followed by methanol-water (98:2). Solvent delivery was automatically programmed with a single-step solenoid valve. The major chlorophylls and the degradation products were separated in 18 minutes. Less than 0.1 pmole of chlorophyll a can be detected by this procedure. This method should serve as a supplement to the simple fluorometric method. For general water analysis, the simple fluorometric method is rapid and precise. For some applications, however, significant artifacts prevent its use alone, for example in the analysis of sediment samples rich in humic and other organic acids. (Baker-FRC)
W82-01619

A SELECTIVE MEDIUM FOR THE ENUMERATION OF STREPTOCOCCUS BOVIS BY MEMBRANE FILTRATION,
Leeds Univ. (England). Dept. of Civil Engineering.
J. I. Oragui, and D. D. Mara.
Journal of Applied Bacteriology, Vol 51, No 1, p 85-93, August, 1981. 4 Tab, 33 Ref.

Descriptors: *Culture media, *Bioindicators, *Streptococcus bovis, *Animal wastes, *Pollutant identification, Microbiological studies, Membrane filters, Agar, Ammonium sulfate, Indicators, Farm wastes, Sewage bacteria, Bacteria, Water analysis.

A new selective medium for the determination and enumeration of Streptococcus bovis was developed for bacterial examination of water and sewage samples. This organism is the predominant fecal streptococcus in farm animals and is relatively rare in humans. Thus it can serve as an indicator of pollution from animal wastes. The membrane-bovis agar medium uses the ability of S. bovis to use ammonium sulfate as its sole nitrogen source as an identifying characteristic. In this medium other common water, sewage, and fecal bacteria are completely inhibited, except for one streptococcus strain associated with pigs. Of 541 colonies isolated from feces, sewage, and stream water, 97% were S. bovis. (Cassar-FRC)
W82-01620

MATACIL RESIDUE DETERMINATION IN FOLIAGE, FISH, SOIL AND WATER,
Mobay Chemical Corp., Kansas City, MO. Div. of Agricultural Chemicals.
C. W. Stanley, and L. M. Delphia.
Journal of Agricultural and Food Chemistry, Vol 29, No 5, p 1038-1039, September-October, 1981. 2 Tab, 5 Ref.

Descriptors: *Matacil, *Pesticide residues, *Gas chromatography, Water analysis, Soil analysis, Insecticides, Separation techniques, Pesticides, Pollutants, Fish, Leaves, Forest soils, Forests, Litter, *Pollutant identification.

A technique is described for detecting the insecticide, Matacil, in foliage, fish, soil, and water without the use of a moisture-sensitive reagent for derivatization. After extraction into 1,2-dichloroethane-methanol, the Matacil was cleaned up by partitioning between organic and aqueous solutions. The sample was derivatized with 1-fluoro-2,4-dinitrobenzene and detected by gas chromatography. Recoveries of the insecticide from fish, foliage and soil fortified with 0.05 ppm Matacil and from water fortified with 0.01 and 0.005 ppm Matacil ranged from 68 to 127%. The lower limit of detection was below 0.001 ppm for water and below 0.01 ppm for fish, foliage and soil. When the present technique is used, the temperature at which the derivatization of Matacil is carried out is not critical, and the resultant derivative is stable. (Geiger-FRC)
W82-01621

SURVIVAL OF ENTEROVIRUSES ADSORBED ON GLASS MICROFIBERS DURING POSTAL TRANSPORT (SURVIE DE VIRUS ENTERIQUES ADSORBES SUR MICROFIBRE DE VERRE AU COURS D'UN TRANSPORT POSTAL),
Nancy-l Univ. (France). Lab. d'Hygiene et de Recherche de la Sante Publique.
J. C. Joret, and J. C. Block.
Canadian Journal of Microbiology, Vol 27, No 2, p 246-248, February, 1981. 2 Tab, 8 Ref.

Descriptors: *Viruses, *Sample preservation, *Water analysis, *Wastewater analysis, Pollutant

identification, *Enteroviruses, Sewage viruses, Poliovirus.

The survival of two enteroviruses was determined after adsorption on glass microfiber filters, 8 micrometers x 60 mm length. Recovery rates for poliovirus type 1, Mahoney strain, were 65 + or - 20% upon immediate elution from the filters and 40 + or - 7% after postal transport at ambient temperatures. Indigenous wastewater viruses showed 100% recovery upon immediate elution, 59% after postal transport at ambient temperatures, and 65% after postal transport at freezing temperatures. Recovery rates were considered satisfactory enough to justify postal shipment of samples for qualitative determination of enteroviruses in water. (Cassar-FRC)
W82-01637

CHARACTERIZATION OF AN ENZYMATIC DETERMINATION OF ARSENIC(V) BASED ON RESPONSE SURFACE METHODOLOGY,
South Carolina Univ., Columbia. Dept. of Chemistry.
R. J. Matthews, S. R. Goode, and S. L. Morgan.
Analytica Chimica Acta, Vol 133, No 2, p 169-182, May 1, 1981. 9 Fig, 4 Tab, 29 Ref. OWRT-B-121-SC(1).

Descriptors: *Arsenic, *Water analysis, Chemical analysis, Enzymes, Pollutant identification.

The use of response surface methodology in developing a method for the enzymatic analysis of arsenic in water is described. A Box-Behnken three-level fractional factorial experimental design was used to characterize the reaction-rate response surface as a function of five experimental factors. Interpretation of the results of regression analysis provides an operational description of the analytical method as well as information that can be correlated with the mechanism of the chemical reaction. The initial simplex optimization produced improved reaction rate response and located a region of near-stationary response. This region, in which further response surface experiments were performed, has been shown to be fairly insensitive to changes in the experimental factors. The characterization of the reaction rate response in this region has facilitated an understanding of the factor effects and interactions that can be correlated with fundamental chemical knowledge to produce an analysis resistant to the effects of uncontrolled changes in experimental factors. (Baker-FRC)
W82-01656

SEDIMENT BACTERIAL INDICATORS IN AN URBAN SHELLFISHING SUBSTUARY OF THE LOWER CHESAPEAKE BAY,
Old Dominion Univ., Norfolk, VA. Dept. of Biological Sciences.
C. W. Erkenbrecher, Jr.
Applied and Environmental Microbiology, Vol 42, No 3, p 484-492, September, 1981. 6 Fig, 2 Tab, 41 Ref. OWRT-A-080-VA(2).

Descriptors: *Bacteria, *Sediments, *Estuaries, Water pollution effects, Shellfish, Coliforms, Feces, Public health, *Chesapeake Bay, Bacterial analysis, Path of pollutants.

The spatial and temporal distributions and compositions of bacteria in sediments and overlying waters in an urban shellfishing area of the lower Chesapeake Bay region, the Lynnhaven Estuary, were determined. Samples were collected in triplicate at least bimonthly from 11 sites. Bacterial analyses and physiochemical analyses were performed on water and sediment samples. The data showed marked fluctuations in the physiocochemical parameters and the indicator bacteria (total and fecal coliforms and fecal streptococci). The inlet site, which had higher water salinity and coarser sediment, had lower overall bacterial desnities than did the headwater sites. Sediment bacterial counts were higher than bacterial counts of the overlying waters. The counts were above the safe limits for shellfish-growing waters and indicated that the system was fecally polluted. Urban and agricultural runoff were the primary sources of pollution, although failed septic tank systems were also thought to contribute to the problem. Thus, sediments seemed to be a reservoir for high densities of indicator bacteria and could pose a health problem. (Small-FRC)
W82-01661

APPLICATIONS OF STRIPPING ANALYSIS TO METAL DETERMINATIONS IN NATURAL WATERS,
Colorado State Univ., Fort Collins. Dept. of Chemistry.
For primary bibliographic entry see Field 1A.
W82-01670

GEOGRAPHIC VARIATIONS IN WATER QUALITY AND RECREATIONAL USE ALONG THE UPPER WALLOWA RIVER AND SELECTED TRIBUTARIES,
Oregon State Univ., Corvallis. Dept. of Geography.
T. R. McDowell.
PhD Thesis, 1980. 235 p, 37 Fig, 19 Tab, 93 Ref, 2 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-13668.

Descriptors: *Water quality, *Baseline studies, *Spatial distribution, *Oregon, Rivers, Water pollution, Recreation, Bacteria, Freshwater, Wallowa River basin, Fecal matter.

This study was designed to examine geographic variations in water quality and recreational use along the upper Wallowa River and selected tributaries in the Wallawa Mountains, an area of concentrated and dispersed wilderness recreation. Analysis conducted during the baseline study revealed that waters in the area drained by the upper Wallowa River were physically and chemically quite pure; however, there were notable temporal and spatial variations in the physical and chemical characteristics of the area's streams. It was concluded that waters upstream from Wallowa Lake are generally nutrient-poor. Nutrient concentrations vary seasonally with hydrological conditions and biological activity, and geographically with differences in watershed lithology. Bacterial water quality based on fecal coliform counts varies significantly between sites and with geographical patterns of recreational use. Bacterial water quality also varies significantly with background environmental conditions (habitats). Bacterial water quality is closely correlated with precipitation events in the middle and lower portions of the study area, but not in the headwaters where sources of fecal contamination are relatively absent. Levels of fecal coliform bacteria in streams outside the alpine zone frequently exceed acceptable limits established for total coliforms in public drinking water; however, no standards exist for unprotected water sources. (Sinha-OEIS)
W82-01681

RANDOM DIFFERENTIAL EQUATIONS IN WATER QUALITY MODELING,
Utah State Univ., Logan.
For primary bibliographic entry see Field 6A.
W82-01688

REVERSE PHASE CONCENTRATION OF TRACE POLYCYCLIC AROMATIC HYDROCARBONS IN WATER,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
D. G. Marsh.
PhD Dissertation, 1980. 182 p, 48 Fig, 33 Tab, 117 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX81-10468.

Descriptors: *Chemical analysis, *Aromatic compounds, *Water pollution, Pollutant identification, Oil pollution, Chromatography, Polycyclic aromatic hydrocarbons(PAHs), Trace levels.

The determination of polycyclic aromatic hydrocarbons (PAHs) has been accomplished in a wide variety of matrixes. The analysis of water samples for trace levels of PAHs has typically been accomplished by cumbersome multiple extraction techniques. An examination of the phenomenon of trace concentration of PAHs was chosen as the experimental emphasis. The retention behavior of the PAHs, their fluorescence spectra, and a fluorescence normalization procedure are presented. The use of spectrofluorometry to separate chromatographically unresolved peaks was examined. Frontal and elution chromatography were compared, and the elution technique was used to predict frontal retention behavior of PAHs in pure water. The relation between mobile phase strength and reverse phase PAH elution retention at low organic mobile phase concentration was examined. The retention characteristics of concentrator columns were predicted based on correlations to known liquid chromatography approaches. The effects of a variety of concentrator columns on the concentrate analysis was examined. Concentrator column packing, type and concentrator column inner diameter were varied and optimum conclusions were obtained. The optimum system was selected and used to analyze highly polluted Virginia Tech Duck Pond water which was spiked with PAHs at the ppt level. (Sinha-OEIS)
W82-01689

TOXIC SUBSTANCES IN WATER: PATTERNS OF CONTAMINATION AND POLICY IMPLICATIONS,
Rutgers - the State Univ., New Brunswick, NJ.
G. W. Page, III.
PhD Thesis, 1980. 294 p, 8 Fig, 31 Tab, 138 Ref, 5 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-22576.

Descriptors: *Water pollution, *Groundwater, *Surface waters, *Toxicity, Public health, *New Jersey, Surface-groundwater relations, Comparison studies, Case studies, Public policy.

Public policy designed to protect public health from the dangers of water supplies contaminated with toxic substances is discussed with particular attention to policy which treats ground water less stringently than surface water in monitoring and treating water for toxic substances. The central research question addressed in this dissertation is how the contamination of ground water with toxic substances compares to the contamination of surface water with toxic substances in New Jersey. The data used include 692 ground water samples and 320 surface water samples collected throughout New Jersey. The method of determining the relative contamination of ground water and surface water by toxic substances is a set of three analyses. These analyses are repeated for several subsets of the data. The results are remarkably consistent for each of the three analyses for every subset of the data. A comparison of the patterns of toxic substances contamination identified by factor analysis in the ground water and the surface water data sets reveals that these patterns of contamination are very highly correlated between the two data sets. Case studies of two municipalities in Middlesex County, New Jersey are presented. The experiences of these two municipalities are compared and contrasted and used to examine the policy implications of toxic substances contamination of water supplies. (Sinha-OEIS)
W82-01695

HEALTH ASPECTS OF ORGANIC SUBSTANCES IN SOUTH AFRICAN WATERS - OPINIONS AND REALITIES,
National Inst. for Water Research, Pretoria (South Africa).
J. F. J. Van Rensburg.
Water SA, Vol 7, No 3, p 139-149, July, 1981. 3 Fig, 7 tab, 22 Ref.

Descriptors: *Drinking water, *Organic compounds, *Carcinogens, Public health, Water quality standards, Water analysis, Water quality management, *Literature review, *South Africa.

A literature review is presented of available information on the determination of permissible concentrations of organic micro-pollutants in potable water in an attempt to propose guidelines for South African water quality standards. Progress in the United States and Europe is summarized. A

relatively inexpensive and simple method of expressing and evaluating the possible health hazard of organic pollution is the OPI (organic pollution index) and related analytical methods. Water supplies exceeding OPI limits could be referred to sophisticated laboratories for detailed analysis. The water supplies that have been investigated in South Africa have not presented a health hazard due to volatile organic micropollutants except for a few locations including the Vaal River below the Barrage. More advanced analytical techniques are needed for non-volatile organic matter in water. When tests indicate the presence of mutagens in potable water, more sophisticated investigations, in this case chemical techniques, should be performed. (Small-FRC)
W82-01712

DISTRIBUTION OF VIBRIO PARAHAEMOLYTICUS IN FINFISH HARVESTED FROM PORTO NOVO (S. INDIA) ENVIRONS: A SEASONAL STUDY,
Center of Advanced Study in Marine Biology, Porto Novo (India).
G. B. Nair, M. Abraham, and R. Natarajan.
Canadian Journal of Microbiology, Vol 26, No 11, p 1264-1269, 1980. 3 Fig, 3 Tab, 31 Ref.

Descriptors: *Vibrio parahaemolyticus, *Bacteria, *Fish, Fate of pollutants, Pollutant identification, Pathogens, Porto Novo, *India, Bay of Bengal.

The pathogenic bacterium, Vibrio parahaemolyticus, was isolated from fish samples collected at five locales in the Porto Novo, India, region as follows: estuary, 35.6%; mangroves, 40.6%; Bay of Bengal, 3.9%; landing site, 46.8%; and fish market, 40.6%; average of all locales, 36.8%. Highest levels of bacteria were found in July and August in the mangroves and in April in the other locales. Mullets had the highest isolation rates, 56.3%. Fish become contaminated at the market through sprinkling with estuarine water and lack of refrigeration. (Cassar-FRC)
W82-01737

ORGANIC SUBSTANCES IN WATER,
Geological Survey, Reston, VA. Water Resources Div.
Available from the Branch of Dist., USGS, 604 S. Pickett St., Alexandria, VA 22304. Geological Survey Circular 848-C, 1981. 19 p, 3 Fig, 2 Tab, 13 Ref. (Edited by Greeson, P. E.).

Descriptors: *Water quality, *Organic compounds, *Environmental effects. *Pollutant identification, Taste, Odors, Classification, Solutes, Natural waters.

This is the third of several compilations of briefing papers on water quality by the U.S. Geological Survey. Each briefing paper is prepared in a simple, nontechnical, easy-to-understand manner. This U.S. Geological Survey Circular contains papers on selected organic substances in water. Briefing papers are included on 'Why study organic substances in water.', 'Taste and odor in water', and 'Classification and fractionation of organic solutes in natural waters'. (USGS)
W82-01783

INFECTIOUS WATERBORNE DISEASES,
Geological Survey, Reston, VA. Water Resources Div.
P. E. Greeson.
Available from the Branch of Dist., USGS, 604 S. Pickett St., Alexandria, VA 22304. Geological Survey Circular 848-D, 1981. 16 p, 8 Fig, 2 Tab, 90 Ref.

Descriptors: *Water quality, *Water pollution effects, *Pollutant identification, *Infection, *Diseases, Bacteria, Viruses, Parasites, Contamination, Drinking water, Waterborne diseases.

This is the fourth in a series of briefing papers on water quality prepared by the U.S. Geological Survey. Each briefing paper is prepared in a simple, nontechnical, easy-to-understand manner. This U.S. Geological Survey Circular contains a paper on; Infectious waterborne diseases', which discusses 36 infectious diseases of man than can be or are strongly suspected of being transmitted by water. Of the 36 diseases, 12 are caused by bacteria, 4 are caused by viruses, 19 are caused by parasites, and 1 has numerous infectious agents. (USGS)
W82-01784

MICROBIOLOGY OF THE AQUATIC ENVIRONMENT,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5C.
W82-01786

COMPARISON OF LIQUID-LIQUID EXTRACTION AND RESIN ADSORPTION FOR CONCENTRATING MUTAGENS IN AMES SALMONELLA/MICROSOME ASSAYS ON WATER,
National Inst. for Water Research, Pretoria (South Africa).
W. O. K. Grabow, J. S. Burger, and C. A. Hilner.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 4, p 442-449, October, 1981. 4 Tab, 14 Ref.

Descriptors: *Salmonella, *Bioassay, *Mutagens, Microorganisms, Contaminants, Potable water, Wastewater, Rivers, Vaal River, Drinking water, *South Africa.

Mutagen recovery from different waters was compared using dichloromethane (DCM) liquid-liquid extraction and adsorption on Amberlite XAD resins, techniques often employed for recovery of mutagens from water. Grab samples were collected from the final product of a multiple-barrier wastewater reclamation plant, from laboratory tap water representing a potable water supply prepared mainly from surface water, and from the Vaal River at points about 50 meters below the barrage, 20 meters below the influent of a wastewater effluent from Sasolburg, and 1 kilometer below the inflow point of a wastewater effluent from Vanderbijlpark. The mutagenicity ratio (MR) values for concentrates of the four Vaal River samples showed that DCM extraction yielded the highest mutagenic activity for two samples, and XAD-2 adsorption for one. DCM extracts had the highest mutagenic activity for two samples, and XAD-2 concentrates for three of the ten samples of reclaimed water. DCM extracts had the highest MR value for 11 and XAD-2 concentrates for two of the 15 tap water samples. Mutagenic activity was detected in DCM extracts of all 15 tap water samples, while XAD concentrates of two samples failed to show mutagenic activity at all. Dose-response tests were conducted on nine tap water samples. At least 14 of the 18 DCM extracts had higher MR values for dimethyl sulfoxide dilutions than for the original extract. In the case of XAD-2 this was noted for only one of the nine concentrates. Although this study shows that DCM liquid-liquid extraction is superior to XAD adsorption for concentrating mutagens from a variety of waters, it indicates that both methods have their limitations. (Baker-FRC)
W82-01812

GAUZE FILTRATION AND ENRICHMENT PROCEDURES FOR RECOVERY OF VIBRIO CHOLERAE FROM CONTAMINATED WATERS,
John Hopkins Univ., Baltimore, MD. Div. of Geographic Medicine.
W. M. Spira, and Q. S. Ahmed.
Applied and Environmental Microbiology, Vol 42, No 4, p 730-733, October, 1981. 3 Fig, 1 Tab, 8 Ref.

Descriptors: *Filtration, *Vibrio, Bacteria, Public health, Epidemics, Water analysis, Enrichment, Pollutants, Human diseases, Microbiological studies, Monitoring, Surface waters, Drinking water.

Gauze filtration was tested as a simple, inexpensive technique for sampling of nonflowing surface waters. The procedure proved more effective in recovering Vibrio cholerae 0:1 than culturing 1 liter water samples and required about the same amount of effort. The most effective combination of enrichment and plating media for isolating V. cholerae from contaminated surface waters is presented. The perfect performance of 18 hr alkaline bile-peptone water (ABPW) enrichment of filtration samples in the study plus the demonstrated superiority of filtration over water grab sampling in 6 hr enrichment cultures suggests that a larger scale evaluation would better demonstrate the significance of this method. The ability of 18 hr ABPW enrichment cultures of filtration samples was then evaluated to isolate laboratory grown V. cholerae biotype eltor from pond water into which it was added in graded concentrations. The procedure was able to detect V. cholerae at concentrations as low as 10 organisms per liter of natural pond water. Thus the method appears accurate and inexpensive for conducting large scale surveillance of water sources for contamination by V. cholerae biotype eltor, the organism which is responsible for the current cholera pandemic in Bangladesh. (Baker-FRC)
W82-01815

DETERMINATION OF HEXACHLOROCYCLOPENTADIENE AT THE NANOGRAM PER LITER LEVEL IN DRINKING WATER,
Health and Welfare Canada, Ottawa (Ontario).
F. M. Benoit, and D. T. Williams.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 3, p 303-308, September, 1981. 1 Fig, 3 Tab, 8 Ref.

Descriptors: *Potable water, *Pollutant identification, *Water sampling, Resins, Solvents, *Hexachlorocyclopentadiene, Water analysis, Chemical analysis, Organic compounds.

A solvent extraction method is described for the determination of hexachlorocyclopentadiene (HCCP) in drinking water. The possibility that HCCP is light sensitive was investigated by storing half of a solution of HCCP at known concentration in the dark and the other half in a clear glass container in the light for a period of nine days. A steady decrease in HCCP concentration in the exposed solution was noted. It was concluded, therefore, that HCCP is light sensitive in both organic and aqueous solutions, and that the rate of decay is dependent on the intensity of the incident radiation. Next the efficiency of XAD-2 resin to extract HCCP from water was estimated by passing tap water through two cartridges containing XAD-2 resin connected in series such that the effluent from the first was passed through the second. It was concluded that the extraction of HCCP from water with XAD-2 macroreticular resin cannot be used to quantify accurately the level of HCCP in drinking water, but may be used to screen water samples qualitatively. In cases where the anticipated levels of HCCP in drinking water are high, analysis of low water volumes by solvent extraction is possible. However, the limit of detection by the organic solvent method is about 50 ng/liter, whereas with the XAD-2 method the level of HCCP in raw water which is detectable is about 0.5 ng/liter. (Baker-FRC)
W82-01819

DETERMINATION OF FREE METAL ION CONCENTRATIONS USING BIOASSAYS,
Canada Centre for Inland Waters, Burlington (Ontario); and National Oceanic and Atmospheric Administration, Ann Arbor. Great Lakes Environmental Lab.
U. Borgmann.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 8, p 999-1002, August, 1981. 2 Tab, 20 Ref.

Descriptors: *Trace metals, *Cooper, *Bioassay, Pollutant identification, Heavy metals, Toxicity, Metals, Aquatic life, *Copepods, Invertebrates, Chelation, Amino acids.

Trace metal levels were determined by comparing metal toxicity to copepods before and after the addition of weak complexing agents (amino acids) with known stability constants. The growth of

freshwater copepods was affected at free copper concentrations as low as the order of 10 to the minus 10th power. These trace levels are lower than those detected by any other method, including metal ion electrodes. The method is applicable to natural waters or artificial media and the decrease in growth rates or any other quantifiable response used as a measure of free metal concentration. (Cassar-FRC)
W82-01821

SIMULTANEOUS DETERMINATION OF TRACE METALS IN SEWAGE AND SEWAGE EFFLUENTS BY INDUCTIVELY COUPLED ARGON PLASMA ATOMIC EMISSION SPECTROMETRY,
Ontario Ministry of the Environment, Rexdale (Ontario). Lab. Services Branch.
M. M. Moselhy, and P. N. Vijan.
Analytica Chimica Acta, Vol 130, No 1, p 157-166, 1981. 2 Fig, 3 Tab, 13 Ref.

Descriptors: *Metals, *Wastewater analysis, *Emission spectroscopy, *Trace metals, Heavy metals, Pollutant identification, Spectroscopy, Atomic absorption spectroscopy.

Inductively coupled plasma emission spectroscopy (I.C.P.) was adapted for simultaneous determination of several trace metals in sewage and sewage effluents. Aqua regia was chosen as the reagent for sample digestion after comparisons with sulfuric-nitric and prechloricnitric acid mixtures. Correlation coefficients between the i.c.p. and atomic absorption methods were 0.979-0.999 for Cr, Pb, Fe, Ni, Cu, Zn, and Cd. Other metals determined were: Al, Ca, Co, Mg, Mn, Mo, Sr, Ti, and V. (Cassar-FRC)
W82-01828

NITRATES, CHLORATES AND TRIHALOMETHANES IN SWIMMING POOL WATER,
Florida International University, Miami. Drinking Water Quality Research Center.
J. A. Beech, R. Diaz, C. Ordaz, and B. Palomeque.
American Journal of Public Health, Vol 70, No 1, p 79-82, January, 1980. 2 Fig, 3 Tab, 18 Ref.

Descriptors: *Swimming pools, *Nitrates, *Chlorates, *Trihalomethanes, Public health, Swimming, Water quality, Human pathology, Metabolism, *Miami, Florida.

Water of selected swimming pools in the Miami area was analyzed for contaminants that might present a hazard to users, including nitrates, chlorates, and trihalomethanes. The average concentration of nitrates was 8.6 mg/liter, and of chlorates was 16 mg/liter. The average concentration of trihalomethanes in beach-front saline pools was 657 micrograms/liter, and in freshwater pools was 125 micrograms/liter. The maximum concentration of nitrate was 54.8 mg/liter, of chlorate 124 mg/liter, and of trihalomethanes 439 micrograms/liter (freshwater) and 1287 micrograms/liter (salt water). While adults can consume considerable amounts of nitrate and chlorate without ill effects, the effects of these chemicals on young infants are not clear. Because of the popularity of infant swimming class, and because of the possibility of infants and young children ingesting large amounts of water during swimming, the effects of these levels of contaminants must be studied further. The adsorption of trihalomethanes through the skin also needs study. (Small-FRC)
W82-01835

DETERMINATION OF GERMANIUM, VANADIUM, AND TITANIUM BY CARBON FURNACE ATOMIC ABSORPTION SPECTROMETRY,
Polish Academy of Science, Zabrze. Inst. of Environmental Engineering.
M. Studnicki.
Analytical Chemistry, Vol 52, No 11, p 1762-1764, September, 1980. 3 Tab, 39 Ref.

Descriptors: *Atomic absorption spectroscopy, *Germanium, *Vanadium, *Titanium, Water analysis, Chemical interference, Metals.

The determination of germanium, vanadium, and titanium by carbon furnace atomic adsorption spectrometry was investigated, with emphasis on interferences which may lead to an increase or decrease in the absorption signal. Acids were found to strongly influence the signal for all three elements. Nitric acid increased the signal of germanium, but decreased the signals of vanadium and titanium. Sulfuric acid decreased the signal of all examined elements. Phosphoric acid increased the signal of vanadium and titanium, but decreased the signal of germanium. Hydrochloric acid increased the signal of titanium and decreased the signals of vanadium and germanium. On the whole, the ammonium salts of these acids had similar effects. For all examined elements, the working range was 0.1 to 0.5 ppm, and calibration graphs were linear up to a concentration of approximately 0.4 ppm. Sensitivities were: 0.015 ppm for germanium 0.03 ppm for vanadium, and 0.09 ppm for titanium. (Small-FRC)
W82-01836

A GEL PARTITION MODEL FOR ORGANIC DESORPTION FROM A POND SEDIMENT,
Maryland Univ., College Park. Dept. of Chemistry.
D. H. Freeman, and L. S. Cheung.
Science, Vol 214, No 3422, p 790-792, November 13, 1981. 3 Fig, 24 Ref.

Descriptors: *Sediments, *Organic carbon, *Ponds, Adsoprtion, *Model studies, Gels, Chemical analysis.

A sediment model is described which expresses the natural affinity of nonpolar compounds for the relatively nonpolar polymeric component, called humin or kerogen, that is present in most sediments. Physical considerations were used to derive criteria that minimize this affinity and maximize the ease of extraction. An experiment was performed on the liquid extraction of a lipophilic compound in a simplified situation where the compound was known to be present in high concentration in an industrial pond sediment. Several experiments were conducted to attempt to distinguish between equilibrium and nonequilibrium desorption from sediment. In general, agreement was noted between the gel partition model and the hypothesized behavior of the humin-kerogen structure in sediment samples during extraction of the lipophilic solute DEHP. The model correctly predicted near-optimal extraction by dichloromethane and predicted conditions for gel concentration that were consistent with the finding of slow secondary diffusion in a nonoptimal liquid. These results indicate that partitioning or adsorption effects alone would tend to be irreversible unless the equilibrium condition is clearly demonstrated experimentally. In aqueous systems equilibrium may be particularly difficult to obtain. In attempting to desorb lipiphilic substances from sediment samples that are finely divided, it is clear that the humin-kerogen pore structure needs to be kept open by use of proper extractive conditions, including use of a suitable swelling-dissolving liquid that provides adequate diffusion rates. (Baker-FRC)
W82-01844

LOADING ESTIMATES TO LAKE ERIE, 1967-1976,.
National Water Research Inst., Burlington (Ontario).
A. S. Fraser, and K. E. Willson.
Scientific Series No 120, 1981. 23 p, 10 Fig, 1 Tab, 16 Ref, 2 Append.

Descriptors: *Wastes, Discharges, *Atmospheric loading, Phosphorous, Nitrogen, Nitrate, Ammonia, Mathematical models, Great Lakes, *Lake Erie, Nutrients, Total load, *Effluents, Water pollution sources.

This report presents the author's best estimate of the loading for several chemical variables to Lake Erie. Every effort has been made to obtain original raw data as accepted by local agencies so that a truly independent assessment of loadings could be made. The raw data, once obtained, were treated uniformly to eliminate the difficulties that arise from the comparison of loads calculated by various techniques. However, because of the limitations of sampling a highly variable natural system in the environment, the results included in this study must be called estimates and hence may be subject to unknown or unaccountable errors, which make placement of confidence limits difficult. Nevertheless, the following document is presented with the belief that the results represent the most comprehensive, independent study of loadings to Lake Erie presently available. (WATDOC)
W82-01852

VARIATIONS AND MECHANISMS OF ASBESTOS FIBRE DISTRIBUTION IN STREAM WATER,
National Water Research Inst., Vancouver (British Columbia). Pacific and Yukon Region.
H. Schreier, and J. Taylor.
Technical Bulletin, No 118, 1981. 17 p, 21 Fig, 3 Tab, 51 Ref.

Descriptors: *Minerals, *Asbestos, Concentrations, *Streams, *Basins, Surveys, Natural sources, Sources, Distribution, *Sumas River Basin, British Columbia, Washington State, Variations, Spatial, Distribution, Temporal distribution.

Asbestos fiber concentrations were determined in a ten-month study on the Sumas River in British Columbia and Washington State. Regional background levels were found to be somewhat lower than the water affected by the slide, but nevertheless the values were high, reaching concentrations of up to 10 sup 10 fibres/litre. Six stations were sampled during the major hydrologic events of the 1979-1980 season, and all showed seasonal fluctuations in asbestos concentration, some as high as four orders of magnitude. In addition, great differences in concentrations were also found between stations (10 sup 8 -10 sup 13 fibers/litre). This suggests that occasionally collected grab samples provide an insufficient data base for asbestos analysis of stream water. A laboratory settling experiment, which used stream bed sediments, was carried out to study the mechanism of transport of fibers. Evidence was produced to suggest that suspended asbestos fibers settle to the bottom in the absence of turbulence and water movement. The rate of settling decreases with time, and smaller fibers appear to remain in suspension longer than larger fibers. Some limited evidence of this process was also found in one stream station where the highest asbestos concentrations and the largest concentrations and smallest range in fiber size, during minimum streamflow. Unfortunately, this process could not be identified consistently, and particle interferences during the settling process are thought to be the cause of the more complex settling pattern of asbestos fibers. (WATDOC)
W82-01853

INTERLABORATORY QUALITY CONTROL STUDY NO. 26, ARSENIC AND SELENIUM IN WATER,
National Water Research Inst., Burlington (Ontario). Water Quality Branch.
V. Cham, and K. I. Aspila.
Report Series No 68, 1980, 12 p, 6 Fig, 6 Tab, 19 Ref, Append.

Descriptors: *Arsenic, *Silenium, *Water analysis, *Toxicity, Carcinogens, Elements, Concentrations, Data collections, Detection limits, Atomic absorption spectrometry, Pollutant identification.

An intercomparison study on the determination of arsenic and selenium in water is described. Thirty Canadian laboratories participated, and each analyzed 10 natural, spiked and distilled water samples preserved with 0.2% H2S04 in polyethylene containers. The concentration of both elements ranged from 0 to 1000 microg/L. Pooled analytical data were assessed using several statistical analyses-which included outlying tests, paired sample treatments, and ranking technique-to determine laboratory performance and bias. The majority of participants using the atomic absorption technique via atomization of hydrides produced reliable results. Based on the data from this study, this technique was assessed to be preferable to colorimetry,

atomic emission and atomic absorption using graphite atomizer because of its good sensitivity and its capability of analyzing the whole concentration range. (WATDOC)
W82-01854

STANDARD PROCEDURE FOR TESTING THE ACUTE LETHALITY OF LIQUID EFFLUENTS.
Environmental Protection Service, Ottawa (Ontario). Water Pollution Control Directorate.
Report No EPS 1-WP-80-1, 1980, 11 p. 4 Ref, Append.

Descriptors: *Acute toxicity, *Effluents, *Rainbow trout(Salmo gairdneri), *Bioassay, Standard methods, Lethal limit, Toxicity, Trout.

This procedure represents a simpler alternative to the test for acute toxicity described in regulations and guidelines already published by the federal government. While it has not been designed for scientific research, this procedure has been developed in the course of a number of years of laboratory experience, as well as through extensive review of available literature and consultation with a number of scientists. It has been demonstrated to be a valid test for lethality of an effluent, and allows a large number of tests to be performed under a variety of circumstances. Other tests may be developed in the future to accommodate changes in bioassay methods and best practicable wastewater treatment technology. The intent of this test is to provide sufficient standardization so that the various effluents now subject to federal regulations and guidelines can be dealt with as equitably as possible. Further information regarding techniques and equipment may be obtained from the Environmental Protection Service (EPS) Laboratories listed in the Appendix. (WATDOC)
W82-01905

NUMERICAL TAXONOMY ANALYSIS OF BACTERIA ISOLATED FROM THE COMPLETED 'MOST PROBABLE NUMBERS' TEST FOR COLIFORM BACILLI,
Maryland Univ., College Park. Dept. of Microbiology.
B. Austin, D. Hussong, R. M. Weiner, and R. R. Colwell.
Journal of Applied Bacteriology, Vol 51, No 1, p 101-112, August, 1981. 2 Fig, 4 Tab, 42 Ref.

Descriptors: *Most Probable Number test, *Coliforms, *Bacteria, *Taxonomy, Pollutant identification, Enterobacter, Lactobacillus, Water analysis, Microbiological studies.

Lactose-fermenting bacteria isolated from water, estuarine sediment, and oyster samples from Chesapeake Bay were identified and compared with results of the widely-used Most Probable Number (MPN) test for coliforms. In all, 13 phena were found. Escherichia coli, Citrobacter freundii, Klebsiella pneumoniae, Serratia liquefaciens, Serratia marcescens, Erwina herbicola, Hafnia alvei, Acinebacter calcoaceticus, and Chromobacterium violaceum were positively identified. Two phena strongly resembled Pseudomonas aeruginosa and P. fluorescens. Two phena, which did not appear to be Enterobacteriaceae, could not be identified. The large number of non-enterobacter isolates suggests that the MPN method may not be reliable for assessing the sanitary quality of water samples. Some strains of E. coli, E. herbicola, H. alvei, and non-enterobacters appeared to lose their ability to ferment lactose upon storage on laboratory media at room temperature for 8 weeks. (Cassar-FRC)
W82-01911

VARIATIONS IN TRACE METAL CONTENT OF THE MUSSEL CHOROMYTILUS MERIDIONALIS (KR.) WITH SEASON AND SEX,
National Research Inst. for Oceanography, Stellenbosch (South Africa).
M. J. Orren, G. A. Eagle, H. F-K. O. Hennig, and A. Green.
Marine Pollution Bulletin, Vol 11, No 9, p 253-257, September, 1980. 4 Tab, 21 Ref.

Descriptors: *Mussels, *Bioindicators, *Trace metals, Monitoring, Sampling, Biological samples, Iron, Copper, Lead, Cadmium, Manganese, Zinc, South Africa.

Trace metal contents of whole bodies of mussels were determined on C. meridionalis collected in June and November from intertidal pools at Bloubergstrand, near Cape Town, South Africa. The mussels in the area had fairly low concentrations of trace metals when compared to those from other areas, but were similar to results obtained for C. meridionalis and Perna perna by other workers at unpolluted sites in the vicinity. In males, copper, iron, lead, zinc, and manganese increased significantly from June to November. In females, iron, lead, cadmium, copper, and zinc increased significantly. This seasonal variation may be due to phytoplankton productivity and the availability of food, or to the effect of temperature on the rate of excretion. Because of the differences found in sexes, for monitoring purposes, only sexually immature animals should be used. Rigid standardization of mussel sampling procedures for use as water quality indicators is needed. (Small-FRC)
W82-01969

WATER QUALITY INDICES: AN ADDITIONAL MANAGEMENT TOOL,
Middlesex Polytechnic, London (England).
For primary bibliographic entry see Field 5G.
W82-01994

ION FLOTATION-SPECTROPHOTOMETRIC DETERMINATION OF TRACES OF CHROMIUM (VI),
Tokyo Metropolitan Univ (Japan). Dept. of Industrial Chemistry.
M. Aoyama, T. Hobo, and S. Suzuki.
Analytica Chimica Acta, Vol 129, p 237-241, August, 1981. 2 Fig, 1 Tab, 5 Ref.

Descriptors: *Metals, *Water pollution control, Natural waters, *Pollutant identification, Pollutants, *Chromium, Monitoring, Industrial wastes, Chemical analysis, Water analysis, Spectrophotometry, Flotation, Separation techniques.

The usefulness of diphenylcarbazide (DPCI) as a selective collector for chromium has been investigated. Optimum conditions are described for the flotation of chromium(VI) in batch and continous experiments. The proposed method is rapid and applicable to the determination of chromium(VI) at microgram/liter levels. For batch flotation enough sulfuric acid was added to a 1 liter sample containing 3-70 micrograms of chromium(VI) to make the acidity 0.1 M. After adding 5 ml of 1% DPCI solution and shaking for 5 min, the solution was transferred to the separation tube. Nitrogen was passed at a flow rate of 105 ml/min into the tube and 1% sodium lauryl sulfate (SLS) solution was pumped into the tube at a flow rate of 0.54 ml/min. The foam coming out of the separation tube was collected for 20 min in the foam collector which contained 0.5 ml of n-butanol. The subsided foam solution was transferred to a 50-ml volumetric flask and diluted to the mark with water. Absorbance was measured at 540 mm, using water as reference. The procedure for continuous flotation is also described. During batch flotation studies the effects of diverse ions on the flotation of Cr(VI) were investigated, and it was determined that only a few ions interfered. Even so, Cr(VI) in the sample is measured. If this system were connected with a continous photometric detector, a good pollution monitoring system would be realized. (Baker-FRC)
W82-02007

ON SITE CONTINUOUS LIQUID-LIQUID EXTRACTION OF NONPOLAR ORGANIC COMPOUNDS IN WATER,
Bremen Univ. (Germany, F.R.). Dept. of Chemistry.
B. Stachel, K. Baetjer, M. Cetinkaya, J. Dueszeln, and U. Lahl.
Analytical Chemistry, Vol 53, No 9, p 1469-1472, August, 1981. 6 Fig, 4 Tab, 7 Ref.

Descriptors: *Insecticides, *Water analysis, Pollutant identification, *Weser River, *Germany, Pesticides, Lindane, Hexachlorobenzene, Hexachlorocyclohexane, Chlorinated hydrocarbons.

The Ahnoff and Josefsson apparatus for determining pesticides in water by continuous liquid-liquid extraction was modified by installation of an electronically directed water level regulator. Analysis of 500 liter water samples using from the Weser River, Federal Republic of Germany, using this method of concentration and gas chromatography gave the following results: alpha-1,2,3,4,5,6-hexachlorocyclo-hexane (alpha-BHC), 3.3 ng per liter; lindane (gamma-BHC), 11.6 ng per liter; hexachlorobenzene (HCB), 0.4 ng per liter; and beta-BHC, not detected. Detection limits (in ng per liter) were: 0.2, 0.5, 0.2, and 0.7, respectively. Laboratory studies of added pesticides gave the following recoveries: alpha-BHC, 77.0%; lindane, 73.8%; and alpha-BHC plus HCB, 44.7%. (Cassar-FRC)
W82-02008

MEASUREMENT OF HEAVY WATER CONCENTRATION WITH A DENSITY METER,
National Inst. of Radiological Sciences, Chiba (Japan). Div. of Environmental Health.
Y. Inoue, K. Tanaka, and Y. Kasida.
Analyst, Vol 106, No 1263, p 609-619, June, 1981. 8 Fig, 5 Tab, 6 Ref.

Descriptors: *Water analysis, *Deuterium, Measuring instruments, Density, Density meter, Heavy water, Water treatment.

The applicability of a high-sensitivity density meter was investigated for the determination of the deuterium content of water, the determination of the separation factor, alpha, in the electrolytic enrichment process for deuterium, and to remove the drawbacks associated with conventional methods of density measurement. The effects of temperature and solute impurities on the method were investigated and the purification of water by sublimation and anion-exchange techniques were examined as a means of overcoming the latter. The methods, using a high-sensitivity density meter, proved applicable to the accurate determination of levels of deuterium in water samples above 0.1 mol-%. Electrical conductivity or specific resistance proved to be a good measure of the purity of the water to be used for the densitometry. Purification of the water to a specific resistance value was achieved easily using a combination of anion exchange and sublimation procedures. These techniques are relatively simple and rapid in comparison with conventional purification methods and the time required for the purification may be shortened by as much as 5 hr per sample. The simultaneous handling of many samples was easy to achieve. The density meter allowed density measurements to be completed within 10 min. In general, this method was superior to the conventional methods with respect to sample size, measuring time, sensitivity and accuracy. (Baker-FRC)
W82-02009

ON THE PRESENCE OF FECAL STEROIDS IN SEDIMENTS FROM TWO MEXICAN HARBORS,
Universidad Nacional Autonoma de Mexico, Mexico City. Centro de Ciencias del Mar y Limnologia.
R. L. Escalona, M. T. L. Rosales, and E. F. Mandelli.
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 2, p 289-295, 1980. 2 Fig, 2 Tab, 13 Ref.

Descriptors: *Aquatic environment, Wastes, *Contamination, *Harbors, Sediments, Feces, Water pollution, Coastal waters, Coasts, Estuaries, Marine sediments, Wastewater, Microorganisms, Bacteria, Bioindicators, *Wastewater, *Mexico.

Samples of sediments from two coastal cities in Mexico were analyzed for coprostanol and cholesterol to determine the degree of sewage pollution in the two areas. Coprostanol concentrations ranged from 0.006 to 0.44 parts per million in the Veracruz harbor. These are relatively low concen-

trations and indicate the absence of direct sewage discharges from the city. Unreported sewage outfalls from shipyards are believed to be the major source of fecal pollution. Concentrations were significantly higher in Mazatlan, ranging from 0.020 to 0.20 parts per million. Mazatlan discharges a high percentage of untreated sewage into the harbor. (Titus-FRC)
W82-02012

AN ANALYSIS OF THE AQUATIC MACROPHYTE, MYRIOPHYLLUM EXALBESCENS, AS AN INDICATOR OF METAL CONTAMINATION OF AQUATIC ECOSYSTEMS NEAR A BASE METAL SMELTER,
Department of Fisheries and Oceans, Winnepeg (Manitoba). Freshwater Inst.
W. G. Franzin, and G. A. McFarlane.
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 4, p 597-605, 1980. 1 Fig, 4 Tab, 9 Ref.

Descriptors: *Aquatic organisms, *Ecosystems, *Contamination, *Trace metals, *Bioindicators, Tissue analysis, Macrophytes, Lakes, Aquatic environments, Physical properties, Chemical properties, Vegetation, Environmental effects, Industrial wastes, Water pollution.

The suitability of Myriophyllum exalbescens as an indicator of metal contamination in aquatic ecosystems was tested. Metal concentrations of samples of the species populations in six lakes with a range of metal contamination in water and sediment were analyzed. Prepared plant samples were analyzed for iron, manganese, lead, copper, cadmium, and zinc by flame atomic absorption spectrophotometry. Comparison of plant metal concentrations with the metal concentrations in lake waters and sediments showed that a fair correspondence existed only for zinc. This result, coupled with observations of year to year variance in plant metal concentrations, suggests that aquatic plants are unreliable indicators. (Titus-FRC)
W82-02016

DETECTION OF ORGANOPHOSPHATE INSECTICIDE BY AN IMMOBILIZED-ENZYME SYSTEM,
Visva-Bharati Univ., Santiniketan (India). Dept. of Zoology.
S. Bhattacharya, C. Alsen, H. Kruse, and P. Valentin.
Environmental Science and Technology, Vol 15, No 11, p 1352-1355, November, 1981. 5 Fig, 2 Tab, 19 Ref.

Descriptors: *Organophosphorus pesticides, *Enzymes, *Insecticides, Pollutant identification, Parathion, Carbaryl, Pesticide residues, Water analysis, Trace levels.

Low levels of organophosphate insecticides were detected in water samples using acetylcholinesterase covalently bound to poly(maleic anhydride) on a Celite 545 column. The second-order rate constant for paraoxon (10 to the minus 7th power M) was within the range of that found in a stirred suspension, but a significant increase in the rate constant was seen at paraoxon concentrations of 10 to the minus 8th to 10th powers M. Reactivation by obidoxime confirmed that the enzyme inhibition effect was caused by an organophosphate. All concentrations of carbaryl-paraoxon mixtures showed a decrease in rate of inhibition on the column. (Cassar-FRC)
W82-02025

EXPERIENCE WITH A SIMPLE METHOD FOR THE BIOLOGICAL EVALUATION OF SURFACE WATER QUALITY,
Rijksinstituut voor Zuivering van Afvalwater, Lelystad (Netherlands).
Th. G. N. Dresscher, and H. van der Mark.
Hydrobiologia, Vol 71, No 1/2, p 169-173, May, 1980. 1 Tab, 19 Ref.

Descriptors: *Bioindicators, *Saprobity, *Water quality, *Pollutant identification, Surface water, Water analysis, Algae, Ciliates, Euglenophyta, Chlorococcales, Diatoms, Peridinium, Chrysophyta, Conjugales.

The simple method for the evaluation of saprobity in surface water, published by the authors in 1974 and 1976, is discussed. It was designed for use by water and sewage treatment laboratories and requires identification of a number of groups rather than species. Organisms in four groups are identified and their presence used in a formula to calculate the saprobic quotient, which ranges from -3 for very severe pollution with many organic substances to +3 for very slight pollution with few organic or inorganic substances. Group A comprises Ciliates (indicators for polysaprobity); Group B, Euglenophyceae (indicators for alpha-mesosaprobity); Group C, Chlorococcales and Diatoms (indicators for beta-mesosaprobity); and Group D, Peridineae, Chrysophyceae, and Conjugales (indicators for oligosaprobity). This method cannot be used satisfactorily when surface water contains a bloom of an organism, during cold weather, and under turbid water conditions. Sampling should be done away from a bank and at a depth of 50 cm. (Cassar-FRC)
W82-02029

TURNOVER OF TRITIATED WATER IN CALAMONDIN PLANTS,
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel).
A. Mantell, E. E. Goldschmidt, and S. P. Monselise.
Journal of the American Society for Horticultural Science, Vol 105, No 5, p 741-744, September, 1980. 1 Fig, 3 Tab, 17 Ref.

Descriptors: *Plant populations, *Water requirements, Absorption, Nutrients, Calamondin plants, Transpiration, *Fruit crops, *Radioactivity, Tritium.

The relative water turnover was investigated in the vegetative and reproductive parts of calamondin plants as affected by different environmental conditions. The plants used were about 3 yr old and 40 cm tall, with fruit at different stages of development. Uptake measurements were made using tritium-labeled nutrient solution. The turnover was much greater in vegetative tissue than in the fruit. Even after three days, the radioactivity of water in the fruit, relative to that in the solution, did not reach 20% compared with about 60% in the leaf tissue. The radioactivity of water in pedicel reached 60%, similar to that in leaf tissue. Decay of radioactivity in fruit was considerably slower than in other organs when the plant was transferred from a labelled to a non-labelled solution. The turnover of water in fruit was extremely slow even when transpiration was increased by exposing the entire plant or the fruit alone to a stream of dry air. Defoliation of fruit-bearing branches decreased the entry of water into fruit tissues. The availability of water for fruit growth in view of the competition offered by the leaves is discussed. (Baker-FRC)
W82-02048

ISOLATION OF THE MYCOBACTERIUM AVIUM-M. INTRACELLULARE-M. SCROFULACEUM COMPLEX FROM TANK WATER IN QUEENSLAND, AUSTRALIA,
Chest Clinic, Brisbane (Australia).
R. E. Tuffley, and J. D. Holbeche.
Applied and Environmental Microbiology, Vol 39, No 1, p 48-53, January, 1980. 1 Fig, 5 Tab, 35 Ref.

Descriptors: *Bacteria, *Water tanks, Human diseases, Fitzroy River, Rivers, Queensland, *Australia, Mycobacterium, Cultivated lands, Agriculture, Cropland, *Rainwater.

The isolation of mycobacteria is reported from 67 of 205 rainwater tanks in three areas of Queensland. M. intracellulare was a comon isolate, and representatives of eight disease-related serotypes were found. Organisms of the MAIS complex and M. gordonae were the most frequent isolates. Rapid growers were found in two tanks near Rockhampton, whereas the M. terrae-M. triviale-M. nonchromogenicum complex was isolated occasionally in the Fitzroy basin. No M. simiae were found. Mycobacteria were recovered from 7 of the 32 tanks sampled repetitively from the city of Toowoomba. All three isolates of M. intracellulare occurred after the heavy summer rainfall in January. M. intracellulare and M. gordonae were the principal isolates recovered from 7 and 9 of the 32 tanks sampled, respectively, in Rockhampton Hinterland. Mycobacteria were isolated from 46 of the 141 tanks sampled in the Fitzroy Basin. The presence of plowed land did not appear to influence the isolation rate of M. intracellulare on rural holdings, but small towns set in virgin bushland had a significantly lower isolation rate for M. intracellulare than did those with adjacent cultivation. The results of serotyping 30 isolates in the MAIS complex indicated that the commonest serotype was serotype 23, which was found in nine separate tanks, five of these being obtained from one area where cultivation extends for 50 km in a strip 5 km wide. Humans who consume the contaminated tank water are free of symptoms, but none have been medically examined. It is suggested that mycobacteria adhering to dust particles disturbed mechanical cultivation may be the source of contamination. (Baker-FRC)
W82-02069

USE OF KNOPP'S METHOD TO ASSESS SELF-PURIFICATION PROCESSES IN WATER BODIES AND WATER COURSES,
Byelorussia Univ., Minsk (USSR). Experimental Biological Special Topics Research Lab.
For primary bibliographic entry see Field 5B.
W82-02073

THE USE OF LEECHES TO IDENTIFY PESTICIDES IN WATER,
Akademiya Nauk SSSR, Borok. Inst. Biologii Vnutrennykh Vod.
L. N. Lapkina, and B. A. Flerov.
Hydrobiological Journal, Vol 16, No 3, p 78-83, 1980. 7 Fig, 2 Ref.

Descriptors: *Water analysis, *Pesticides, Agricultural chemicals, Chemical analysis, Bioassay, *Leeches, Toxicity, Organophosphorus compounds, Organochlorines, Organic pesticides, Bioindicators, *Pollutant identification.

Leeches of the family Hirudinidae were placed in glass jars with screw caps containing at least 200 ml of water per leech. Leeches were thus exposed to chlorophos, carbophos, rogor, sevin, polychloropinene, and lindane. Also tested were three pharmacological preparations: eserine, proserine, and armine. It is noted that the symptom of the toxic action of chlorophos and PCP on different species of leech indicates the possibility of using members of this class of worms to detect the presence of particular substances in water. The sensitivity and rapidity of this method of analysis differ in relation to the specific poison being studied and the species used. A poison concentration of 0.1 mg/l causes specific bending under of the hind segments in the medicinal leech within 40 min in sevin solutions, 3.5 hr in armine, and 27.5 hr in chlorophos. Deeper stages of intoxication, including shortening of the body, opening of the pharynx, phasic increase, and decline of mass are not reached under the effect of sevin and chlorophos at this concentration, but in armine solutions they are manifested within 7-8 hr. An increase of sevin concentration to 1 mg/l and of chlorophos to 0.3 mg/l leads to the manifestation of poisoning symptoms and to more rapid poisoning. The sensitivity of this method of analysis is of interest when compared with that of other methods of analysis for these contaminants in water. (Baker-FRC)
W82-02075

5B. Sources Of Pollution

SEDIMENT-CONTAMINANT TRANSPORT MODEL,
Battelle Pacific Northwest Lab., Richland, WA.
Y. Onishi.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107,

No HY9, p 1089-1107, September, 1981. 10 Fig, 20 Ref.

Descriptors: *Kepone, *Sediment transport, Sediment deposition, *Path of pollutants, Pesticides, Insecticides, Adsorption, *James River, Virginia, Model studies, Rivers, Suspended sediments, FETRA model.

An unsteady two-dimensional element model, FETRA, was developed to simulate sediment and pollutant transport in rivers and estuaries. It includes sediment/contaminant interactions such as adsorption and desorption of contaminants; and transport, deposition, and resuspension of contaminated sediments. The model handles three sizes of sediment separately. The sediment transport submodel includes mechanisms of: (1) advection and diffusion/dispersion of sediments; (2) fall velocity and cohesiveness, (3) deposition on the river bed, (4) erosion from the river bed, and (5) sediment contributions from point/nonpoint sources and subsequent mixing. The migration of sediment and the pesticide kepone, deposited in the James River Estuary, Virginia, in the early 1970s was simulated. During calibration the model was adjusted until total sediment concentrations at maximum ebb, slack tide, and maximum flood for a net fresh water river discharge of 58.3 cu meters per sec at River Mile 76 were reproduced. The model was verified for a net fresh water discharge of 247 cu meters per sec. The computed dissolved kepone concentrations were 0.0048-0.0084 micrograms per liter and the total kepone concentration, 0.007-0.017 micrograms per liter, with peak liter and the total kepone concentration, 0.007-0.017 micrograms per liter, with peak concentration at River Mile 48 at the maximum flood tide. The model suggests that suspended sediments carry 12-53% of the total kepone being transported, while 47-88% is dissolved. Over a tidal cycle the average kepone concentration was 0.0076 micrograms per liter, indicating that 14.0 kg of kepone is transported toward Chesapeake Bay each year at a fresh water discharge of 58.3 cu meters per sec. (Cassar-FRC)
W82-01614

MATACIL RESIDUE DETERMINATION IN FOLIAGE, FISH, SOIL AND WATER,
Mobay Chemical Corp., Kansas City, MO. Div. of Agricultural Chemicals.
For primary bibliographic entry see Field 5A.
W82-01621

INFLUENCE ON GROUNDWATER FROM THE BERMED INFILTRATION POND,
Dorchester County Health Department, Cambridge, MD.
For primary bibliographic entry see Field 5D.
W82-01622

NITROUS OXIDE EMISSION FROM SIMULATED OVERLAND FLOW WASTEWATER TREATMENT SYSTEMS,
Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.
For primary bibliographic entry see Field 5D.
W82-01624

NITRATE REDUCTION TO AMMONIUM AND ORGANIC NITROGEN IN AN ESTUARINE SEDIMENT,
Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.
R. J. Buresh, and W. H. Patrick, Jr.
Soil Biology and Biochemistry, Vol 13, No 4, p 279-283, 1981. 4 Tab, 17 Ref.

Descriptors: *Estuarine environment, *Chemical reactions, *Nitrogen, Nitrates, Ammonia, Sediments, Fate of pollutants, *Estuarine environment.

The probable magnitude of conversion of nitrate to ammonium and organic nitrogen in a flooded estuarine sediment was investigated. Sediment covered by a layer of water was incubated in unsealed containers open to the air. Nitrate was added to the overlying water of the sediment-water systems in order to simulate the fate of nitrate entering an anaerobic sediment zone from the overlying water column and aerobic sediment layer. The reduction of nitrate in nature is presumably better represented by this type of incubation technique than by one employing an inert gas atmosphere. In order to determine what effect the intensity of reduction has on nitrate reduction the influence of redox potential on nitrate reduction to ammonium was also investigated. Estuarine sediment was obtained with a Peterson dredge from the bottom of a shallow lake in coastal Louisiana. Total N content, total C content, and pH of the sediment were 0.52, 7.8, and 7.4%, respectively. Water salinity and pH in the lake from which the sediment was obtained were 20 mg/ml and 7.8, respectively. The study showed that after the addition of labelled nitrate to the sediment-water systems the quantity of labelled organic N continually increased with time, whereas labelled ammonium-nitrogen initially increased more rapidly, but then decreased. These trends suggest that at least some labelled ammonia formation preceded production of labelled organic nitrogen. Dissimilatory reduction of nitrate to ammonia and subsequent incorporation of the ammonia into organic matter was the probable mechanism for the formation of labelled ammonia and organic nitrogen. The results of the study suggest that only about 15% of the nitrate reduced in the examined estuarine sediment was reduced to ammonia and recycled in the sediment. (Baker-FRC)
W82-01625

A GRAPHICAL APPROACH TO PREDICTION OF GROUNDWATER POLLUTANT MOVEMENT,
North Carolina State Univ. at Raleigh. Dept. of Marine Earth, and Atmospheric Sciences.
C. W. Welby.
Bulletin of the Association of Engineering Geologists, Vol 18, No 3, p 237-243, August, 1981. 8 Fig, 8 Ref.

Descriptors: *Groundwater movement, *Path of pollutants, *Waste disposal, *Flow nets, Landfills, Model studies, Geohydrology, Mathematical studies, Graphical methods, Leachates, Graphical analysis, Flow pattern, Fate of pollutants, Water pollution effects, Prediction, Groundwater pollution.

In analyzing a potential or actual groundwater pollution problem, it is important to accurately estimate when and where the contaminant may come into contact with the biological realm and the amounts that may appear at an outflow boundary over a period of time. Geography-time distributions and geography-quantity distributions are useful aids in making decisions concerning waste disposal processes. A method using contour maps and simple graphs and based on flow net and vector analyses allows for prediction of pollutant arrival times at an outflow boundary and variations of pollutant concentrations across that boundary in space and with time. Macro- and megascale aspects of groundwater pollution may be studied with this procedure. The technique may be applied to problems of potential groundwater pollution by sanitary landfill leachate, leaks from waste-holding ponds, or leaks from underground gasoline storage tanks. The present method may also be used in reconnaissance studies for evaluating hazardous waste sites using available hydrogeologic data. In addition, the method can be used for site evaluation and for the prediction of long-term downstream effects of contaminant leakage from a disposal site. (Geiger-FRC)
W82-01634

PERSPECTIVE ON MANAGEMENT AND DISPOSAL OF HAZARDOUS WASTES,
North Carolina State Univ. at Raleigh. Dept. of Marine Earth and Atmospheric Sciences.
For primary bibliographic entry see Field 5E.
W82-01635

TEMPORAL AND SPATIAL VARIATIONS OF MERCURY, LEAD, ZINC, AND COPPER IN SEDIMENTS OF THE SAGUENAY FJORD,
Laval Univ. (Quebec). Dept. of Chemistry.
C. Barbeau, R. Bougie, and J-E. Cote.
Canadian Journal of Earth Sciences, Vol 18, No 6, p 1065-1074, June, 1981. 7 Fig, 4 Tab, 20 Ref.

Descriptors: *Sedimentation rates, *Heavy metals, *Fjords, Canada, Mercury, Lead, Zinc, Cores, *Saguenay Fjord, Quebec.

This paper examines trace metal contents of core sediments taken in the Sanguenay fjord in relation to the dating provided by cesium-137 and the industrial and geological events up to 1978. Core sediment samples were taken in 1976 and 1978. The upper part of most cores contained high concentrations of mercury and decreasing concentrations of lead and zinc. The thickness of mercury-enriched sediments varied from high in the northern basin to low in the southern and intermediate basins, with an increase in the western basin. Except for the increased consumption of gasoline after the Second World War, there is no chronological mark related to lead in the Saguenay region. The pre-1940 period is characterized by an average concentration of 17 microg/g of lead, with the highest values close to 40 microg/g. Post-1940 concentrations are of an average 45 microg/g. The narrow range of concentration and the average values of 85 and 21 microg/g for zinc and copper in pre-1940 sediments indicate that not much enrichment of the sediments took place before 1940. The enrichment factor during the post-1940 period is identical for both elements, but much smaller than for lead. It was concluded that the northern basin of the fjord holds most of the anthropogenic material, but the accumulation rates and loadings vary significantly inside the basin. More than 50% of the sediments settle in the southern part of the basin. Material from the 1971 Saint-Jean-Vianney landslide is present in most parts of the basin and has modified the quality of sediments until at least 1976. Mercury input is below 0.5 microg/g in fresh sediment since 1970. (Baker-FRC)
W82-01639

COOLING POTENTIAL OF MISSOURI RIVER IN MISSOURI,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
A. R. Giaquinta.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 106, No HY11, p 1813-1825, November, 1980. 3 Tab, 4 Fig, 7 Ref. OWRT-B-061-IA(3).

Descriptors: *Rivers, *Thermal properties, *Cooling, *Electric powerplants, Effective capacity, Temperature effects, Water temperature, Water cooling, Condensers, Powerplants, Ecology, Energy, Climatic data, Flow, Thermal capacity, Reservoirs, *Missouri River, Missouri.

The steady-state Iowa Thermal Regime model was used to determine the thermal regimes of the Missouri River along a study reach corresponding to average meteorological and hydrological conditions for one month of each of the four seasons. The natural and modified thermal regimes resulting from the imposition of external heat loads from power plants and other sources are calculated. Results are shown in the form of temperature distributions along the river for the cases of both existing power plants and power plants proposed for installation within the next decade. Based on the existing thermal standards of the state regulatory agencies, the remaining heat assimilation capacity of the river is computed, and sites and capacities of future permissible once-through-cooled power plants of a reasonably large size are determined. The resultant temperature distributions corresponding to these future permissible plants are also presented. No remaining heat assimilation capacity in the vicinity of Kansas City exists. No additional power plants upstream from Kansas City could be installed because of their downstream effects. At the low flow conditions, some existing and proposed power plants can violate the excess temperature limitation if they operate at full load. The total future permissible plant capacity, based on low flow conditions, is about 1300 NW for fossil-fueled plants. (Titus-FRC)
W82-01654

PERIPHYTIC COMMUNITY RESPONSE TO CHRONIC NUTRIENT ENRICHMENT BY A RESERVOIR DISCHARGE,

Wyoming Univ., Laramie. Dept. of Zoology and Physiology.
For primary bibliographic entry see Field 5C.
W82-01658

SEDIMENT BACTERIAL INDICATORS IN AN URBAN SHELLFISHING SUBSTUARY OF THE LOWER CHESAPEAKE BAY,
Old Dominion Univ., Norfolk, VA. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5A.
W82-01661

NUTRIENT RUNOFF FROM AGRICULTURAL AND NON-AGRICULTURAL WATERSHEDS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Engineering.
M. D. Smolen.
Transactions of the ASAE, Vol. 24, No. 4, p 981-987, July/August, 1981. 4 Fig, 5 Tab, 15 Ref. OWRT-A-058-VA(4).

Descriptors: *Watersheds, *Nutrient removal, Nitrogen, Phosphorus, Leaching, Rainfall, Land use, Farming, *Agricultural runoff.

This study was designed to assess changes in the nitrogen and phosphorus content of stream water attributable to agricultural cropping activity. The background nutrient content was examined as represented by the non-agricultural control watershed. While sediment is considered important, it was not measured directly. Three adjacent watersheds at the Institute near Blackstone, Virginia were selected for hydrologic and water quality monitoring. They had been out of agricultural production for the preceding 35-40 years. In 1975 and 1976 corn and grasses were planted over large areas. Most fertilizer applications occurred during these two years. In subsequent years most of the fertilizer was associated with small plot research. The findings of the study indicate that agricultural activity caused a significant increase in nitrogen and phosphorus concentration and yield. Spring and fall nitrogen and phosphorus peak concentrations occurred earlier in the treated watershed and paralleled the timing of cultural activity. Background water quality, as represented by the control watershed, showed extremely low inorganic nitrogen content. Although there was a 2.5 to 3-fold increase in total phosphorus content in the treated watershed, there was little increase in soluble orthophosphate concentration. Essentially all of the excess phosphorus attributable to agricultural cropping activity was found in the organic and particulate bound fraction, which may be amenable to control by soil conservation practices. Mass balance of the inorganic nitrogen input to the watersheds from rainfall and the export of total nitrogen in streamflow suggests that the control watershed was very nearly in equilibrium with respect to nitrogen. (Baker-FRC)
W82-01662

WATERSHED CONSTITUENT LOADING ANALYSIS UTILIZING EMPIRICAL HYDRO-CHEMICAL MODELING TECHNIQUES,
Utah State Univ., Logan.
J. S. Fifield.
PhD Dissertation, 1980. 230 p, 26 Fig, 22 Tab, 65 Ref, 2 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-05104.

Descriptors: *Watersheds, *Model studies, Salts, Chemistry, Colorado River, *Salinity, *Dissolved solids, Path of pollutants, *Salt loading, Stream loading, Hydro-chemical models, Basin constituents.

In studying the hydrochemical characteristics of a watershed, a valuable tool available to engineering lies in utilization of computer models. One stochastic, one lump parameter and 13 deterministic models were reviewed and analyzed for technique, assumptions, data requirements and ability to simulate the hydrology and chemical system of a basin. In order to obtain sufficient chemical data at a low cost, it was proposed that complex chemical agorithms might be adequately represented by the results of empirical analysis that utilize only stream quantity and quality data. Concluding that complex algorithms can be adequately represented by the results of empirical analysis resulted in the modification of a hydrologic model to a hydrochemical model. The modified deterministic model was calibrated on 80,200 acres of the Grand Valley, Colorado. Subsequent management runs indicate that only a net minimal reduction of salt loading to the Colorado River will be realized by lining canals, laterals and ditches whereas substantial reduction will result upon increased farm efficiency and/or reduction of spills. When optimal management conditions are met, sulfate will decrease the most and potassium the least. A reduction in the amount of data needed to perform basin with hydrochemical research of salt loading to a stream is realized thus resulting in lower costs for calibration and management studies utilizing deterministic models. (Sinha-OEIS)
W82-01676

BIOLOGICAL AND PHYSICAL INVESTIGATIONS OF BODIES OF WATER BENEATH DENSE WATER HYACINTH POPULATIONS BEFORE AND AFTER CHEMICAL TREATMENT,
Florida Univ., Gainesville. Dept. of Botany.
W. W. Brower, II.
PhD Dissertation, 1980. 277 p, 122 Fig, 5 Tab, 23 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX 81-05560.

Descriptors: *Water quality, *Aquatic weeds, *Herbicides, Water hyacinth, Chemical treatment, *Ponds, Weed control, Eichhornia crassipes.

Dense infestations of water hyacinths or other free-floating, mat-forming aquatic weed species, dramatically affect the water quality below them. Hyacinth mats were chemically treated with 2,4-D, which proved to be an efficient means of aquatic weed control. After chemical teatment, floating mats of dying hyacinths were persistent on the pond surfaces for several months. Water quality under the decaying mats was worse than under actively growing hyacinths. Phytoplankton and zooplankton populations were much reduced while the periphyton diatom populations were variable. Open water conditions were established approximately six months after herbicide application, and water quality slowly improved. Phytoplankton populations were large after hyacinth treatment and disappearance, being mostly composed of blue-green algae, but with occasional large seasonal green algae populations. Periphyton diatom populations increased in both the pond surfaces and depths. Zooplankton populations were reduced after open water conditions were established and were largely composed of various rotifers and crustaceans. Sedimentation was 5.8 times greater after herbicide application. (Sinha-OEIS)
W82-01678

GEOGRAPHIC VARIATIONS IN WATER QUALITY AND RECREATIONAL USE ALONG THE UPPER WALLOWA RIVER AND SELECTED TRIBUTARIES,
Oregon State Univ., Corvallis. Dept. of Geography.
For primary bibliographic entry see Field 5A.
W82-01681

TOXIC SUBSTANCES IN WATER: PATTERNS OF CONTAMINATION AND POLICY IMPLICATIONS,
Rutgers - the State Univ., New Brunswick, NJ.
For primary bibliographic entry see Field 5A.
W82-01695

ECOLOGICAL AND PHYSIOLOGICAL FEATURES OF THE ROOT SYSTEM OF INSHORE HYDROPHYTES,
Ukrainian Academy of Sciences, Kiev (USSR). Institute of Hydrobiology.
N. N. Smirnova.
Hydrobiological Journal, Vol 16, No 3, p 38-48, 1980. 106 Ref.

Descriptors: *Self-purification, *Aquatic plants, *Swamps, Wetlands, *Hydrophytes, Calcium, Potassium, Nitrogen, Phosphorus, Metabolism, Roots, Nutrients, Eutrophication, Water quality, Literature review, Hydrobiology, Fate of pollutants, Nutrients.

Data concerning anatomy, morphology and metabolism peculiarities of higher aquatic plants and their root systems was analyzed. The structural functional features of the plants' growth under different ecological conditions are studied. In contrast to terrestrial plants, the root system of hydrophytes is permanently located in a bottom material that is supersaturated or inundated with water. Among the higher water plants there have been appreciable phylogenetic changes of anatomical and morphological structure, especially in the root system. Inshore hydrophytes are a transitional form between land plants and true hydrophytes, and consequently their anatomical and morphological structure has typical attributes of both. The specific habitat of aquatic and swamp plants has promoted the development of anatomical and morphological features, ensuring the normal gaseous metabolism of the root system with receipt of sufficient oxygen from the atmosphere by the subterranean organs. The self-purification of water bodies results from physicochemical processes and from the activity of hydrobionts. The absorbing capacity of higher water plants is most important in this regard. The absorbing function of the root system is expressed to different degrees in highly hydrophilous plants in relation to the chemical nature of the water and the reserves of nutrients in the bottom deposits. The most important chemical elements for determining the degree of eutrophication of water bodies, such as nitrogen, phosphorus, potassium, and calcium, may be removed from circulation in a water body for a fairly long time by means of reeds, reedmance, bulrushes, and reed sweetgrass. The subaerial portion of the plant biomass may be harvested at the end of the growing season, thus removing these chemicals more completely. (Baker-FRC)
W82-01715

FORMATION OF WATER QUALITY IN THE IRTYSH-KARAGANDA CANAL,
Ukrainian Academy of Sciences, Kiev (USSR). Institute of Hydrobiology.
O. P. Oksiyuk, G. N. Oleynik, G. B. Tulepova, A. N. Timerkayeva, and E. G. Belobaba.
Hydrobiological Journal, Vol 16, No 3, p 31-38, 1980. 7 Fig, 9 Ref.

Descriptors: *Canals, *Water quality, *Bacteria, *Aquatic plants, Nitrogen, Organic matter, Minerals, Plankton, Water pollution sources, Aquatic life, Water conveyance, Water transfer, *Irtysh-Karaganda Canal, *USSR, Diversion channels.

The Irtysh-Karaganda canal was constructed to convey water to the industrial regions of the dry area of Central Kazakhstan. Its source of water is the Belaya River, an arm of the Irtysh. The overall length of the canal is 457 km. The canal is intended to receive local runoff, the bulk of which enters it during the flood period. The canal and its reservoirs are intensively overgrown with higher water plants, forming a large phytomass and appreciably affecting water quality. Monthly data on hydrochemical, bacteriological and hydrobiological indices covering a two-year period at fixed observation points along with the results of an expedition study in July 1977-1979 provided material for this study on water quality formation along the canal. In the spring, permanganate oxidizability (PO) is mainly attributable to the local runoff entering the canal at flood time. Values are especially high in the middle part of the canal. After the water has passed through the reservoirs PO increases, and it continues to increase to the end of the canal. The water in the canal is gradually enriched with organic matter in July, with evidence indicating an increase in bichromate oxidizability as the water passes through the reservoirs and comes to the end of the canal. The concentration of ammonia nitrogen in the canal water is low. The dynamics of mineral forms of nitrogen in the canal are not uniform. In the first third of the canal the abundance of bacterioplankton is slightly reduced, but after the reservoirs it increases to the level on entry. The quantity of heterotrophic bacteria in

flood water varies widely. Distribution of bacteria of the E. coli group and the distribution of dry residue are considered briefly. (Baker-FRC)
W82-01716

DISTRIBUTION OF VIBRIO PARAHAEMOLYTICUS IN FINFISH HARVESTED FROM PORTO NOVO (S. INDIA) ENVIRONS: A SEASONAL STUDY,
Center of Advanced Study in Marine Biology, Porto Novo (India).
For primary bibliographic entry see Field 5A.
W82-01737

EFFECTS OF A CATTLE FEEDLOT ON GROUND-WATER QUALITY IN THE SOUTH PLATTE RIVER VALLEY NEAR GREELEY, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
R. G. Borman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-224321, Price codes: A05 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 80-83, 1981. 78 p, 14 Fig, 10 Tab, 19 Ref.

Descriptors: Water quality, *Groundwater pollution, Water pollution sources, *Feedlots, *Farm wastes, *Cattle, Nitrates, Leachate, Percolation, Observation wells, Water table, Chemical analysis, *Colorado, South Platte River valley.

Changes in water quality in an alluvial aquifer resulting from the operation of a feedlot stocked with 90,000 cattle have been minimal. Monitoring water quality in 19 observation wells from April 1974, prior to the operation of the feedlot, to June 1978, after about 4 years of operation, indicates that chloride concentrations have increased slightly in one well downgradient from a runoff-retention pond. Chemical analyses of water from two lysimeters installed in the unsaturated zone indicate that leachate from the feedlot has percolated to a depth of at least 5 feet but has not percolated to a depth of 20 feet. The small changes in groundwater quality caused by the feedlot are likely the result of the limited available recharge, a relatively impermeable manure pack, soil clogging under the cattle pens resulting in slow vertical movement of leachate through the unsaturated zone, soil clogging under the unlined runoff-retention ponds, and denitrification in the unsaturated zone. (USGS)
W82-01790

QUALITY OF WATER AND TIME OF TRAVEL IN PART OF TILLATOBA CREEK BASIN, MISSISSIPPI, OCTOBER 1974 TO SEPTEMBER 1980,
Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-01791

PERSISTENCE OF 3-(TRIFLUOROMETHYL)-4-NITROPHENOL IN AQUATIC ENVIRONMENTS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
D. A. Thingvold, and G. F. Lee.
Environmental Science and Technology, Vol 15, No 11, p 1335-1340, November, 1981. 6 Fig, 1 Tab, 30 Ref.

Descriptors: *3-(Trifluoromethyl)-4-nitrophenol, *Fish management, *Degradation, Lamprey, *Great Lakes, Pesticides, *Larvicides, Fate of pollutants, Microbial degradation, Phenols, Organic compounds, Lakes, Aquatic environment.

A sea lamprey larvicide, 3-(trifluoromethyl)-4-nitrophenol (TFM), did not degrade chemically or microbially in sediment-free water over an 80 day test period in the laboratory. Added since 1958 to tributaries of the Great Lakes, the chemical enters the lakes and persists for extended periods. It is expected that the level could approach 0.015 micrograms per liter, considerably less than levels harmful to nontarget aquatic life. The LC50 for rainbow trout is 0.53 to 40 mg per liter, depending on life stage. No degradation was evident with organisms derived from sediments, lake water, activated sludge, raw sewage, river water, and with microorganisms adapted to small amounts of TFM. Nutrient enrichment studies with sucrose and glucose-glutamate produced no TFM degradation. In a cometabolism test with sodium benzoate, the benzoate was metabolized, but the TFM remained. Although no degradation was seen in these aqueous system tests, decomposition in sediments or by photolysis cannot be ruled out without testing. (Cassar-FRC)
W82-01798

OXIDATION OF PHENOLIC ANTIOXIDANTS IN A RIVER SYSTEM,
Midwest Research Inst., Kansas City, MO.
V. Lopez-Avila, and R. A. Hites.
Environmental Science and Technology, Vol 15, No 11, p 1388-1390, November, 1981. 2 Fig, 1 Tab, 4 Ref.

Descriptors: *Phenols, *Chemical wastewater, *Organic compounds, Antioxidants, Fate of pollutants, *Path of pollutants, Sediments, Oxidation-reduction potential, Quinones, *Pawtuxet River, Rhode Island, Chemical industry, Rivers.

The general environmental fate of phenolic antioxidants in river systems is transformation into quinones or quinone methides. The formation of 2,6-di-tert-butylbenzo quinone from 2,6-di-tert-butylphenol (BHT), an antioxidant, was studied in sediment cores near to and 1 km downstream from a plant on the Pawtuxet River, Rhode Island, where antioxidants are manufactured. The phenol is oxidizing to the quinone up to the 18 cm depth in the near-plant sediment core and up to the 36 cm depth in the downstream core; below that depth the opposite reaction is occurring. Considering the sedimentation rates, these transformation depths are at 9 years ago (near-plant) and 12 years ago (downstream). An unknown compound, later identified as 2,6-tert-butylbenzoquinone 4-(carboxymethyl)methide, was observed at concentrations of 20 ppb in river water but not in wastewater. This is an oxidation product of the methyl and octadecyl esters of 3-(3,5-di-tertbutyl-4-hydroxy) propionic acid, also antioxidants manufactured at the plant. (Cassar-FRC)
W82-01801

ORGANIC COMPOUNDS FOUND NEAR DUMP SITES IN NIAGARA FALLS, NEW YORK,
Indiana Univ. at Bloomington. Dept. of Chemistry.
V. A. Elder, B. L. Proctor, and R. A. Hites.
Environmental Science and Technology, Vol 15, No 10, p 1237-1243, October, 1981. 1 Fig, 7 Tab, 12 Ref.

Descriptors: *Water pollution sources, *Waste disposal, *Chemical wastes, Organic compounds, *Waste dumps, Landfills, *Love Canal, Niagara River, Rivers, Industrial wastes, New York.

This paper reports the identification of antrhopogenic organic compounds at three sites in and near the Niagara River, in the city of Niagara Falls, New York. The 102nd Street dump site forms a bay 0.8 km long and 0.4 km wide which is actually part of the Niagara River. Four different dump sites make up the shoreline of the 102nd Street bay. It also receives runoff from the Love Canal area through a storm sewer. Another site was Bloody Run Creek, which is 200 meters long and is little more than a drainage ditch for the Hyde Park landfill. The third sampling site was Gill Creek, which runs through an industralized complex. All sampling sites drain directly into the Niagara River. Seventy-nine organic compounds were found in the 102nd Street bay area, Bloody Run Creek, and Gill Creek. Most were present at levels of 0.1 to 1 ppb. Compounds which had been dumped in large amounts were detected in most water and sediment samples. Large amounts of chlorinated benzenes and toluenes were found at all three sites. Other compounds included chlorotoluenes, polycyclic aromatic hydrocarbon derivatives, PCBs, trichlorophenol and other phenols, benzotrifluorides, mirex, and phenothiazine. A large number of benzyl derivatives and a few unusual fluorinated compounds were also found. These were probably waste byproducts of the industrial chemical production of benzyl chloride and (trifluoromethyl)chlorobenzene, respectively. These hazardous waste disposal sites were the major sources for most of the compounds identified. (Baker-FRC)
W82-01802

ENVIRONMENTAL ASSESSMENT OF INDUSTRIAL DISCHARGES BASED ON MULTIPLICATIVE MODELS,
Environmental Protection Agency, Research Triangle Park, NC.
M. R. Leadbetter, and W. G. Tucker.
Environmental Science and Technology, Vol 15, No 11, p 1355-1360, November, 1981. 1 Fig, 1 Tab, 6 Ref.

Descriptors: *Industrial wastewater, *Water pollution sources, Fate of pollutants, Wastewater disposal, Variability, *Model studies, Mathematical studies, Mathematical models, Effluents, Statistics, Errors.

The severity of a substance in an industrial discharge is defined as the ratio of the substance concentration to an estimated safe level. If the ratio is greater than 1, the source is classified as dirty, and if less than 1, as clean. When severities downstream from the source are of interest, a transport model must be used to relate the concentrations to factors measured at the source. Use of a multiplicative model on an effluent discharge from an industry is illustrated. The model is designed to classify a large number of the clean-dirty borderline cases as dirty, while minimizing the number of rather clean sources which are classified incorrectly. Another illustration using a textile plant effluent measured total suspended solids over 40 days to produce 57 observations. Considering only one measurement, 47 of the 57 cases were designated as dirty, but taking two observations on each of five representative days produced a clean classification. Severity at a downstream point can be calculated using concentration of pollutant in effluent, effluent discharge rate, river flow rate, and the standard concentration. (Cassar-FRC)
W82-01808

PREDICTING PRIORITY POLLUTANTS FROM PETROCHEMICAL PROCESSES,
Environmental Protection Agency, Washington, DC.
H. E. Wise, Jr., and P. D. Fahrenthold.
Environmental Science and Technology, Vol 15, No 11, p 1292-1304, November, 1981. 5 Fig, 5 Tab, 6 Ref.

Descriptors: *Chemical wastewater, *Organic compounds, *Priority pollutants, Water pollution sources, Chemical industry, Nitrophenols, Nitrogen compounds, Polynuclear aromatic hydrocarbons, Plastics, *Petroleum products, Metals, Chlorinated hydrocarbons, Aromatic compounds, Phenols, Nitrosamines, Chlorophenols.

Characterization of wastewater effluent from 172 commercial products and processes at 40 sites in the organic chemical, plastics, and synthetic fiber industries revealed that priority pollutants were associated with certain combinations of precursors and generic processes. Although the precursors and processess are widely used, it is only the particular critical combinations that produce priority pollutants. Most of these are associated with the early stages of production and are generally refined away on the route to the commercial product. Of the 116 recognized organic priority pollutants, 75 were verified in this study. Although some feed stocks such as acrylonitrile, phenol, and vinyl chloride are themselves priority pollutants, some are also introduced as impurities or reaction products of impurities in feedstocks or solvents. A table lists the 17 plastics and synthetic fibers effluents which contained greater than 0.5 ppm of priority pollutants, the monomers, and the chemical nature of pollutants generated. A similar table lists 71 organic chemical effluents which contained greater

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than 0.5 ppm priority pollutants, with the generic processes, feedstocks, and chemical nature of pollutants generated. (Cassar-FRC)
W82-01809

COMPOSITION OF LEACHAGE FROM SURFACE-RETORTED AND UNRETORTED COLORADO OIL SHALE,
Colorado Univ at Boulder. Dept. of Geological Sciences.
K. G. Stollenwerk, and D. D. Runnells.
Environmental Science and Technology, Vol 15, No 11, p 1340-1346, November, 1981. 2 Fig, 5 Tab, 47 Ref.

Descriptors: *Leachates, *Oil shale, *Solute transport, Fate of pollutants, Water pollution sources, Colorado, Trace elements, Metals, Dissolved solids, Water quality, Waste characteristics, Mine wastes, Molybdenum, Arsenic, Selenium, Boron, Fluorine.

Groundwater and surface water in the Piceance Creek Basin, Colorado, may become contaminated by elements leached from retorted and fresh oil shale if development of this resource proceeds in this region. Laboratory leaching studies determined that a typical initial leachage composition from shale piles would probably contain the following pollutants (in mg per liter): fresh oil shale--total dissolved solids (TDS) 18000, Mo 9, B 32, F 16; Paraho retorted oil shale--TDS 28000, Mo 3, B 3, F 10; TOSCO II retorted oil shale--TDS 55000, Mo 9, B 18, F 19. The elements As and Se appear to present no threat to water quality. It is predicted that Mo would be present as Mo04(2-), boron as B(OH)3 and B(OH)4(-), and fluorine as free F(-). Although sulfuric acid would be generated, the abundance of carbonates and alkaline soils in this region would neutralize most of the acid, preventing acid pollution problems. The degree of leaching and contamination depends on many factors: chemical composition of the oil shale, presence of readily soluble minerals, temperature and atmosphere in retort, particle size distribution of retorted oil shale, annual precipitation, and location of shale pile in the drainage basin. Although the initial leachage would not meet recommended water quality criteria, the concentrations of TDS, Mo, and B would be reduced after passage of 1 or 2 pore volumes of water through the shale. This might require 1 or 2 centuries. F would remain at high concentrations, however, (Cassar-FRC)
W82-01810

INVESTIGATION OF SELECTIVE UPTAKE OF POLYCHLORINATED BIPHENYLS BY SPARTINA ALTERNIFLORA LOISEL,
North Carolina State Univ. at Raleigh. Pesticide Residue Research Lab.
E. Mrozed Jr., and R. B. Liedy.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 4, p 481-488, October, 1981. 1 Fig, 2 Tab, 5 Ref.

Descriptors: *Estuarine environment, *Polychlorinated biphenyls, *Aquatic plants, Adsorption, Accumulation, Chromatography, *Path of pollutants, Metabolism.

The movement of chlorinated hydrocarbons in the estuarine ecosystem and the role of Spartina alterniflora Loisel in this movement have been investigated. Specifically, the study was designed to provide evidence that S. alterniflora represents a potential pathway for the movement of PCB's in the estuarine system, to determine if uptake of PCB'S is a selective process, and to assess the effect of selective uptake on the reliability of concentration estimates based on the use of standard-sample chromatogram comparisons. A total of 0.3 mg of Aroclor 1254 was applied to 3.0 kg of washed coarse river bottom sand contained in buckets. Five S. alterniflora specimens were planted in each bucket of treated soil and immediately watered with nutrient solution. The final PCB concentration was 1.0 or 0.75 ppm based on soil dry weight or soil and water weight, respectively. Plants were harvested after a 90-day growth period with average minimum and maximum daily temperatures of 15.32 and 0.2 or 31.4 and 0.5 degrees C respectively. Samples were prepared for chromatography of soil, belowground tissues, and aerial tissues. The uptake of PCB's by S. alterniflora was shown to be selective for the lower chlorinated components of Aroclor 1254. Early peaks were enhanced relative to the standard in both types of plant tissue samples. Shifting of the chromatographic pattern of Aroclor 1254 as a result of PCB uptake indicates that this process changes the character of the PCB mixture. Enhancement of the early eluting components in belowground tissues is probably a result of the water solubility of the variously chlorinated congeners. Further shifting of the pattern towards the lesser chlorinated components in the aerial tissues suggests that some alteration of the mixture occurs within the plant. (Baker-FRC)
W82-01813

DENITRIFICATION ASSOCIATED WITH PERIPHYTON COMMUNITIES,
Geological Survey, Menlo Park, CA. Water Resources Div.
F. J. Triska, and R. S. Oremland.
Applied and Environmental Microbiology, Vol 42, No 4, p 745-748, October, 1981. 2 Fig, 13 Ref.

Descriptors: *Denitrification, *Cladophora, Chlorophyta, Streams, Rocks, Sedimentary rocks, Nitrous oxide, Algae, Nitrogen, Oxygen.

The periphyton community was examined in San Francisquito Creek, a small suburban drainage about 30 miles south of San Francisco. The community consisted of a Cladophora sp, mat which developed over the stream bed rocks. During summer low flows the filamentous mat undergoes senescence characterized by dense epiphtyic growth of diatoms, bacteria, and accumulation of fine organic particles which coat the filament surface. The fine particulates, when examined microscopically, contained a dense and diversified bacterial flora. Algal tissue were composited into a single sample. The scrapings of decomposing mats produced nitrous oxide when incubated under nitrogen plus 15% acetylene. Denitrification was enhanced by sodium nitrate and was inhibited by autoclaving, mercuric chloride, and oxygen. No nitrous oxide was formed without acetylene being present. Chloramphenicol did not inhibit nitrous oxide formation. Therefore the enzymes were constitutive. Incubation of periphyton scrapings in the light during field experiments inhibited denitrification due to algal photosynthetic oxygen production. The diurnal periphyton-associated denitrification rate was estimated to be 45.8 micromol of nitrous oxide per square meter per day as determined by averaging light, aerobic plus dark, and anaerobic rates over a 24 hr period. (Baker-FRC)
W82-01814

DISSOLVED HYDROCARBONS AND RELATED MICROFLORA IN A FJORDAL SEAPORT: SOURCES, SINKS, CONCENTRATIONS, AND KINETICS,
Alaska Univ., Fairbanks. Inst. of Marine Science.
D. K. Button, B. R. Robertson, and K. S. Craig.
Applied and Environmental Microbiology, Vol 42, No 4, p 708-719, October, 1981. 5 Fig, 4 Tab, 37 Ref.

Descriptors: *Biodegradation, *Hydrocarbons, *Seawater, Toluene, Estuaries, Fjords, Harbors, Water pollution sources, Microbiological studies, Oil tankers, Water treatments, Ballast, Port facilities, Terpenes, Conifers, Alaska, *Port Valdez.

The dynamics of dissolved hydrocarbon metabolism in seawater were investigated. Shallow-water samples were taken from Port Valdez and from a more oceanic station in Prince William Sound. The study was performed by continuous addition of radiolabeled toluene, representing a solute component, of the treated oil tanker ballast water which is discharged at Port Valdez. At 0.5 micrograms of toluene added per liter, most rates of toluene oxidation were in the range of 1 to 30 pg/liter/hr. Near the ballast water injection point, a layer of warm ballast water, rich in bacteria, that was trapped below the less-dense fresh surface water was detected. Toluene residence times were about 2 weeks in this layer, 2 years elsewhere in Port Valdez, and 2 decades in the surface water of the adjacent, more oceanic receiving estuary. Mixing was adequate for a steady-state treatment; it was demonstrated that 98% of the toluene was flushed from Port Valdez before metabolism, giving a resultant steady-state concentration of 0.18 micrograms/liter. Total bacterial biomass from direct counts and organism size data was usually near 0.1 mg/liter. However, the values ranged up to 0.8 mg/liter in the bacteria rich layer. The origin of additional hydrocarbon source was sought to explain the observations that the population of toluene oxidizers was large with respect to the amount of toluene consumed and that water from a nearby, nonpolluted estuary was equally active in facilitating toluene metabolism. Terpenes can be washed from spruce trees by simulated rainfall, and thus riparian conifers may provide an additional and significant hydrocarbon source to seawater. (Baker-FRC)
W82-01816

A SURVEY OF TRIHALOMETHANES IN THE DRINKING WATER SYSTEM OF MURJREESBORO, TENNESSEE,
Middle Tennessee State Univ., Murfreesboro.
W. B. Kasso, and M. R. Wells.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 3, p 295-302, September, 1981. 4 Fig, 1 Tab, 10 Ref.

Descriptors: *Trihalomethanes, *Potable water, *Water treatment, Water pollution sources, Organic compounds, Disinfectants, Chlorination, Drinking water, *Murfreesboro, Tennessee.

A study was performed to establish consistent and accurate trihalomethane levels to which Murfreesboro residents are being exposed and to evaluate seasonal changes and patterns of THM concentrations as related to the distribution of drinking water. Murfreesboro is a city of about 35,000 persons located 30 miles southeast of Nashville. Two separate water treatment plants, each with distinct water sources, serve the community. Six sample sites were chosen, and sampling continued for a period of 10 months. Average chloroform levels in samples collected were lowest in the winter, of the three seasons monitored. Spring levels were slightly higher, and summer values were well above the maximum contamination levels of 100 ppb established by the EPA. Bromodicloromethane concentrations followed a similar seasonal pattern, while chlorodibromomethane levels were relatively steady during the 10 months. Three sites averaged above the maximum allowable total trichloromethane contamination level of 100 ppb, with highest concentrations again in summer. These sites were fed entirely by a specific water plant. The variation from site to site was attributed mainly to the differences in source water plants and the distance of each site from the respective water plant. The plant with the highest levels of chloroform obtained its raw water from the Stones River; the other water treatment plant obtained its raw water from groundwater sources. Various methods of improving the quality of water at the substandard plant are briefly considered. (Baker-FRC)
W82-01817

FATE OF KEPONE AND MIREX IN A MODEL AQUATIC ENVIRONMENT: SEDIMENT, FISH, AND DIET,
Missouri Univ.-Columbia. School of Forestry, Fisheries and Wildlife.
D. R. Skaar, B. T. Johnson, J. R. Jones, and J. N. Huckins.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 3, p 931-938, August, 1981. 6 Fig, 35 Ref.

Descriptors: *Kepone, *Mirex, *Food chains, *Fate of pollutants, Pesticide residues, Insecticides, Bluegills, Fish, Daphnia, Aquatic environment, Degradation, Sediments, Accumulation, Metabolism, Chlorinated hydrocarbons.

Kepone and mirex did not degrade after 56 days' incubation in freshwater sediments under aerobic or anaerobic conditions and moved through a daphnia-bluegill food chain. A concentration of 0.1

micrograms per g of either insecticide labeled with C14 showed no primary or biological degradation in two sediments, one from kepone-contaminated Bailey Creek and one with no kepone contamination. After 28 days exposure to 0.046 plus or minus 0.01 mg per kg in food and 158 plus or minus 13 ng per liter in water, bluegills contained 1.68 plus or minus 0.11 mg per kg kepone, mean total body residue. The accumulation factor was 10,606. Equilibrium had not been reached during the test. The estimated half life of kepone in these fish was 25 days. Mirex exposure for 28 days at 0.24 plus or minus 0.05 mg per kg in food and 161 plus or minus 11 ng per liter in water produced a mean total body residue of 1.98 plus or minus mg per kg. The accumulation factor was 12,274, with no significant elimination in mirex-free water. Neither insecticide was metabolized by the fish. Bluegills exposed to insecticide-free water and fed contaminated daphnia for 28 days accumulated 0.036 plus or minus 0.005 mg per kg kepone and 0.143 plus or minus 0.29 mg per kg mirex for mean total residues of 0.078 plus or minus 0.020 mg per kg kepone and 0.125 plus or minus 0.037 mg per kg mirex. The fish accumulated twice as much DDT under similar conditions. (Casar-FRC)
W82-01820

DETERMINATION OF MINERAL FIBER CONCENTRATIONS IN FISH TISSUES,
Environmental Research Lab.-Duluth, MN.
For primary bibliographic entry see Field 5C.
W82-01822

POTENTIAL FOR BIODEGRADATION OF PHTHALIC ACID ESTERS IN MARINE REGIONS,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
B. F. Taylor, R. W. Curry, and E. F. Corcoran.
Applied and Environmental Microbiology, Vol 42, No 4, p 590-595, October, 1981. 3 Fig, 4 Tab, 26 Ref.

Descriptors: *Organic compounds, *Biodegradation, *Bacteria, Estuaries, Seawater, Rivers, Mississippi River, Deltas, Marine sediments, Phthalate esters, Marine environment, Sediments, Fate of pollutants.

This paper describes the presence of bacteria which aerobically degrade phthalic acid and phthalic acid esters (PAEs) in water and sediments from marine sources. This potential for PAE degredation was determined by comparing the counts of bacteria which grew aerobically on dibutyl phthalate (DBP) with the total counts of aerobic heterotrophic bacteria. The study took place in the Mississippi River estuary. Water samples and surface sediments from freshwater and marine environments were also collected from the Miami region and the New Orleans delta region. Bacteria that grew aerobically on DBP and o-phthalic acid were readily detected in both sediments and water samples. Pure cultures of bacteria were isolated on seven different phthalic acid esters from freshwater and marine sources. The marine isolates were taxonomically diverse and grew on a variety of phthalic acid esters. Dibutyl phthalate and o-phthalic acid supported growth in full-strength synthetic seawater medium, but sodium-dependent catabolism was demonstrable only for o-phthalic acid. The present study indicates that a variety of bacteria exist in some regions that can degrade o-phthalic acid and its esters in marine media. (Baker-FRC)
W82-01829

VOLTAMMETRIC STUDIES ON THE STABILITY OF THE ZN(II) CHELATES WITH NTA AND EDTA AND THE KINETICS OF THEIR FORMATION IN LAKE ONTARIO WATER,
Kernforschungsanlage Juelich, G.m.b.H. (Germany, F.R.). Inst. fuer Chemie.
For primary bibliographic entry see Field 2H.
W82-01839

NITROUS OXIDE IN FRESHWATERS OF THE GREAT LAKES BASIN,
Cornell Univ., Ithaca, NY.
For primary bibliographic entry see Field 2H.
W82-01841

TOXICITY AND BOD EFFLUENTS DERIVED FROM KRAFT PULPING OF AGED WOOD CHIPS,
A. Wong.
Pulp and Paper Canada, Vol. 82 No 7, p 33-34, 36-38, 40-41, July, 1981. 14 Fig, 2 Tab, 22 Ref.

Descriptors: *Pulp and paper industry, *Toxicity, Effluents, Kraft mills, Biological oxygen demand, *Industrial wastes.

The effects of pulping and aged wood chips on mill effluent quality, yield and quality of byproducts, and on pulp quality were studied. It was proposed that it might be possible for kraft mills to reduce their discharges of toxic substances by judicious storage of chips prior to pulping. An experimental chip pile was built at a bleached kraft mill. The bark content of the chips was about 6%. The temperature within the chip pile was monitored regularly at six different locations. The ambient air temperature appeared to have some effect on the interior temperature of the chip pile. Although the temperature in the center of the chip pile ranged from 30 degrees C near the start of the experiment to about 5 degrees C at the end of the test, it is not known whether there was a high microbiological activity within the pile at such temperatures. The toxicity of the blow liquor derived from the pulping of the aged lodgepole pine chips was decreased in comparison to that of blow liquor derived from the pulping of fresh wood chips, by as much as 39% for liquor which had been produced from 26 week old chips. For spruce chips there was no appreciable change in toxicity. A loss of acetone-soluble and ether-soluble extractibles for both pine and spruce chips took place during storage. The decrease in resin acids in blow liquor was noted to be greater for pine than for spruce in storage. The biological oxygen demand of pine and spruce blow liquors was not changed substantially over the 26 week chip storage period. It was concluded that the toxicity of the blow liquor derived from the pulping of aged wood chips was decreased slightly in comparison to that of blow liquor derived from the pulping of fresh wood chips. The yield and quality of tall oil also declined. The loss of turpentine yield for both chips was considerable. Burst and tear strengths of pulps produced from aged wood chips were not altered appreciably. (Baker-FRC)
W82-01845

LOADING ESTIMATES TO LAKE ERIE, 1967-1976,
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 5A.
W82-01852

VARIATIONS AND MECHANISMS OF ASBESTOS FIBRE DISTRIBUTION IN STREAM WATER,
National Water Research Inst., Vancouver (British Columbia). Pacific and Yukon Region.
For primary bibliographic entry see Field 5A.
W82-01853

INTERLABORATORY QUALITY CONTROL STUDY NO. 26, ARSENIC AND SELENIUM IN WATER,
National Water Research Inst., Burlington (Ontario). Water Quality Branch.
For primary bibliographic entry see Field 5A.
W82-01854

THE NATURAL ACIDITY OF SOME UNPOLLUTED WATERS IN SOUTHEASTERN ALASKA AND POTENTIAL IMPACTS OF ACID RAIN,
Oak Ridge National Lab., TN. Environmental Sciences Div.
D. W. Johnson.
Water, Air and Soil Pollution, Vol 16, No 2, p 243-252, August, 1981. 1 Fig, 3 Tab, 29 Ref.

Descriptors: *Organic acids, *Baseline studies, *Acid rain, *Acidic water, *Watershed models, Forest watersheds, Watersheds, Acidic soils, Bogs, Color, Hydrogen ion concentration, Alkalinity, Model studies, Minerals, Surface water, Anions, Cations, Sulfates, Alaska.

Near Petersburg, Alaska, natural, unpolluted waters draining surface soils and bog soils containing organic acids display pH values below 4.7. Nearby streams have pH values around 6 or slightly below. Studies were carried out to determine the role of carbonic and organic acids in forest soil leaching processes at this site as compared to others in Washington and Costa Rica. Water samples were collected and analyzed for color, pH, alkalinity and various minerals, anions and cations. Projections of the effects of acid rains and organic acids were formulated using a worst-case model. Results showed that the greatest potential declines in pH would occur in the already acidic waters, while very little change would occur in the near neutral waters. In neither case do the predicted changes in acidity present cause for alarm, since the occurrence of acidic precipitation is not common in this area at present. The findings of this forest watershed study may serve as background data in the event of future pollution by sulfate inputs. (Geiger-FRC)
W82-01867

DEPOSITION OF SULPHUR GASES FROM MULTIPLE SCATTERED SOURCES IN ALBERTA,
Department of Agriculture, Lacombe (Alberta). Research Station.
D. R. Walker, A. C. Dick, and M. Nyborg.
Water, Air, and Soil Pollution, Vol 16, No 2, p 223-231, August, 1981. 2 Fig, 6 Tab, 11 Ref.

Descriptors: *Water pollution sources, *Sulfur, *Fate of pollutants, *Air pollution effects, Path of pollutants, Industrial wastes, Air pollution, Sulfate, Environmental effects, Crop yield, Legumes, Rainfall, *Alberta, Canada.

The deposition of sulfur (S) on soils, plants, and free water surfaces was studied at 47 monitoring stations located in the Canadian provinces of Alberta and Saskatchewan. Results were analyzed in relation to sampling site distance from industrial S emission sources. Approximately 7 to 9 kilograms/hectare of sulfate sulfur was deposited annually in a 4600 sq km area containing or adjacent to ten S emission sources with provincially-set emission standards of 330 tons of S/day. The annual S deposition rate declined to 4 to 6 kilograms/hectare at distances of 40 or more km from the S emission sources. S levels in rainfall ranged from 0.7 to 3.9 kilograms/hectare in the high S emission area. Free-water surface sites within the high S emission area adsorbed 2 to 3 times the amount of S adsorbed at sites 40 or more km away from the S emission sources. Lower yields of legume crops were obtained for non-fertilized plots far away from S emission sites than for non-fertilized plots close to S emission sources. (Geiger-FRC)
W82-01868

THE MERCURY CYCLE,
Swedish Water and Air Pollution Research Lab., Goeteborg (Sweden).
C. Brosset.
Water, Air, and Soil Pollution, Vol 16, No 2, p 253-255, August, 1981. 1 Fig.

Descriptors: *Path of pollutants, *Mercury, *Lakes, *Water pollution, *Air pollution, Heavy metals, Precipitation, Metal complexes, Seasonal variation, Fate of pollutants, Hydrogen ion concentration, Pesticide kinetics, *Sweden.

An intensive study of Hg in air, precipitation, and lake water in Sweden has resulted in the development of a tentative model for the cycling of this heavy metal. In the ground layer air mercury is present mostly as a metallic vapor. The total concentration of Hg decreases, but the ratio of water-soluble Hg to total mercury increases, with height above the ground. Most of the water-soluble Hg is formed in the air by oxidation or methylation and

is wet and dry deposited in the water phase of terrestrial and aquatic systems. Deposited Hg is reduced to metallic vapor and temporarily or permanently bound to condensed phases. The reaction velocity of these processes determines the level of respective Hg compounds in the water phase. The reemission of mercury vapor into the atmosphere shows a seasonal variation, while the magnitude of reemissions is determined by specific properties of the local receptor. Data supporting the proposed mercury cycle is discussed. High concentrations of methylmercuric chloride generally are found in lakes with low water pH. Levels of this mercury compound in fish meat seem to be directly related to the concentration of methylmercuric chloride in lake water. (Geiger-FRC)
W82-01869

TRANSPORT OF NONPOLAR ORGANIC COMPOUNDS FROM SURFACE WATER TO GROUNDWATER. LABORATORY SORPTION STUDIES,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschutz, Zurich (Switzerland).
R. P. Schwarzenbach, and J. Westall.
Environmental Science and Technology, Vol 15, No 11, p 1360-1367, November, 1981. 5 Fig, 5 Tab, 27 Ref.

Descriptors: *Organic compounds, *Sorption, *Infiltration, Fate of pollutants, Path of pollutants, Chlorinated hydrocarbons, Hydrocarbons, Leaching, Landfills, Groundwater recharge, Recharge, Water treatment, Aquifers, Sediments.

Sorption equilibria for low concentrations of nonpolar organic compounds of low to intermediate lipophilicity in a river water-groundwater infiltration system were described by the equation S = K sub p times C, where S = concentration in liquid phase. Sorption by aquifer materials was reversible. This relationship is important in several applications: treatment of river water by artificial or natural bank infiltration, artificial groundwater recharge, and leaching of pollutants from landfills. Laboratory experiments were conducted using toluene; di-, tri-, and tetramethylbenzenes; n-butylbenzene, tetrachloroethylene, chlorobenzene, and di-, tri-, and tetrachlorobenzenes with several sorbents (natural river and lake sediments, kaolin, silica, and activated sewage sludge). For a variety of sorbents, the partition coefficient for a particular compound can be estimated from its 1-octanol/water partition coefficient and from the organic carbon content of the sorbents if the amount of organic carbon is greater than 0.1%. The compounds under investigation were highly mobile in organic-poor sorbents. Flow velocities affected sorption kinetics and thus material transport. (Cassar-FRC)
W82-01873

THE SIGNIFICANCE OF WET AND DRY SYNOPTIC REGIONS ON LONG-RANGE TRANSPORT OF POLLUTION AND ITS DEPOSITION,
British Meteorological Office, Bracknell (England).
F. B. Smith.
Atmospheric Environment, Vol 15, No 5, p 863-873, 1981. 7 Fig, 4 Tab, 6 Ref.

Descriptors: *Pollutants, *Precipitation, *Fallout, Synoptic analysis, Rainfall, *Air pollution, Mathematical studies, Sulfur dioxide, Model studies.

This paper has developed the idea of Rodhe and Grandell for differentiating between synoptic regions with a high probability of rain and those with little or no rain in the average Lagrangian removal of sulfur pollution from air in the boundary layer. To describe this intermittent wet deposition, four simultaneous rate of change equations were presented and solved. The equations also include the effects of dry deposition, oxidation of sulfur dioxide to sulfate, and the probability that the pollution may be advected from dry regions into wet regions and vice versa. The wet deposition terms reflect the geographical variation of long-term average rainfall and the variation of the probability of rain with wind direction. The equations thus represent the average statistical fate of pollution on its way from its source to a specified receptor. As an example, the average wet deposition rates at Frankfurt for different wind directions were compared on the assumption that all the sulfur pollution originates from a ring of imaginary equal continuous sources 900 km upwind. Three main conclusions were reached. First, the wet depositions were significantly different from those obtained using the simple model which fails to differentiate between mobile wet and dry synoptic regions. Second, the results are somewhat insensitive to the selected magnitudes of the parameters, which is fortunate, as they are not accurately known. Third, the wet depositions are not highly sensitive to the upwind average rainfall probability distributions. Typically, variations of only 20% in average wet-deposition rates with wind direction are implied. (Baker-FRC)
W82-01877

TRANSPORT OF SALTS IN CATCHMENTS AND SOILS,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Forest Research.
For primary bibliographic entry see Field 2G.
W82-01880

TOXICANT ACCUMULATION IN HYDROBIONT TISSUES FOLLOWING EFFLUENT DISCHARGE,
Irkutskii Gosudarstvennyi Univ. (USSR). Biological and Geographical Research Inst.
For primary bibliographic entry see Field 5C.
W82-01919

BIODEGRADATION OF SODIUM ALKYLBENZENESULFONATE IN PLANKTON-CONTAINING POND WATER,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
N. A. Potapova, N. P. Galagan, I. A. Babenko, and L. I. Bagnyuk.
Hydrobiological Journal, Vol 16, No 4, p 49-53, 1980. 1 Fig, 1 Tab, 9 Ref.

Descriptors: *Ponds, *Biodegradation, *Surfactants, *Bacteria, *Plankton, Dissolved oxygen, Sludge, Organic compounds, Industrial wastes, Fate of pollutants, Model studies, Water pollution effects.

This paper reports a small part of the current research on the biodegradation of sodium alkylbenzenesulfonate (SABS), an anionic surfactant, in model ecosystems of various complexity. The object of the study was to examine the decomposition of SABS in natural water containing plankton and the effect of SABS on the plankton biocenosis. The following parameters were investigated: temperature, pH of the medium, content of dissolved oxygen, total abundance of bacterioplankton and the ratio of morphological groups in it, bacterial destruction, aggregation, and dehydrogenase activity of the bacterioplankton. The degradation of the SABS was estimated from the alteration of its content in time. Experiments were carried out under laboratory conditions in June-July 1979. The aquaria were filled with pond water containing plankton and with the same water to which sludge from a pond had been added. Samples were taken on days 1, 3, 5, 10, 15, 20, 25, and 40. SABS was added to the experimental aquaria at a rate of 2 mg/l. The background SABS content in the control and experimental aquaria of both systems was 0.02-0.04 mg/l. The degradation of SABS within 40 days was complete in the system to which sludge was added, and 92% in the system without sludge. The addition of SABS did not affect dissolved oxygen content or the pH of the medium, but did change the structure and functional state of the bacterioplankton. Changes in bacterial destruction and in the aggregation of the bacterioplankton were dependent on the level of degradation of SABS and on the type of system, whereas changes in dehydrogenase activity were dependent solely on SABS concentration. A strong negative correlation between the aggregation of the bacterioplankton and bacterial destruction was noted. (Baker-FRC)
W82-01925

THERMOPHILLIC AND THERMOTOLERANT FUNGI ISOLATED FROM THE THERMAL EFFLUENT OF NUCLEAR POWER GENERATING REACTORS: DISPOSAL OF HUMAN OPPORTUNISTIC AND VETERINARY PATHOGENIC FUNGI,
Chicago Univ., IL. Dept. of Medicine.
J. W. Rippon, R. Gerhold, and M. Heath.
Mycopathologia, Vol 70, No 3, p 169-179, 1980. 1 Fig, 13 Tab, 22 Ref.

Descriptors: *Fungi, *Public health, *Thermal water, Fate of pollutants, Aspergillus, Pathogens, Cooling water, Thermophilic fungi, Powerplants, Quad Cities Power Plant, Illinois, Nuclear powerplants.

Samples of water, foam, microbial mat, soil, and air obtained near the Quad Cities Power Station, Illinois, during 1977-78 contained 53 species of thermotolerant and thermophilic fungi. Eleven species of opportunistic Mucocorales and Aspergillus and 1 veterinary pathogen, Dactylaria gallopava, were found in soil, water, foam, and mat in the intake bay, discharge bay, and cooling canal, where the water is warm. Aspergillus fumigatus was most numerous. In areas of cooler water the opportunistic fungi decreased in abundance. Air samples from 6 locations contained 9 species of fungi in low abundance. This study confirms that there is little public health hazard due to dissemination of thermophilic fungi from the pow[illegible] plant area to the environment. (Cassar-FRC)
W82-01928

ACID RAIN AGREEMENT,
R. J. Smith.
Science, Vol 209, No 4459, p 890, August 22, 1980.

Descriptors: *Acid rain, *International agreements, *Political constraints, Canada, Water quality control, Institutional constraints, Water pollution sources.

Scientific working groups from Canada and the U.S. have been established to prepare for acid rain negotiations scheduled for June 1981. The groups will take air samples and estimate impact of acid rain on the environment, determine the precise origin of acid rain, and develop a strategy for abatement. Some constraints on the negotiations are costs (potentially $400-500 million for Canada and 5 to 8 times that for the U.S. between now and 2000), the relative independence of Canada's provinces, and the U.S. utility lobby. (Cassar-FRC)
W82-01933

CHROMIUM LEVELS IN FISH FROM A LAKE CHRONICALLY CONTAMINATED WITH CHROMATES FROM COOLING TOWERS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
J. W. Elwood, J. J. Beauchamp, and C. P. Allen.
International Journal of Environmental Studies, Vol 14, No 4, p 289-297, 1980. 2 Fig, 4 Tab, 33 Ref.

Descriptors: *Chromium, *Fish, *Cooling water, Fate of pollutants, White Oak Lake, Melton Hill Reservoir, *Tennessee, *Reservoirs, Lakes, Chromates, Metals, Heavy metals, Bluegills, Mosquitofish, Bass, Absorption, Accumulation.

Chromium levels in fish were determined in White Oak Lake, contaminated with chromates from cooling water blowdown, and the nearby uncontaminated Melton Hill Reservoir. Total Cr levels (in mg per liter) in White Oak water were 0.1-0.3 in 1969, 0.1 in 1973, and 0.01-0.14 in 1974. Fish species were bluegill (Lepomis macrochirus), largemouth bass (Micropterus salmoides), goldfish (Carassius auratus), and mosquitofish (Gambusia affinis). Results suggest that Cr levels in muscle and whole body of most species analyzed are inversely related to fish weight. Mean Cr concentration (in micrograms per g) in bluegill were 1.22, muscle

and 1.45, whole body; and in largemouth bass 0.51, muscle and 0.82, whole body. There were no significant differences between Cr levels in: (1) bluegill vs. largemouth bass, (2) whole body vs. muscle tissues, and (3) fish from the contaminated vs. the uncontaminated reservoirs. Goldfish collected in 1969 contained 9.79 micrograms per g (whole body), and 0.92 micrograms per g in 1973. Feeding habits apparently did not affect Cr levels. It is possible that fish can regulate Cr concentrations actively by reduced absorption and/or increased secretion of Cr or passively by a limitation of binding sites, or that some of the Cr is in a non-absorbable form. (Cassar-FRC)
W82-01941

THE CONTAINMENT OF AN OIL SLICK BY A BOOM PLACED ACROSS A UNIFORM STREAM,
McGill Univ., Montreal (Quebec). Dept. of Civil Engineering and Applied Mechanics.
For primary bibliographic entry see Field 1B.
W82-01956

INORGANIC CHEMISTRY OF PARTICULATE MATTER FROM THE NEARSHORE ZONE OF LAKE MICHIGAN,
Michigan Univ., Ann Arbor. Great Lakes and Marine Waters Center.
For primary bibliographic entry see Field 2H.
W82-01959

SELENIUM: A WATER POLLUTANT FROM FLUE GAS DESULFURIZATION,
Slippery Rock State Coll., PA. Dept. of Chemistry.
W. G. Sayre.
Journal of the Air Pollution Control Association, Vol 30, No 10, p 1134, 1980. 1 Tab, 3 Ref.

Descriptors: *Selenium, *Industrial wastes, Water pollution sources, Groundwater pollution, Water quality, Drinking water, Public health.

Small discharges of the blowdown water from the scrubber loop of some flue gas desulfurization techniques could cause large scale problems of surface or groundwater pollution. This discharge would contain maximum SeO3(-2) concentrations of 15.2 mg/liter and maximum concentrations of SeO4(-2) of 1.1 times 10 to the 6th power mg/liter. The levels of selenate and selenite are many orders of magnitude larger than permissible levels for drinking water. (Small-FRC)
W82-01960

MIXING ZONE ANALYSIS FOR RIVER PLUMES,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
P. P. Pialy.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE4, p 731-746, August, 1981. 5 Fig, 3 Tab, 13 Ref.

Descriptors: *Thermal pollution, *Mathematical models, *Temperature effects, Water pollution, Mixing, Nuclear powerplants, Water cooling, Water quality standards.

Steam-electric powerplants which utilize open-cycle cooling of plant condensors discharge heated water directly into natural water bodies. This results in the formation of thermal plumes in the receiving water in regions adjacent to the discharge outfall, with a mixing zone, in which the temperature gradient is largest, occurring near the outfall. Allowable maximum sizes for these mixing zones are usually specified for a given plant for both a seasonal mean flow condition and a seasonal worst-case flow, generally equal to the 7-day, 10-year low flow for the season. This paper describes a method for using field data from thermal plume surveys to develop mixing zone models capable of evaluating the effects of thermal discharges. These models can be used to develop proper compliance criteria for powerplant operations at low river flows. If the regulatory agency which routinely reviews and verifies the powerplant compliance with the applicable standards accepts and approves the data sets generated by these models for a given powerplant, it may waive the requirement for monthly plume surveys, which are commonly required under current regulations. (Carroll-FRC)
W82-01961

UPLAND MARSH FOR WATER QUALITY CONTROL,
Agricultural Research and Education Center, Lake Alfred, FL.
S. F. Shih.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE4, p 861-864, August, 1981. 1 Fig, 2 Tab, 3 Ref.

Descriptors: *Marshes, *Time series analysis, *Water quality control, Wastewater treatment, Wetlands, Nutrients, Mathematical studies, Vegetation, Plant growth, *Plant nutrient uptake.

Although many studies have investigated the use of vascular plants to improve the water quality of fresh water marshes, previous researchers have not emphasized the application of models to determine plant nutrient uptake in marshes. This study used time series analysis to analyze plant nutrient uptake, used the F-test as the statistical criterion to determine the possibility of any component existing in series, and demonstrated the application of time series analysis to interpolate missing data. Since plant nutrient uptake is a function of time, time series analysis can be used to observe the trends, cyclical movement, and residual pattern of a water quality system in marsh areas. Total phosphate data taken at 4 hour intervals over a 5 day period in September was used to demonstrate the application of time series analysis. The Fourier coefficients, amplitude, phase angle, and percent of variance were determined for each harmonic at three sampling sites. The Fourier analysis showed that three harmonics explained over 83 percent of the variance. The amplitudes were much smaller in the marsh than in the slough, confirming the reduction of total phosphate after the water flowed through the marsh zone. Interpolation of missing data based on time series function resulted in somewhat higher values than estimations based on conventional linear function. The F-test for the cyclic function component of the marsh site was significant at the 0.01 level, demonstrating the existance of the cyclic component in the marsh zone system. (Carroll-FRC)
W82-01962

THE MODELING OF AQUATIC ECOLOGICAL SYSTEMS,
Akademiya Nauk URSR, Kiev. Inst. Kibernetiki.
A. G. Ivakhnenko.
Hydrobiological Journal, Vol 16, No 3, p 1-9, 1980. 4 Fig, 1 Tab, 25 Ref.

Descriptors: *Mathematical models, *Ecosystems, *Forecasting, *Water pollution sources, Planning, Mathematical studies, Statistical methods, Computers, Water quality, Lakes, Reservoirs, Lake Baikal, Dnieper reservoirs, USSR.

General properties of mathematical models of aquatic ecological systems are discussed, and modeling languages, typical input and output requirements, and problems with models are considered. Output variables that adequately describe the state of the object have to be selected. A support function and a structure for the mathematical model, such as order of derivatives, must be selected. Estimates of the parameters or coefficients of the model must also be obtained. A computer can be used to scan a large number of variables and determine which equations are most useful to the model. Long term forecasting and the optimization of the planning of water systems are two applications for aquatic system models. The uses of these techniques are illustrated by examples from Lake Baikal and the Dnieper chain reservoirs. (Small-FRC)
W82-01972

DREDGED MATERIAL EVALUATIONS: CORRELATIONS BETWEEN CHEMICAL AND BIOLOGICAL EVALUATION PROCEDURES,
For primary bibliographic entry see Field 5C.
W82-01985

SCALE-DEPENDENT DISPERSION IN A STRATIFIED GRANULAR AQUIFER,
National Hydrology Research Inst., Ottawa (Ontario).
For primary bibliographic entry see Field 2F.
W82-01986

ACID RAIN AND ENVIRONMENTAL POLICY,
Thompson (Boyce) Inst., Ithaca, NY.
J. S. Jacobson.
Journal of the Air Pollution Control Association, Vol 31, No 10, p 1071-1073, October, 1981. 1 Tab, 14 Ref.

Descriptors: *Acid rain, *Decision making, Acidity, Rainfall, Cost-benefit analysis, Economic aspects.

Various seemingly paradoxical scientific questions are posed which relate to the problem of acid rain and its effect on the environment and environmental policy. The first paradox discussed concerns the supposed increase in fossil fuel usage over the last several decades, with the resultant increases in emissions of pollutants from the combustion of fuels which cause acid rain. Despite these increases, experts do not agree on whether acidity of rain has increased in eastern North America. The second paradox concerns the effect of acid rain on vegetation. If the rain is supposedly harmful, why have some reports shown increases and others, decreases in the growth of crops and trees with the application of simulated acid rain. The third paradox concerns the effect of acid rains on fish life in lakes. If acid rain falls throughout eastern North America, why have some lakes become acid and lost fish populations while others have not. Since unequivocal answers to these scientific questions are not available, a systematic approach is needed for developing policy which can be useful for solving the problem. It appears that traditional cost-benefit analysis can not be the sole basis for decision-making, but that it will be helpful. Research needs must be identified, and the upper and lower limits for alternative strategies must be determined. (Baker-FRC)
W82-01987

A NATIONAL SURVEY OF TRI(HALOALKYL)-, TRIALKYL-, AND TRIARYLPHOSPHATES IN CANADIAN DRINKING WATER,
Environmental Health Directorate, Ottawa (Ontario).
D. T. Williams, and G. L. LeBel.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 4, p 450-457, October, 1981. 3 Tab, 14 Ref.

Descriptors: *Potable water, *Organophosphorus compounds, *Canada, Phosphates, Rubber, Drinking water, Water pollution sources.

Twenty-nine municipalities across Canada were chosen for a survey regarding potable water contaminants. Samples of potable water were collected twice a year at the treatment plant of each municipality. Contaminants investigated included tri(haloalkyl)-, trialkyl- and triarylphosphates (TAP). A comparison of TAP levels with raw water sources indicated that higher TAP levels were found in potable water obtained from river sources as compared to lake sources. Groundwater sources in general gave very low TAP levels in the treated water. Of the drainage basins involved, St. Lawrence, Great Lakes, and Lake Winnipeg basins have higher levels of TAP compared to Atlantic Sea Board, Columbia, and Pacific Sea Board basins. The fraction of TAP values greater than 10 ng/liter was only 10% with the exception of tributoxyethyl phosphate, for which values were higher than 10 ng/liter. This compound is used in rubber gaskets such as those installed in plumbing, and high contaminant levels can result if water is left standing in water pipes. Studies are suggested to

locate the specific sources of TAP contamination. (Baker-FRC)
W82-01989

MATHEMATICAL MODELING OF STREAM WATER QUALITY BY A NEW MOMENT METHOD: FIELD INVESTIGATION OF A TIDAL RIVER,
National Cheng Kung Univ., Tainan (Taiwan). Dept. of Environmental Engineering.
For primary bibliographic entry see Field 7B.
W82-01995

COMPARATIVE LIMNOLOGY OF INNER LONG POINT BAY, LAKE ERIE, AND ADJACENT WATERS OF THE OUTER BAY,
Ontario Ministry of Natural Resources, Wheatley. Lake Erie Fisheries Research Station.
J. H. Leach.
Journal of Great Lakes Research, Vol 7, No 2, p 123-129, 1981. 2 Fig, 3 Tab, 24 Ref.

Descriptors: *Limnology, *Lakes, *Water pollution effects, Aquatic productivity, Nutrients, Shallow water, Bays, Deep water, Alkalinity, Dissolved oxygen, Water properties, *Lake Erie, Long Point Bay.

Water quality and productivity were investigated in the Inner and Outer Long Point Bay, and current limnological conditions in the Inner Bay were compared with the results of a 1962 study. The Inner Bay is unique, as it has not been subjected to the pollutant loadings from point sources typical of most of the bay. The area east of the bay is currently undergoing industrial and urban development, and this study will provide benchmark data against which future studies of the environment can be compared. The Inner Bay, because of shallow depth and higher nutrient regimes, was more productive than the Outer Bay and had extensive macrophyte growths and higher chlorophyll alpha standing crops. All fourteen parameters studied were significantly different in the two bays except for nitrate, total alkalinity, and dissolved oxygen. The Inner Bay is eutrophic while the Outer Bay is mesotrophic. Changes in the Inner Bay since the 1962 study included increases in nitrate and nitrite and total alkalinity. (Small-FRC)
W82-02005

GEOLOGIC ASPECTS OF WASTE DISPOSAL SITE EVALUATIONS,
Law Engineering Testing Co., Marietta, GA.
For primary bibliographic entry see Field 5E.
W82-02011

ENVIRONMENTAL FATE OF METHYL EUGENOL,
Science and Education Administration, College Station, TX. Cotton Insects Research Lab.
T. N. Shaver, and D. L. Bull.
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 4, p 619-626, 1980. 4 Fig, 1 Tab, 6 Ref.

Descriptors: Environmental effects, *Pesticides, Organic compounds, *Tomatoes, Soil analysis, Crop production, Agricultural chemicals, Water sampling, Chemical analysis, Leaching, Radioactive half-life, Bioaccumulation, Radioactive tracers, Radioisotopes, Carbon, Chromatography, *Methyl eugenol, *Fate of pollutants.

The fate of methyl eugenol in soil, water, and tomatoes is described. Methyl eugenol is a compound used as a synthetic lure in fruit fly control programs. Samples of radioactive and nonradioactive methyl eugenol were prepared and applied to soil, water and tomatoes. The half-life of methyl eugenol was measured in the samples, and samples were analyzed for the presence of eugenol. Results indicate that methyl eugenol dissipates rapidly from soil and water. About 98% of the material was lost within 96 hr at 32 degrees C. Leaching studies indicate that the compound is immobile in the soils tested, sand and loam. Only 3.8% of the applied dose of methyl eugenol was recovered after a 24 hr period from tomatoes treated topically. A small increase in unextractable radiocarbon was noted in the tomato pulp after 3 days. (Titus-FRC)
W82-02013

PARASITE OVA IN ANAEROBICALLY DIGESTED SLUDGE,
Cutter Lab., Shawnee, KS. Bayvet Div.
R. G. Arther, P. R. Fitzgerald, and J. C. Fox.
Journal of the Water Pollution Control Federation, Vol 53, No 8, p 1334-1338, August, 1981. 3 Tab, 24 Ref.

Descriptors: *Parasite, *Eggs, *Sludge lagoons, Land application, Lagoons, Diseases, Public health, Pathogens, Sludge disposal, Water pollution sources, Fate of pollutants, Anaerobic digestion, Nematodes, *Chicago.

Lagooned anaerobically digested sludge samples from the Metropolitan Sanitary District of Greater Chicago were examined for viable parasitic ova on four dates during 1976 and 1977. Mean numbes of ova per 100 g dry lagooned sludge and the % capable of embryonation were as follows: Ascaris spp., 203, 24%; Toxocara spp. 173, 10%; Toxascaris leonina, 48, 43%; and Trichuris spp., 36, 6%. In fresh anaerobically digested sludge 20-64% of ova were capable of embryonation. The fact that ova of four genera of parasites survived anaerobic sludge digestion and lagooning shows that land application methods should be carefully evaluated. Conditions which favor development of parasites into transmissible forms are overhead spraying and surface irrigation. Subsurface injection and deep trench operation decrease the number and concentration of ova dispersed on the surface and reduce the oxygen available to the ova. However, subsurface application would also protect the ova from ultraviolet light and dehydration, which are unfavorable for embryonation. Sources of these parasitic ova are infected humans, pigs, dogs, and cats; they reach the sewer system from pasture runoff, slaugherhouses, street runoff, and animal shelter wastewater. (Cassar-FRC)
W82-02018

AQUATIC MICROBIOLOGY WITH REFERENCE TO TANNIN DEGRADATION,
Madras Univ. (India). Centre of Advanced Study in Botany.
A. Mahadevan, and G. Muthukumar.
Hydrobiologia, Vol 72, No 1/2, p 73-79, July, 1980. 3 Fig, 2 Tab, 42 Ref.

Descriptors: *Tannins, *Aquatic fungi, *Microbial degradation, Reviews, Degradation, Biodegradation, Fungi, Aquatic bacteria, Aquatic environment, Organic compounds, *Tannery wastes, Chemical properties, Microorganisms, Waste treatment, Microbiological studies, Water pollution sources, Fate of pollutants.

This review discusses tannin degradation in the aquatic environment. Tannins reach the rivers of India from many sources, notably tannery wastes. Plant tannins are amorphous, water soluble, polyhydroxy polyphenolic substances of molecular weights 500-3000, which form complexes with proteins and polymerize. Tannins are toxic to many microorganisms and inhibit microbial growth by suppressing respiration, nitrification, or enzyme action. The compounds may be degraded by some bacteria, yeast, and fungi, but vary in their susceptibility according to chemical form and particular organism. Microorganisms which can degrade tannins belong to the following species: Fusarium, Cylindrocarpon, Endothia, Achromobacter, Pseudomonas, Aspergillus, Penicillium and others. Degradation of tannins is greater in sugar-free media and with nitrogen sources such as sodium nitrate and ammonium sulfate. (Cassar-FRC)
W82-02028

PLANT BIOTESTS IN THE BIOINDICATION OF THE RAINFALL POLLUTION IN AN OIL REFINERY REGION,
Akademia Rolniczej, Warsaw (Poland). Inst. of Environmental Protection.
For primary bibliographic entry see Field 5C.
W82-02033

TERRAIN, GROUNDWATER AND SECONDARY SALINITY IN VICTORIA, AUSTRALIA,
Soil Conservation Authority of Victoria, Kew (Australia).
For primary bibliographic entry see Field 2F.
W82-02046

BROMIDE IN CANTERBURY GROUND WATER,
Department of Scientific and Industrial Research, Christchurch (New Zealand). Chemistry Div.
E. T. J. Bathurst, L. J. Thomson, and L. F. Wilkinson.
New Zealand Journal of Marine and Freshwater Research, Vol 14, No 4, p 409-411, 1980. 2 Fig, 3 Ref.

Descriptors: *Bromides, *Industrial wastes, Methyl bromide, Path of pollutants, Water pollution sources, *New Zealand, *Groundwater pollution.

Citizens living south and west of Christchurch, New Zealand, draw their water from unconfined aquifers, which are feared to be contaminated with methyl bromide industrial wastes. Analysis of 250 of the 600 wells in the area showed a bromide:chloride ratio which was constant and close to that of natural waters. Although a few wells had bromide levels as high as 0.2 mg per cu meter and high levels of dissolved ions, these higher concentrations were not widespread. It was concluded that the present bromide levels were no threat to health. (Cassar-FRC)
W82-02056

DEGREE OF POLLUTION OF SEVERAL MAJOR STREAMS ENTERING TOLO HARBOUR, HONG KONG,
Chinese Univ. of Hong Kong, Shatin. Dept. of Biology.
M-H. Wong, KC. Ho, and TT. Kwok.
Marine Pollution Bulletin, Vol 11, No 2, p 36-40, February, 1980. 2 Fig, 7 Tab, 16 Ref.

Descriptors: *Water pollution sources, *Industrial wastes, *Municipal wastes, River water, *Tolo Harbour, *Hong Kong, Land development, Marine environment, Marine sediments, Nitrogen, Phosphorus, Cadmium, Copper, Iron, Manganese, Lead, Zinc, Organic compounds, Path of pollutants.

Tolo Harbour is a land-locked sea in Hong Kong which has only a narrow outlet. Although untreated domestic and industrial wastes discharged into the harbor via several major streams are expected to be diluted and flushed away by tidal waves, decreasing volume of water in the harbor has led to low dilution of the wastes. Water and sediment samples from eight rivers were analyzed for total nitrogen content, total phosphate, cadmium, copper, iron, manganese, lead, and zinc. The sediment samples were also examined for total organic carbon. The pH of the water samples ranged from 6.0 to 8.1, with values falling between 6.8 and 7.8 for most rivers. Five of the rivers showed extremely low dissolved oxygen values, indicating that these rivers were bacteriologically active and contaminated by organic wastes. All of the water samples showed only trace amounts of phosphate. The high nutrient load in the sediments of two of the rivers indicates serious organic pollution. Water samples collected from seven of the eight rivers were found to contain one or more metal pollutants in concentrations exceeding the upper safety limits for drinking water. Sediments for five of the rivershad high levels of one or more heavy metals. Three rivers were found to be grossly polluted by both organic and inorganic contaminants. Strong legislation regarding the discharge of untreated wastes, careful planning of residential and industrial development, and a plan for final disposal of pig and poultry manure from agricultural areas are needed to prevent further deterioration of the harbor's environment. (Carroll-FRC)
W82-02058

THE DYNAMICS OF ANAEROBIC PHENOL BIODEGRADATION IN LOWER GREENLAND,

Harwell Lab., Oxon (England). Environmental and Medical Sciences Div.
J. F. Rees, and J. W. King.
Journal of Chemical Technology and Biotechnology, Vol 31, No 5, p 306-310, May, 1981. 2 Fig, 2 Tab, 12 Ref.

Descriptors: *Phenols, *Biodegradation, *Landfills, Leaching, Anaerobic digestion, Percolation, Simulation analysis, Waste disposal, Groundwater pollution, Mathematical equations.

The high solubility and poor adsorption of phenol by domestic refuse in a landfill environment can result in the leaching of phenol and pollution of groundwater. The most significant mechanism for reducing the concentration of phenol within the landfill and within an underlying porous rock formation may be anaerobic biodegradation. An artificial landfill leachate containing phenol was percolated through columns of disturbed Lower Greensand in an effort to establish the rates of anaerobic phenol degradation in a porous rock formation and to identify inhibitory concentrations of phenol and other factors affecting those rates. Phenol degradation was observed at concentrations up to 8.2 grams per cubic decimeter, but decomposition was increasingly inhibited above 3.0 grams per cubic decimeter. Maximum decomposition rates were observed at concentrations ranging from 1.5 to 3.0 grams per cubic decimeter. The maximum reaction velocity values at a flow of 0.5 cubic centimeters per hour was 1.05 grams per cubic decimeter per hour, and the Michaelis constant value was 450 milligrams phenol per cubic decimeter. The zero order rate constant and first-order rate constant increased with increasing flow rate. The data were used to develop equations for calculating the rates of phenol degradation in a real landfill. (Carroll-FRC)
W82-02071

USE OF KNOPP'S METHOD TO ASSESS SELF-PURIFICATION PROCESSES IN WATER BODIES AND WATER COURSES,
Byelorussia Univ., Minsk (USSR). Experimental Biological Special Topics Research Lab.
G. A. Inkina, and N. V. Dubko.
Hydrobiological Journal, Vol 16, No 3, p 69-73, 1980. 3 Tab, 12 Ref.

Descriptors: *Water analysis, *Self-purification, Water quality, Microorganisms, Oxidation, Fate of pollutants, Biotransformation, Lakes, Rivers, *USSR, Volga River.

Research was carried out in lakes of different types and in the Svisloch and Volga Rivers as moderately polluted water courses, in order to obtain comparative data by Knopp's method on the self-purification capacity of waters of different origin and to test the method under different conditions. Unfiltered and filtered water were used; oxygen content was determined in the control and experimental flasks, as were the abundance of microorganisms, the doubling time of the bacterial biomass, and the rate of cell respiration. The lakes contained water ranging from pure through eutrophic to highly eutrophic in character. It was concluded that the 6 hour duration suggested for the experiment by Knopp was too short for the lakes investigated. The relative heterotrophic activity of the bacteria was determined by the method of Godlewska-Lipowa for the water bodies and water courses investigated. According to current data the coefficient of heterotrophic activity (A/B) should increase as the pollution of water bodies and water courses increased. Use of the method revealed an inverse relation between the A/B coefficient and the extent of trophicity of the lakes in contrast to the positive correlation found by Godlewska-Lipowa in the Mazurian lakes in Poland. It was thus found in the application of the methods of Knopp and Godlewska-Lipowa to water bodies and water courses of various types and degrees of pollution that these methods do permit some assessment of potential capacity of the aquatic microflora to mineralize organic matter of the protein and carbohydrate type. However, further development is needed, and these methods cannot now be recommended as standard methods of water assessment. (Baker-FRC)
W82-02073

HYDROLOGIC AND ANTHROPOGENIC FACTORS AFFECTING WATER QUALITY IN THE RIVERS OF THE UKRAINIAN CARPATHIANS,
Akademiya Nauk URSR, Kiev. Inst. Hydrobiologii.
V. M. Shmakov.
Hydrobiological Journal, Vol 16, No 3, p 62-66, 1980. 1 Fig, 2 Tab, 4 Ref.

Descriptors: *Rivers, *Water quality, *Ukraine, *Water pollution sources, Hydrologic properties, Hydrologic aspects, Flow characteristics, Flow rates, Flow discharge, Hydrodynamics, USSR.

The Dniester, Danube and Visla basins contain the rivers of the Carpathian region of the Ukraine. The mean annual discharge of all the rivers of the region is about 15 cubic kilometers. Water consumption in the region is about 17% of the annual discharge. A large part of the wastewater discharged by the various areas of the economy is treated so as to upgrade it to established standards. A portion of the water is discharged without treatment. Basic hydrologic factors which affect the water quality of the Carpathian rivers include water content, flow rate, water temperature, the vegetation of the basin, the soils and subsoils of the basin, and the state of the water surface. An increase in the water content of rivers improves their capacity for dilution and self-purification and has a positive effect on water quality. The rivers of the southwestern slope of the Carpathians have the greatest water content. The water content of the rivers changes in the course of the year. A high water period occurs from March to August in the mountains, with the least discharge noted in winter and autumn. The Volhynian-Podolian region is typified by a spring flood, a summer low-water period, autumn floods and a winter low-water period. An increase in water temperature increases its dissolving power and content of dissolved salts. The concentration of pollutants in the river waters in the individual zones of the region differs in relation to hydrologic conditions, the siting of industrial enterprises, and population densities. The effect of the anthropogenic factor on river water quality in the region is felt up to an altitude of 400-500 meters and is increased at lower altitudes. (Baker-FRC)
W82-02076

BACTERIOPLANKTON AND PHYTOPLANKTON IN THE KIEV SECTOR OF KANEV RESERVOIR DURING THE PERIOD OF ITS FORMATION,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
For primary bibliographic entry see Field 2H.
W82-02081

STREAM POLLUTION IN HONG KONG - AN APPRAISAL,
Hong Kong Univ. Dept. of Botany.
I. J. Hodgkiss.
Environmental Conservation, Vol 8, No 2, p 119-125, Summer, 1981. 1 Fig, 4 Tab, 16 Ref.

Descriptors: *Natural streams, *Hong Kong, *Water pollution sources, Water quality, Water law, Water pollution prevention, Environmental protection.

Stream pollution in Hong Kong is discussed, with an outline of the history of stream pollution, data on the magnitude of the present problem, and future prospects. Many of the lowland streams are severely polluted, despite government attempts to control effluent discharges to streams. Ordinances were seldom enforced in the past, but new legislation is being passed which can be effective if enforced. Until a government policy toward existing industrial dischargers is established there will be little relief. Also, agricultural discharges must be treated. If domestic, industrial, and agricultural pollution sources are controlled, stream quality can be improved. (Small-FRC)
W82-02084

HYDROCARBON CONCENTRATIONS IN WATER AND SEDIMENTS FROM UK MARINE WATERS, DETERMINED BY FLUORESCENCE SPECTROSCOPY,
Ministry of Agriculture, Fisheries and Food, Burnham-on-Crouch (England). Fisheries Lab.
R. J. Law.
Marine Pollution Bulletin, Vol 12, No 5, p 153-157, May, 1981. 3 Fig, 4 Tab, 15 Ref.

Descriptors: *Oil pollution, *Hydrocarbons, *Water analysis, *Path of pollutants, Water pollution sources, English Channel, North Sea, *United Kingdom, Irish Sea, Estuaries, Sediments, Pollutant identification, Organic compounds, Spectroscopy.

Sediment and water at the 1 meter depth were sampled in the North Sea, English Channel, Irish Sea, and several estuaries along the United Kingdom coast, January 1978 to September 1979. Fluorescence spectroscopy revealed that the mean total hydrocarbon concentrations of water samples were (in micrograms per liter, using Ekofisk light crude oil as a standard): northern North Sea, 1.3; western Channel, 1.5; eastern Channel and southern North Sea, 2.5; and Irish Sea, 2.6. Estuarine and coastal samples were higher in hydrocarbons, up to 74 micrograms per liter at the main entrance to the River Mersey, a heavily industrialized area. Sediment total hydrocarbon levels were 0.27 to 340 micrograms per g dry weight, based on Ekofisk crude oil as a standard, the higher values occurring inshore. The highest total hydrocarbon concentration in offshore sediments was 120 micrograms per g at the Norfolk gas field. Water sampling 22 days after the wreck of the tanker, Amoco Cadiz, on the Brittany coast in early 1978 showed higher concentrations than in the following year. Concentrations of hydrocarbons were higher in fine sediments than in coarse sediments. (Cassar-FRC)
W82-02097

AMERICIUM IN INTERTIDAL SEDIMENTS FROM THE COASTAL ENVIRONS OF WINDSCALE,
Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
S. R. Aston, and D. A. Stanners.
Marine Pollution Bulletin, Vol 12, No 5, p 149-153, May, 1981. 6 Fig, 2 Tab, 13 Ref.

Descriptors: *Americium, *Radioisotopes, *Nuclear energy, Plutonium, Water analysis, Sediments, Intertidal areas, Windscale, *Ravenglass Estuary, Path of pollutants, England.

Americium activities ranged from < 3 pCi per g to 191 pCi per g in intertidal sediments collected along the open coast and embayments of northwest England. The study centered on Ravenglass Estuary, 10 km south of the Windscale nuclear fuel reprocessing plant. Greatest activities were found in the Ravenglass Estuary (River Esk, mean 69 pCi per g; River Irt, mean 60 pCi per g). These levels are 7 times higher than levels found in sediments 10 km from Windscale in the northeast Irish Sea (15-47 pCi per g). Study of a 10 meter x 10 meter area showed no correlation of americium activity with grain size of sediment. However, americium activities ranged from 46.9 to 195.8 pCi along a transect through salt marsh (mean activity 102.8 pCi per g), silt bank (mean 65.6 pCi per g) and channel section. Explanations for this enrichment in the marshes were: (1) only spring tides at high water cover this area, and (2) the rate of sediment accumulation is slow and may allow americium formation from plutonium in the surface sediments. (Cassar-FRC)
W82-02098

5C. Effects Of Pollution

ACID PRECIPITATION,
B. Hileman.
Environmental Science and Technology, Vol 15, No 10, p 1119-1124, October, 1981. 7 Fig.

Descriptors: *Water pollution effects, *Acid rain, *Air pollution effects, *Fishkill, Air pollution, Fallout, Drinking water, Water pollution, Precipi-

tation, Environmental effects, Aquatic life, Hydrogen ion concentration, Water pollution sources, Nitrogen compounds, Sulfuric acid, Runoff, Water pollution control.

When acid precipitation falls on areas that lack calcium carbonate, the acid is not neutralized and the runoff may acidify nearby lakes and streams killing fish and other aquatic organisms. Significant portions of Ontario, Quebec, and the eastern United States receive precipitation that is about 40 times more acidic than background values. Acid deposition into the atmosphere is caused mainly by emissions of SO2 and nitrogen oxides from the burning of fossil fuels. The sulfate ion also exchanges readily with calcium ions in soil leaving hydrogen ions behind to acidify the soil and water contained in a watershed. It has been difficult to assign a relative importance to man-made and natural sources as causative agents for acid precipitation. Acid waters tend to dissolved aluminum compounds, thus releasing aluminum ions which are very toxic to fish. Often in acidic lakes, filamentous algae and fungi proliferate. The loss of fish and many amphibians from acidified waters may affect populations of birds that feed on these organisms. Acid rain leaches many major minerals and trace metals from soils. It may also retard the decay of leaves slowing the rate of return of nutrients to the soil. Acid rain may cause drinking water supplies to become contaminated by heavy metals. Some emission control strategies and regulatory measures to control the problem are discussed. (Geiger-FRC)
W82-01607

AN ALTERNATIVE FOR MEETING THE NITRATE STANDARD FOR PUBLIC WATER SUPPLIES,
Harvard School of Public Health, Boston, MA. Dept. of Epidemiology.
G. F. Craun.
Journal of Environmental Health, Vol 44, No 1, p 20-25, August, 1981. 29 Ref.

Descriptors: *Drinking water, *Nitrates, *Water pollution effects, Potable water, Nitrites, Human diseases, Diseases, Public health, Epidemiology, Water pollution sources, Water treatment, *Methemoglobinemia, Infants.

In 1945, nitrate in drinking water was first associated with methemoglobinemia in infants. The development of the disease depends on the bacterial conversion of nitrate to nitrite before or after ingestion and occurs almost exclusively in infants less than 3 months old. Most reported cases have been associated with drinking water contaminated with more than 22 mg/liter nitrate-nitrogen. Some surface water supplies, primarily reservoirs, have been found to intermittently exceed the EPA limit on nitrate levels. Many individual wells in Illinois, Kansas, Missouri, Nebraska, Oklahoma, Texas, and Wisconsin have been reported to exceed 10 mg/l nitrate nitrogen, but EPA regulations do not apply to individual water systems. A survey of 8844 wells in Illinois showed that 27% of them exceeded 10 mg/l nitrate-nitrogen and in one county in Texas some wells exceeded 110 to 690 mg/l nitrate-nitrogen levels. Water high in nitrate can be blended with water low in nitrate to produce water that does not exceed the EPA limit, but this may not be technically or economically feasible in some areas. Although technology does exist to remove nitrate from water, the treatment is considered too sophisticated for smaller water systems, and costs for equipment, operation, maintenance, and disposal of the highly concentrated waste products from treatment are expensive. A program to warn parents to substitute an alternate source of water for infant feeding has been successfully instituted in the past in some areas where the nitrate levels have exceeded the limits. For example, in two California water systems that exceeded the limit, consumers received a printed warning on every water bill, and a further warning was sent to all new parents from the county health department. (Baker-FRC)
W82-01623

INCREASED TOXICITY OF AMMONIA TO RAINBOW TROUT (SALMO GAIRDNERI) RESULTING FROM REDUCED CONCENTRATIONS OF DISSOLVED OXYGEN,
Montana State Univ., Bozeman. Fisheries Bioassay Lab.
R. V. Thurston, G. R. Phillips, R. C. Russo, and S. M. Hinkins.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 8, p 983-988, August, 1981. 3 Fig, 2 Tab, 19 Ref.

Descriptors: *Ammonia, *Trout, *Dissolved oxygen, Water pollution effects, Fish, *Toxicity, Oxygen depletion, Nitrogen compounds, Rainbow trout.

Ammonia toxicity to rainbow trout (Salmo gairdneri) fingerlings increased as dissolved oxygen (D.O.) decreased over the test range 2.6-8.6 mg per liter. In 96-hour flow-through tests, some of the LC50 values (in mg NH3 per liter) ranged from 0.812 at 8.58 mg per liter D.O., to 0.316 at 2.64 mg per liter D.O. Fish were reared in water from a ground spring. Reduced D.O. concentrations were achieved by mixing this water with degassed water. The LC50 values were reached earlier at low D.O. concentrations than at high concentrations. Similar toxicity tests at 12, 24, 48, and 72 hours showed that the shorter the time period, the more pronounced the positive relationship between LC50 and D.O. concentration. This suggests that either individual fish requiring higher oxygen concentrations died early in the tests and/or the survivors became acclimatized to the ammonia. The recommended minimum D.O. concentration of 5.0 mg per liter (EPA, 1977) caused 30% less tolerance to ammonia than at 8.5 mg per liter D.O. Since any reduction below the highest tested (8.6 mg per liter) reduced tolerance of rainbow trout fingerlings to ammonia, it is recommended that water quality standards for D.O. consider the possible background levels of ammonia as well as the likelihood of temporary increases in those concentrations. (Cassar-FRC)
W82-01629

RELATIONSHIPS BETWEEN NANNOPLANKTON AND LAKE TROPHIC STATUS,
McGill Univ., Montreal (Quebec). Dept. of Biology.
S. Watson, and J. Kalff.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 8, p 960-967, August, 1981. 4 Fig, 3 Tab, 42 Ref.

Descriptors: *Trophic level, *Algae, *Nannoplankton, Plankton, Eutrophication, Water pollution effects, Lakes, *Lake Memphremagog, Biomass, Nutrients, Quebec-Vermont.

Analysis of data from Lake Memphremagog, which exhibits varying degrees of eutrophication, and published data from other lakes supported the hypotheses that as eutrophication increases (1) nannoplankton biomass increases and (2) the percentage of nannoplankton biomass decreases. This was true when trophic status was defined by total algal biomass. Seasonal means of total phosphorus, but not necessarily single measurements of total P, also correlated well with trophic status. However, the relationship of total P to hypothesis (2) was valid only in Lake Memphremagog, not in the other lakes. Net plankton had a less predictable relationship with total P than did nannoplankton. Empirical relationships to predict total nannoplankton from total algal biomass or total P were presented. (Cassar-FRC)
W82-01640

RELATING POPULATION GROWTH TO SHELLFISH BED CLOSURES: A CASE STUDY FROM NORTH CAROLINA,
East Carolina Univ., Greenville, NC. Dept. of Sociology and Anthropology.
J. R. Maiolo, and P. Tschetter.
Coastal Zone Management Journal, Vol 9, No 1, p 1-18, 1981. 1 Fig, 2 Tab, 28 Ref.

Descriptors: *Water pollution effects, *Population dynamics, *Coastal zone management, Ecological effects, Economic impact, Environmental effects, *Shellfish, Population density, Coastal waters, Economic aspects, Shellfish farming, Cost-benefit analysis, Regression analysis, Impaired water quality, Case studies, *North Carolina.

During the 1970's legislation was passed showing local and national concern for regulating the development of coastal zones. Yet there remains a scarcity of data and methodologies for use in estimating the social and economic impacts of coastal development. In an empirical attempt to address this problem, data from two North Carolina coastal counties covering a 27-year period was analyzed. Over the time span examined, population growth in both counties was accompanied by increasing amounts of estuarine acreage closed to shellfishing due to decreased water quality along with decreased landings and exvessel values in the hard clam fishery. Specific estimates of landings and value losses per 1,000-person increase in the permanent population (as a proxy for total population) were developed by regression analysis. The economic and social consequences of coastal population growth are discussed. More research is needed on treatment of polluted waters, the cost-benefits of alternative growth patterns, and the effects on the coastal fish and shellfish markets and industry. (Geiger-FRC)
W82-01641

ACUTE TOXICITY OF INCREASED PH TO FRESHWATER SHRIMP PARATYA CURVIROSTRIS,
Auckland Regional Authority (New Zealand). Water Lab.
T. L. Shaw.
New Zealand Journal of Marine and Freshwater Research, Vol 15, No 1, p 91-93, 1981. 1 Fig, 1 Tab, 7 Ref.

Descriptors: *Hydrogen ion concentration, *Toxicity, *Shrimp, Water pollution effects, Alkaline water, Thermal powerplants, Industrial wastes, Rivers, *New Zealand, Waikato River, Freshwater shrimp.

The sensitivity of migrating freshwater shrimps to a range of pH values in the Waikato River was investigated. Migrating shrimps were trapped and exposed to pH values ranging from 7.47 through 10.66. Distributions of mortality in solutions in which death occurred were log-normal. There was no mortality in the control solution nor in those in which the initial pH was 9.50 or less. Localized increases in the pH of the river water to 9.71 would be detrimental to Paratya curvirostris populations. It is not known if the migration behavior of the shrimp would be changed or if migration would be disrupted. A thermal power station on the river has been granted a permit to discharge 8200 cu m of highly alkaline waste per day (up to 55 moles of hydroxide equivalent). The maximum concentration of hydroxide must not exceed 0.07 mM. Most of the plume should remain below pH 8.85. It is not known how these changes in the sublethal alkali concentrations will affect shrimp. (Small-FRC)
W82-01645

EUTROPHICATION OF THE SALT VALLEY RESERVOIRS, 1968-73. I. THE EFFECTS OF EUTROPHICATION ON STANDING CROP AND COMPOSITION OF PHYTOPLANKTON,
Nebraska Univ., Lincoln. School of Life Sciences.
G. L. Hergenrader.
Hydrobiologia, Vol 71, No 1/2, p 61-82, May 27, 1980. 16 Fig, 6 Tab, 33 Ref. OWRT-A-067-NEB(1), 14-34-0001-1129.

Descriptors: *Eutrophication, *Phytoplankton, *Standing crops, Turbidity, Water pollution effects, Fertilizers, Agriculture, Nutrients, Chlorophyll a, *Salt Valley, *Nebraska, *Reservoir, Species distribution, Cyanophyta, Diatoms, Eutrophic lakes, Lakes.

The effects of eutrophication on standing crop and phytoplankton composition were investigated in four Salt Valley, Nebraska, flood control reservoirs during June, July, and August 1968-1973. These impoundments, constructed in 1961-1968, receive nutrient-rich runoff from land used for

intensive row crop agriculture. The oldest reservoir, Wagon Train, differed from the other three, Branched Oak, Pawnee, and Stagecoach, in its high inorganic turbidity, which controlled the production processes and affected the phytoplankton crop. Mean summer chlorophyll a concentrations in Wagon Train were usually in the range of 25-34 mg per cu meter, with a mean high in 1973 of 56.4 mg per cu meter. In the clear water reservoirs, chlorophyll a, phytoplankton number, and phytoplankton volume were correlated with reservoir age, the oldest having chlorophyll a concentrations up to 247 mg per cu meter and mean phytoplankton volumes up to 329 cu mm per liter, values in the hypertrophic class. The clear water reservoirs had 2-6 times higher chlorophyll a contents at the end of the study, the newest reservoir showing the greatest increase. Blue-green algae (Microcystis, Aphanizomenon, and Anabaena) quickly became dominant by the second year after construction. They comprised 80-95% of the total in most years. In Wagon Train, diatoms predominated in the early years of the study, 1968-1970. All lakes were considered eutrophic or hypereutrophic and are expected to remain so unless the agricultural practices change or the clear reservoirs develop turbidity. (Cassar-FRC)
W82-01653

PERIPHYTIC COMMUNITY RESPONSE TO CHRONIC NUTRIENT ENRICHMENT BY A RESERVOIR DISCHARGE,
Wyoming Univ., Laramie. Dept. of Zoology and Physiology.
M. D. Marcus.
Ecology, Vol 61, No 2, p 387-399, 1980. 7 Fig, 3 Tab, 65 Ref. OWRT-C-7054(6207)(3).

Descriptors: *Nutrients, *Diatoms, *Eutrophication, Nitrogen, Chlorophyll, Population dynamics, Algae, Plankton, *Reservoir releases, Downstream, Ecological effects, Streams.

This report describes periphytic development and growth in a stream below a montane reservoir with a deep-water release. The first study presented characterizes temporal and spatial periphytic growths and diatom populations on microscope slides at four stream sites below the reservoir. The second study examined increasing periphytic accumulations and diatom succession on two series of slides at a single site. Comparisons of the most upstream site with the three lower sites revealed that the discharges to Hyalite Creek stimulated periphytic productivity, increased periphytic proportions of chlorophyll a in the organic accumulations, and increased diatom species diversity and evenness. It was thought that ammonia nitrogen discharged from the reservoir was the primary factor influencing periphytic growth. Cocconeis placentula var. lineata generally dominated 70-80% of the diatom communities at the three downstream sites, whereas only three individuals of this species were noted at the upper site. Species other than Cocconeis appeared to have higher initial growth rates. Due to higher efficiencies for obtaining or incorporating limiting nitrogen resources, Cocconeis became the dominant species downstream. Species diversity at first increases and subsequently decreases as a function of resource abundance. (Baker-FRC)
W82-01658

EFFECT OF ALUMINUM SPECIATION ON FISH IN DILUTE ACIDIFIED WATERS,
Syracuse Univ., NY. Dept. of Civil Engineering.
C. T. Driscoll, Jr., J. P. Baker, J. J. Bisogni, Jr., and C. L. Schofield.
Nature (London), Vol 284, No 5752, p 161-164, March 13, 1980. 2 Fig, 1 Tab, 14 Ref. OWRT-A-073-NY(2).

Descriptors: *Acidic water, *Fish, *Aluminum, Sublethal effects, Water pollution effects, Acidity, Chemical properties, Toxicity, Hydrogen ion concentration, Speciation, Organic compounds, Fluorides, Sulfates, *Adirondack region, New York.

Water quality data were collected from several acidified lakes and streams in the Adirondack region of New York State in order to characterize aluminum chemistry in these waters and to assess the relative toxicity of various aluminum species to fish. Total aluminum levels increased dramatically with decreasing pH. Increased levels of labile aluminum, including free aluminum and aluminum fluoride, hydroxide, and sulfate complexes, accounted for most of the response to decreasing stream pH and increasing flow. Variations in organically chelated aluminum were found to be independent of hydrogen ion activity but significantly correlated with total organic carbon measurements. Aluminum complexes with dissolved organic ligands comprise the dominant fraction of aluminum in the waters studied, while fluoride complexes were the dominant inorganic aluminum species. Studies of the toxicity of various aluminum species to brook trout fry and to white sucker fry showed that complexation of aluminum with fluoride and/or with citrate significantly reduced the toxicity of aluminum solutions to these fry and that aluminum toxicity to fish is dependent on hydrogen ion activity. Aluminum toxicity to these fish decreased with decreasing pH. Fry survival rates in water treated with aluminum and complexed with fluoride and/or citrate were not significantly different from control solutions at equivalent pH values. Since organically complexed aluminum is the dominant form of aluminum species in these waters, it is suggested that measurements of total aluminum concentrations may result in substantial overestimations of potential toxicity. (Carroll-FRC)
W82-01663

THE EFFECTS OF CHLORINATED SEA WATER ON THE BLUE CRAB, CALLINECTES SAPIDUS,
College of William and Mary, Williamsburg, VA. Dept. of Marine Science.
C. E. Laird.
PhD Dissertation, 1980. 152 p, 39 Fig, 16 Tab, 100 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX81-03589.

Descriptors: *Water pollution, *Toxicity, *Chlorination, *Crabs, Estuaries, Seawater, Mortality, Callinectes sapidus.

The effects of chlorinated sea water on the blue crab, Callinectes sapidus Rathbun, were evaluated through measurements of acute toxicity, serum constituents (protein, total ninhydrin positive substances, chloride, osmotic, sodium, potassium, calcium, and magnesium concentrations), oxygen consumption and ventilation rates in whole crabs, and oxygen consumption of excised gills. Histological examination of gills was also performed. The 96-hr LC50 for female blue crabs exposed to chlorinated sea water at 21 deg. C and 14 o/oo was 0.86 mgC12/1 C10 (chlorine induced osidants). The value for males under similar conditions was 0.84 mgC12/1 C10. Mortality was uncommon below 0.61 mgC12/1, but reached 100% with as little as 1.15 mgC12/1. Since magnesium regulation in the blue crab occurs at the bladder wall, the implication is that C10 acts on the crab at this internal site. This possibility compounds the already difficult problem of toxicant identification when using C10. (Sinha-OEIS)
W82-01679

PETROLEUM DEGRADATION BY NATURALLY OCCURRING POPULATIONS OF MARINE BACTERIA FROM MIDDLE ATLANTIC OUTER CONTINENTAL SHELF WATERS,
College of William and Mary, Williamsburg, VA. Dept. of Marine Science.
For primary bibliographic entry see Field 5G.
W82-01683

PHYTOPLANKTON PHOTOSYNTHESIS AND ITS RELATION TO STANDING CROP AND NUTRIENTS IN TWO WARM-MONOMICTIC SOUTH ISLAND LAKES,
Otago Univ., Dunedin (New Zealand). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W82-01700

EFFECTS OF ARTIFICIAL SHADING ON PERIPHYTON AND INVERTEBRATES IN A NEW ZEALAND STREAM,
Auckland Univ., (New Zealand). Dept. of Zoology.
D. R. Towns.
New Zealand Journal of Marine and Freshwater Research, Vol 15, No 2, p 185-192, 1981. 3 Fig, 1 Tab, 32 Ref.

Descriptors: *Algal growth, *Invertebrates, *Light penetration, Stream biota, Natural streams, Snails, Caddisflies, *New Zealand, Eutrophication, Periphyton, Aquatic plants, Comparison studies, Canopy, Sunlight.

The association between longterm periphyton cover and the abundance of invertebrates was investigated by artificially shading a small section of the Waitakere River prone to extensive periphyton growth. Invertebrates were sampled in shaded and unshaded areas. Beneath the canopy, the light intensity was 6% of that recorded in the unshaded area under overcast conditions. All visible attached periphyton disappeared in the shaded area, and total detritus dry weights were significantly lower. The snail, Potamopyrgus antipodarum, dominated the shaded area and was also abundant outside of the canopy. The hydropsychid caddisfly and the blackfly were more abundant under the canopy, but all chironomid species and rhyacophilid, hydroptilid, and conoesucid caddisflies were more abundant outside. The study indicates that the fauna associated with extensive algal cover make up three groups. The first comprises species directly associated with living algal material. The second includes species which feed on the inhabitants of algal cover and/or algal detrius but are excluded from areas of extreme cover through interference with attachment sites. The third is species which are most abundant in sections prone to long-term periphyton growths, but are not affected by the removal of living algae by shading. (Small-FRC)
W82-01701

ECOLOGICAL STUDIES OF PHYTOPLANKTON IN THE WAIKATO RIVER AND ITS CATCHMENT,
Auckland Univ., (New Zealand). Dept. of Botany.
C. W. Y. Lam.
New Zealand Journal of Marine and Freshwater Research, Vol 15, No 1, p 95-103, 1981. 6 Fig, 5 Tab, 24 Ref.

Descriptors: *Phytoplankton, *Nutrients, *Population density, Aquatic plants, Water analysis, Temperature effects, Rivers, Flow, Waikato River basin, *New Zealand, Eutrophication, Water pollution effects, *Ecological effects.

Sixty-nine genera (118 species) of phytoplankton were identified in the main streams and lakes of the Waikato River catchment. The study also included in situ readings of temperature, conductivity, and dissolved oxygen, and laboratory chemical analysis of water samples. The phytoplankton density increased downstream, reflecting the general enrichment of water from Lake Taupo to the river mouth. Changes in nutrient content that occurred between Lake Aratiatia and Lake Ohakuri were of major importance. The maximum and minimum of population density were controlled by seasonal changes of Melosira granulata var. angustissima. Temperature appeared to be an important factor controlling algal abundance. Flow rate also seemed important, but further research is needed to delineate the relative importance of flow conditions and temperature during the critical summer months. (Small-FRC)
W82-01704

ON THE USE OF CAROTENOID STRATIGRAPHY IN LAKE SEDIMENTS FOR DETECTING PAST DEVELOPMENTS OF PHYTOPLANKTON,
For primary bibliographic entry see Field 2H.
W82-01706

EFFECT OF THE COPPER CONTENT OF DISTILLERY SPENT WASH ON ITS UTILIZA-

TION FOR SINGLE-CELL PROTEIN PRODUCTION BY GEOTRICHUM CANDIDUM, HANSENULA ANOMALA AND CANDIDA KRUZEI,
New Univ. of Ulster, Coleraine (Northern Ireland). School of Biological and Environmental Studies.
J. P. Quinn, T. W. Barker, and R. Marchant.
Journal of Applied Bacteriology, Vol 51, No 1, p 149-157, August, 1981. 5 Fig, 1 Tab, 21 Ref.

Descriptors: *Fermentation, *Copper, *Toxicity, Heavy metals, Yeasts, Fungi, Aquaculture, Biomass, Microorganisms, Industrial wastewater, Wastewater treatment, Water pollution effects, Chelation, Organic matter, *Whiskey distillery wastewater.

A fungus, Geotrichum candidum, and two yeasts, Hansenula anomala and Candida kruzei, obtained from Irish malt whiskey distillery spent wash, were grown in batch and continuous culture on samples of the spent wash, which contained copper at several concentrations ranging from 3.0 to 22.0 mg per liter. Maximum growth rates of G. candida were 0.294-0.337/hr at Cu concentrations of 3.0-11.5 mg per liter 0.255/hr at 17.5 mg Cu, per liter and 0.263/hr at 22.0 mg Cu per liter. This 20% reduction in growth rate at the highest Cu concentrations is less than expected because the high level of organic matter in the spent wash produces considerable complexing of the Cu, thus reducing toxicity. The biomass accumulated as much as six times the Cu present in the spent wash. In continuous culture with a mixed population of the three organisms, the biomass yields declined with increasing dilution rate and the cell Cu concentration increased, so that total Cu removed from the medium remained fairly constant. It is unlikely that the Cu levels normally found in spent wash (3-16 ppm) would inhibit the growth rate of these organisms. However, the Cu accumulated in the biomass is in excess of those recommended for animal diets. (Cassar-FRC)
W82-01750

IMPACTS OF NAVIGATIONAL DREDGING ON FISH AND WILDLIFE: A LITERATURE REVIEW,
Fish and Wildlife Service, Washington, DC. Office of Fishery Assistance.
For primary bibliographic entry see Field 6G.
W82-01768

ORGANIC SUBSTANCES IN WATER,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5A.
W82-01783

INFECTIOUS WATERBORNE DISEASES,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5A.
W82-01784

MICROBIOLOGY OF THE AQUATIC ENVIRONMENT,
Geological Survey, Reston, VA. Water Resources Div.
Available from the Branch of Dist., USGS, 604 S. Pickett St., Alexandria, VA 22304. Geological Survey Circular 848-E, 1981. 33 p, 15 Fig, 6 Tab, 27 Ref. (Greeson, P.E., editor).

Descriptors: *Water quality, *Microbiological studies, *Aquatic environment, *Aquatic life, Ecosystems, Lakes, Reservoirs, Detritus, Decomposing organic matter, *Water pollution effects, Stormwater, Bacteria, Chemical reactions, Iron compounds, Iron bacteria.

This is the fifth of several compilations of briefing papers on water quality prepared by the U.S. Geological Survey. Each briefing paper is prepared in a simple, non-technical, easy-to-understand manner. The U.S. Geological Survey Circular contains papers on the microbiology of the aquatic environment. Briefing papers are included on 'The ecological role(s) of aquatic microorganisms in lakes and reservoirs', 'Effects of bacteria on the chemical and physical state of iron', and 'Microorganisms in stormwater: A summary of recent investigations'. (USGS)
W82-01786

BIOTA AND BIOLOGICAL PARAMETERS AS ENVIRONMENTAL INDICATORS,
Geological Survey, Reston, VA. Water Resources Div.
Available from the Branch of Dist., USGS, 604 S. Pickett St., Alexandria, VA 22304. Geological Survey Circular 848-B, 1981. 24 p, 4 Fig, 56 Ref. (Edited by Greeson, P.E.).

Descriptors: *Water quality, *Benthos, *Aquatic life, *Environmental effects, Species diversity, Algal growth, Biomass, Adenosine triphosphate, Lake classification.

This is the second of several compilations of briefing papers on water quality prepared by the U.S. Geological Survey. Each briefing paper is prepared in a simple, nontechnical, easy-to-understand manner. This U.S. Geological Survey Circular contains papers on selected biota and biological parameters as environmental indicators. Briefing papers are included on 'Species diversity and its measurement', 'Algal growth potential', 'Estimation of microbial biomass by measurement of adenosine triphosphate (ATP)', and 'Lake classification: Is there method to this madness.'. (USGS)
W82-01794

EUTROPHICATION OF THE SALT VALLEY RESERVOIRS 1968-73. III. THE MACROINVERTEBRATE COMMUNITY: ITS DEVELOPMENT, COMPOSITION, AND CHANGE IN RESPONSE TO EUTROPHICATION,
Nebraska Univ., Lincoln. School of Life Sciences.
G. L. Hergenrader, and D. C. Lessig.
Hydrobiologia, Vol 75, No 1, p 7-25, 1980. 10 Fig, 5 Tab, 65 Ref. OWRT-A-014-NEB(8).

Descriptors: *Reservoirs, *Macroinvertebrates, *Eutrophication, Water pollution effects, *Salt Valley, Nebraska, Invertebrates, Aquatic animals, Eutrophic lakes, *Nutrients, *Agricultural runoff, Midges, Oligochaetes, Clams, Hexagenia.

The macroinvertebrate communities in four Salt Valley, Nebraska, flood control reservoirs were studied during 1968-70. All the reservoirs are shallow and eutrophic, receiving nutrients from agricultural runoff. The most recently filled reservoir was least eutorphic, although the chlorophyll a standing crop was low in the oldest (Wagon Train), which was high in inorganic turbidity. In the newest reservoir, chironomids, oligochaetes, and fingernail clams were the early colonizers. Oligochaetes and fingernail clams decreased with increasing eutrophication. Hexagenia reached a maximum in the middle of the eutrophication continuum (Pawnee) and was absent from the most eutrophic reservoir (Stagecoach). Palpomyia increased with increasing eutrophication. Chaoborus was present in all reservoirs and did not show tendencies to increase or decrease with eutrophication. Chironomids were predominant in all reservoirs in the last year of the study. Standing crop was greatest in late fall-early winter and smallest during summer. (Cassar-FRC)
W82-01797

ESTUARINE DREDGE AND FILL ACTIVITIES: A REVIEW OF IMPACTS,
Florida State Dept. of Environmental Regulation, Tallahassee,
For primary bibliographic entry see Field 2L.
W82-01805

ACUTE TOXICITY OF AN IN SITU SHALE OIL PROCESS WASTEWATER AND IT'S MAJOR COMPONENTS TO DAPHNIA MAGNA,
Colorado State Univ., Fort Collins.
L. N. Burnham, W. W. Melvin, and R. M. Buchan.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 3, p 338-343, September, 1981. 2 Fig, 3 Tab, 11 Ref.

Descriptors: *Oil shale, *Toxicity, *Industrial wastewater, Shales, Microorganisms, *Daphnia, Crustaceans, Inorganic compounds, Industrial wastes, Wastewater, Water pollution effects.

The potential environmental hazard of an in situ shale oil process wastewater to aquatic organisms was investigated by determining the acute toxicity (48 hr) of this effluent to Daphnia magna. The effluent under study was obtained from the Laramie Energy Technology Center's experimental true in situ shale oil site near Rock Springs, Wyoming. A synthetic effluent was also prepared by mixing each of the major inorganic components identified in the real effluent at the concentrations found. The acute toxicity of this synthetic mixture was then compared with that of the original samples. Differences in the acute toxicities for the two test waters, the original sample and the synthetic effluent, were significant. The original effluent was 1.5 times as toxic as the synthetic mixture. Linearity was exhibited between log concentration and mortality for both the original effluent sample and the synthetic mixture. Regression lines were parallel, indicating similar modes of toxicity. In fact, the synthetic mixture appeared to exert its toxic effect as though it were a dilution of the original effluent. While these results indicate an important role for inorganics, particularly un-ionized ammonia, in the toxicity of the original effluent, the inorganics cannot be construed to be primarily responsible for the acute toxicity demonstrated against D. magna. It appears that not all the toxic components of the original effluent have as yet been identified. (Baker-FRC)
W82-01811

COMPARISON OF LIQUID-LIQUID EXTRACTION AND RESIN ADSORPTION FOR CONCENTRATING MUTAGENS IN AMES SALMONELLA/MICROSOME ASSAYS ON WATER,
National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 5A.
W82-01812

EFFECT OF AN AERIAL APPLICATION OF CARBARYL ON BROOK TROUT (SALVELINUS FONTINALIS),
Maine Univ. at Orono. Dept. of Zoology and Columbia National Fisheries Research Lab., MO.
T. A. Haines.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 4, p 534-542, October, 1981. 4 Fig, 1 Tab, 14 Ref.

Descriptors: *Fish, *Pesticides, *Water pollution effects, Maine, Carbaryl, *Trout, Organic chemicals, Toxicity, Pesticide toxicity, Streams, Water pollution sources, Small watersheds.

Carbaryl was applied to two small forested watersheds at the rate of 0.5 lb active ingredient/acre in two applications spaced 7 days apart to determine the effect of this split application on brook trout mortality, condition factor, food, and brain AChE activity. The areas chosen were drained by two small streams located in northwestern Maine. Endemic brook trout predominated in the fish fauna of both streams. Mean fish brain AChE activity was significantly lowered (15 to 34%) in fish from the Little Russel Stream; slightly smaller reductions were found in fish from Logan Brook. The results of the in situ toxicity test indicated no mortalities associated with spray application. The AChE depression in fish of the Little Russel Stream dissappeared within 24 hr. The fish stomach contents, expressed as percent of body weight, did not change after the first spraying but did increase after the second. The increase in invertebrates in the stomachs after spraying resulted primarily from increased numbers of Ephmeroptera and Trichoptera, and to a lesser extent, Diptera. (Baker-FRC)
W82-01818

DETERMINATION OF MINERAL FIBER CONCENTRATIONS IN FISH TISSUES,
Environmental Research Lab.-Duluth, MN.
A. R. Batterman, and P. M. Cook.

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Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 8, p 952-959, August, 1981. 3 Fig, 2 Tab, 15 Ref.

Descriptors: *Asbestos, *Fish, *Mineral industry, Fate of pollutants, Lake Superior, Pollutant identification, Fibers, Accumulation, Electron microscopy, Trout, Catfish, Arctic char, Anadromous fish.

Mineral fibers in fish tissue were determined by transmission electron microscopy examination after removal of water and organic matter by freeze-drying and low temperature ashing. Lake trout native to Lake Superior waters containing amphibole fibers from asbestos industry tailings had large numbers of chemically similar amphibole fibers in kidney tissue (up to 1428 fibers per mg), but only a few fibers in muscle (5 per mg) and liver (45 per mg). Only one amphibole fiber was found in all tissue samples from fish raised in the laboratory in amphibole-contaminated water. Lake trout from two locations with different fiber concentrations had corresponding differences in tissue fiber concentrations. The probable route for fiber accumulation in fish tissue is ingestion in food. The low levels of mineral fibers found in fish muscle tissue indicate that human consumption of fish from asbestos-contaminated waters is not of such great concern as asbestos-contaminated drinking water. (Cassar-FRC)
W82-01822

METHANOGENESIS IN FRESHWATER SEDIMENTS: INHERENT VARIABILITY AND EFFECTS OF ENVIRONMENTAL CONTAMINANTS,
Tennessee Univ., Knoxville. Dept. of Microbiology.
D. Pedersen, and G. S. Sayler.
Canadian Journal of Microbiology, Vol 27, No 2, p 198-205, February, 1981. 4 Fig, 5 Tab, 32 Ref.

Descriptors: *Methane bacteria, *Variability, *Sediments, Toxicity, *Water pollution effects, Lake sediments, Bacteria, Organic compounds, Polychlorinated biphenyls, Mercury, Phenanthrene, Polynuclear aromatic hydrocarbons, Paraquat, Herbicides, Coal liquefaction, Phenols, Melton Hill Reservoir, Tennessee.

The following aspects of methanogenesis in freshwater sediments were examined: temporal and spatial variability and effects of contaminants. At three sampling sites in the Melton Hill Reservoir, Tennessee, daily rates of methane production in the sediments varied substantially between replicates, among subsamples at a site, and among the three sites. Maximum rates occurred in August (24.4 plus or minus 24.6 to 764 plus or minus 75.6 nmol methane per g dry weight sediment) and minimum in January (0.3 plus or minus 0.5 to 22.2 plus or minus 4.4 nmol methane per g sediment). Statistical analysis showed that 20% of the variation in rates of methanogenesis could be attributed to the % of organic matter, 11% to pH, 6.6% to E sub h and the incubation temperature, and 3.7% to redox potential of the sediment. Neither number of methanogens nor depth of overlying water were significant in this respect. When toxicants were added to sediments, methanogenesis was inhibited at concentrations of 2570 mg per liter methyl viologen (paraquat), 100 mg per liter phenanthrene, and a 1:30 dilution of coal liquefaction waste effluent. No inhibition was seen after statistical analysis of test results from adding up to 10 mg per liter mercuric chloride or 10 mg per liter polychlorinated biphenyls. Effects of the toxicants were much slighter than expected, probably as a result of their interaction and inactivation with the sediments. (Cassar-FRC)
W82-01825

MERCURY METHYLATION BY FISH INTESTINAL CONTENTS,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
J. W. Rudd, A. Furutani, and M. A. Turner.
Applied and Environmental Microbiology, Vol 40, No 4, p 777-782, October, 1980. 2 Fig, 1 Tab, 27 Ref.

Descriptors: *Bioindicators, *Fish, *Mercury, *Methylation, Lakes, Radiometry, Bacteria, Water pollution effects, Canada, Ontario, *Wabigoon River basin.

Mercury methylation by fish intestinal contents was investigated as part of a larger project concerned with the severe mercury pollution problem of the Wabigoon River system of Northwestern Ontario. Fish were sampled from Clay Lake and Ball Lake, which are part of the Wabigoon River system, and from other nearby lakes which are not contaminated with mecury. Methylation occurred in the gut contents of fish obtained from five of the six lakes, and it occurred in all six species tested. Fish methylating activity was plotted against the total weight of intestinal contents, and something other than the quantity of food seemed to be influencing the rate of methylation. It may be the larger quantity of intestinal mucus found in the piscivorous species. Intestinal mucus is the site of the intense bacterial activity in other species and may be important here with respect to the contribution of intestinal mercury methylation to the concentration of mercury in the tissues. A radiochemical method was used which enabled the study of methylation in natural samples over short time periods. This method will be useful in the determination of mercury uptake routes. (Small-FRC)
W82-01830

NITRATES, CHLORATES AND TRIHALOMETHANES IN SWIMMING POOL WATER,
Florida International University, Miami. Drinking Water Quality Research Center.
For primary bibliographic entry see Field 5A.
W82-01835

EFFECTS OF SEDIMENTATION ON THE GRAVELS OF AN INDUSTRIAL RIVER SYSTEM,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
A. W. H. Turnpenny, and R. Williams.
Journal of Fish Biology, Vol 17, No 6, p 681-693, December, 1980. 6 Fig, 4 Tab, 26 Ref.

Descriptors: Dissolved oxygen, *Silting, *Fish populations, Gravel, Silt, *Coal mining, Industrial wastes, Rivers, *Mine wastes, Spawning, Fish eggs, Trout, Fish stocking, *Wales, *Ecological effects.

The effects of coal industry siltation on the natural recovery of trout populations in an industrial river were assessed in the Ebbw Fawr, South Wales. Fertilized rainbow trout eggs were planted in river gravels. Dissolved oxygen content of the water was determined, as was the apparent velocity of water flow through the gravels. Survival ranged from 91% in a control group to 0% at stations below the steelworks. Oxygen deprivation was responsible for high mortalities during incubation and the production of undersized fry. A progressive decline in dissolved oxygen was found in artificial redds due to siltation with resulting stagnation of intra-gravel water. The natural limiting factor may be the behavioral responses of spawning fish, as trout will not attempt to cut a redd when gravel permeability is low and where an appreciable downwelling is not detected by the fish. Fish stocking policies and the enhancement of natural recruitment by spawning channels may partially remedy the effects of many years' pollution of the rivers of the South Wales coal area. (Small-FRC)
W82-01881

ACUTE TOXICITIES OF THE HERBICIDES KOMEEN AND HYDROTHOL-191 TO GOLDEN SHINER (NOTEMIGONUS CRYSOLEUCAS),
California State Dept. of Fish and Game, Sacramento. Water Pollution Control Lab.
B. J. Finlayson.
Bulletin of Environmental Contamination and Toxicology, Vol 25, No 4, p 676-681, October, 1980. 2 Tab, 14 Ref.

Descriptors: *Fish, *Toxicity, *Herbicides, Pesticides, Aquatic weed control, Canals, Hardness, Chemical properties, Water pollution effects, Natural waters, Laboratory studies, Komeen, Hydrothol-191.

Studies were performed in American River water (soft) and a formulated hard water to determine the toxicity of the herbicides Komeen (Copper-ethylenediamine complex; 8% copper equivalent) and Hydrothol-191 (endothall) to fish. Komeen and Hydrothol-191 were suggested for controlling Hydrilla infestation in the All American Canal System (California). No previous continuous-flow toxicity tests on representative fish species had been conducted, nor had the effects of water quality on toxicity been investigated. Golden shiners were fasted for 48 hr, and acclimated to soft water for 2 wk or to hard water for 4 days prior to testing. Flow-through bioassays were conducted in 20 liter plexiglass tanks. Komeen 96-hr LC50 values were 630 ppm in hard water and 67 ppm in soft water. Hydrothol-191 120-hr LC50 values were 0.32 ppm in hard water and 1.6 ppm in soft water. It was concluded that of the two herbicides only Komeen can be used in this environment without extensive fish loss. (Carroll-FRC)
W82-01882

THE VALUE OF ECOLOGICAL MONITORING IN THE MANAGEMENT OF PETROLEUM INDUSTRY EFFLUENT DISCHARGES: EXPERIENCE IN ESSO PETROLEUM COMPANY U.K. REFINERIES,
Esso Petroleum Co. Ltd., London (England).
For primary bibliographic entry see Field 5G.
W82-01913

GENERALIZED COMPUTER SIMULATION MODEL FOR THE IMPACT ASSESSMENT OF INDUSTRIAL WATER USE ON FISH POPULATIONS,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemistry and Environmental Engineering.
C. Kleinstreuer, and B. E. Logan.
Water Science and Technology, Vol 13, No 7, p 363-390, 1981. 13 Fig, 1 Tab, 49 Ref.

Descriptors: *Fish populations, *Powerplants, *Industrial water, Cooling water, Water pollution effects, Impingement, Industrial wastes, Intakes, *Model studies, Computer models, Fisheries, Aquatic life, Oxygen, Dissolved oxygen, Fish harvest, Environmental effects, Entrainment.

The effects of man's activities on fish populations are simulated with a computer model. In the modeling framework, fish losses are regarded as sinks to the ecosystem. A lumped parameter approach is used. Components of the model are input data (environmental boundary conditions, plant operational conditions, and data on species concentration and fish life cycles), flow sub-models (ecosystem discretization and hydrodynamic factors), water quality submodels (temperature, dissolved oxygen, and pollutants), and a fish population model (age-structured fish population and net fish losses from natural or man-induced causes). This multi-species simulation is age-structured like a Leslie matrix and predicts oscillatory behavior like the Lotka-Volterra equation. A case study using far-field fish data from Lake Dardanelle and impingement data from Arkansas Nuclear One, Russelville, reveal that impingement dynamics are a reflection of the aquatic population dynamics. Estimates for gizzard shad and white crappie populations agreed well with actual data sets. The threadfin shad population dynamics were not as comparable, probably because the temperatures used were not representative enough. This model is also useful for evaluation of powerplant site alternatives and design and the impacts of industrial wastes, sudden dissolved oxygen depletions, and excessive fishing. (Cassar-FRC)
W82-01915

VARIANCE ESTIMATES FOR A DYNAMIC EUTROPHICATION MODEL OF SAGINAW BAY, LAKE HURON,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 2H.
W82-01917

TOXICANT ACCUMULATION IN HYDROBIONT TISSUES FOLLOWING EFFLUENT DISCHARGE,
Irkutskii Gosudarstvennyi Univ. (USSR). Biological and Geographical Research Inst.
Ya. M. Grushko, O. M. Kozhova, and L. M. Mamontova.
Hydrobiological Journal, Vol 16, No 3, p 55-58, 1980. 34 Ref.

Descriptors: *Bioaccumulation, *Effluents, *Fate of pollutants, Self-purification, Heavy metals, Cadmium, Mercury, Arsenic, Zinc, Lead, Cobalt, Copper, Naphthalene, Pyrene, Toxicity, Methyl antracene, Pyrelene, Benzanthrene, Organic compounds, *Fish, Plants, Hydrobiology, Literature review, Public health.

Data has been drawn from various literature sources concerning the accumulation of toxic substances in hydrobiont tissues after the fish and aquatic organisms were exposed to effluent discharge. Cadmium, chromium, copper, lead, nickel, zinc, and silver are accumulated in fish tissues from water polluted by industrial effluents. Mercury is accumulated from water by microorganisms and by the tissues of benthic organisms and fishes. An increase in the concentration of cadmium by comparison with the environmental concentration was noted in the liver, gills and muscle tissues of fishes. Hydrophytes and rice growing in water are polluted by cadmium and accumulate it. Arsenic and chromium were also shown to accumulate in fish tissues. Some organometallic compounds were also concentrated from water in the tissues of hydrobionts. The tissues of Daphnia accumulate methylmercury. Phenylmercuric acetate is concentrated from water by fishes, mollusks, various microorganisms and insects. Chlorinated biphenyls are concentrated by hydrobionts from water polluted by chemical industry effluents. Fish also concentrate the saturated hydrocarbons. Other organic toxicants such as insecticides and carcinogens are capable of biological accumulation in hydrobionts. The fact that many toxicants are accumulated by hydrobionts from the water of water bodies polluted by high concentrations of effluents must be taken into consideration when setting the maximum permissible concentrations of noxious substances in water bodies. The accumulation of toxicants by hydrobionts cannot be regarded as a factor in the self-purification of water bodies, as there is a risk that hydrobionts will die or that their fecundity will be reduced, and a high risk of poisoning to persons eating fish products exists. (Baker-FRC)
W82-01919

EFFECT OF SODIUM DODECYLSULFATE ON UNICELLULAR GREEN ALGAE OF THE GENUS CHLORELLA,
Akademiya Nauk URSR, Kiev. Inst. Botaniki.
L. I. Lenova, S. S. Stavskaya, and M. Ya. Ratushnaya.
Hydrobiological Journal, Vol 16, No 3, p 58-61, 1980. 5 Fig, 14 Ref.

Descriptors: *Surfactants, *Algae, Detergents, Dispersants, Soaps, Chlorella, Environmental effects, *Water pollution effects.

The effect of an individual anionic surfactant, sodium dodecylsulfate (SDS), on bacterially pure cultures of unicellular green algae of the genus Chlorella was investigated. Bacteria-free cultures of 3 intact and 23 mutant algal strains of Chlorella genus were used. In order to select strains capable of growing in the presence of surfactants, the algae under investigation were reared in agar nutrient media with SDS in various concentrations (1-200 mg/l). In the research in liquid media, the effect of the substance on the algae was assessed from the increase in biomass, counting the total number of Chlorella cells in a Goryayev chamber, and from the ratio of living to dead cells. The study showed that SDS in a concentration of 1-50 mg/l did not have an adverse effect on algal growth in rearing of C. vulgaris strains in the agarized nutrient medium. Inhibition of the growth of all the algal strains investigated, to different degrees, was noted in the presence of 100 mg/l SDS. The algae did not grow on solid media containing 200 mg/l of the surfactant. The mutant Chlorella strains behaved differently. Some inhibition of growth by comparison with controls was noted in the rearing of strains g-9, 14, 244, g-10, g-6, and 31 mut, reared on FDGA liquid medium to which surfactant was added. Microfloccules appeared in the experimental cultures of g-9, 14, g-10 and g-6, 31 mut on the fifth through sixth days, with their quantity increasing toward the end of the study. The content of dead cells increased appreciably, and cell detritus appeared. Marked inhibition of growth was noted for strains ty-0-19 and T5E12, which can be reared in the liquid nutrient medium with the surfactant. The data obtained indicate that the maximum dose of SDS that does not inhibit cell division in the algae investigated is 50 mg/l and, for only one strain, 200 mg/l. In no case was there a reduction in inhibition over time. (Baker-FRC)
W82-01920

BIOLOGICAL POLLUTION AND POLLUTION CONTROL IN CANALS DIVERTING FLOW FROM ONE RIVER BASIN TO ANOTHER,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
O. P. Oksiyuk, and F. B. Stol'berg.
Hydrobiological Journal, Vol 16, No 4, p 1-6, 1980. 8 Ref.

Descriptors: *Canals, *Biomass, *Eutrophication, Water quality, Aquatic life, Aquatic plants, Phytoplankton, Benthos, Agricultural runoff, Industrial wastes, Self-purification, Water transfer, Diversion channels, Diatoms, Interbasin transfer, Water treatment, *USSR.

The balance between the processes of self-purification and biological pollution in canals is dependent on the abundance of algae, and also on those characteristics of artificial watercourses that affect their self-cleansing capacity. Water in canals originating from lowland rivers and from reservoirs created on them is especially subject to biological pollution. The bloom created by diatoms is one of the major sources of biological pollution in canals diverting flow from basin to basin. Filter plants that take water from the canal experience great difficulties every year at the time of profuse growth of diatoms. The amount of phytoplankton removed at the Upper Kal'mius filter plant reaches 10 to 50 t per day. Increased amounts of coagulants (2-2.5 times) are required for water purification. Polyacrylamide is added, and intensive rinsing of the filters is carried out frequently. Activated charcoal is also used, and chlorination procedures are modified. In contrast to phytoplankton, which is directly removed from the water at pumping stations, plant foulings, large quantities of which develop on the sides of lined canals, usually emerge as an indirect source of biological pollution that has an adverse effect on water quality due to the entry of decay products into the water. The stability of the substrate in canals creates conditions conducive to the formation of a large algal biomass on the slopes, as a result of which a large amount of organic matter accumulates, and the mineralization of this matter does not proceed sufficiently. The major means of controlling biological interference is preventing entry of biogenic matter via the effluents from industrial enterprises, built-up areas, and agricultural lands. (Baker-FRC)
W82-01922

THE HYDROFLORA OF URBAN PONDS AS AN INDEX OF THEIR SANITARY AND BIOLOGICAL STATE,
Kharkov Univ. (USSR).
For primary bibliographic entry see Field 2H.
W82-01924

BIODEGRADATION OF SODIUM ALKYLBENZENESULFONATE IN PLANKTON-CONTAINING POND WATER,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
For primary bibliographic entry see Field 5B.
W82-01925

OCCULT HEMOGLOBIN AS AN INDICATOR OF IMPINGEMENT STRESS IN FISHES,
New York State Dept. of Public Service, Albany. Office of Environmental Planning.
P. A. Isaacson, and N. J. Morrisson, III.
Progressive Fish Culturist, Vol 42, No 1, p 9, January, 1980. 1 Ref.

Descriptors: *Fish, *Fish barriers, *Powerplants, Cooling water, Fish behavior, Gills, Blood, Fish physiology, Entrainment, Stress analysis.

The use of occult hemoglobin in fish dermal mucus was assessed as an indicator of impingement stress. During the impingement process at cooling water intake sites, fish are subjected to various types of stress which can result in the death of fish. Fish collected from traveling screens at an operating power plant on the upper Hudson River were tested for stress using the hemoglobin released into the dermal mucus of the teleostean fishes as an indicator. Hemastix, a commercially available test strip, was used. The method was effective, but the test strips may be too sensitive, in that any stress including that of capture releases sufficient occult hemoglobin to give a maximum color reaction. (Small-FRC)
W82-01931

ZOOPLANKTON SPECIES DIVERSITY IN LAKE ST. CLAIR, ONTARIO, CANADA,
Windsor Univ. (Ontario). Dept. of Biology.
J. M. Winner, P. H. Patrick, and D. G. Wallen.
Hydrobiologia, Vol 75, No 1, p 57-63, October, 1980. 4 Fig, 4 Tab, 24 Ref.

Descriptors: *Lakes, *Zooplankton, *Species diversity, *Lake St. Clair, Ontario, Nutrients, Invertebrates, Water quality, Chlorophyll a, Nitrates, Phosphates, Silicates, Eutrophied lakes, Water pollution effects, Cladocerans, Copepods, Rotifers, Thames River, Primary productivity, Productivity, Urban runoff, Agricultural runoff.

Zooplankton species diversity, chlorophyll a, and water quality were studied in Lake St. Clair, Ontario, during the summer of 1971. The lake receives urban and agricultural runoff. As determined by weekly sampling at three sites the chemical parameters of the water were as follows (in g per liter): chlorophyll a, 0.02-8.65; particulate C, 25.5-270; nitrate, 2.0-55.9; total P, 0-0.033; and reactive silicate, 121-4990. Stations 1 and 2, enriched by Thames River drainage, had the highest primary productivity and zooplankton species diversity. There was no significant correlation between total zooplankton diversity and chlorophyll a. However, chlorophyll a, reactive silicate and nitrate correlated positively with cladocerans and copepods at stations 2 and 3. Rotifers were negatively correlated with chlorophyll a, nitrate, and reactive silicate. The results indicate that cladocerans, copepods, and rotifers occupy different ecological niches, and that in nutrient-rich lakes, factors other than food are limiting. (Cassar-FRC)
W82-01937

EFFECTS OF THE AQUATIC HERBICIDE 2,4-D DMA ON THE ECOLOGY OF EXPERIMENTAL PONDS,
Columbia National Fishery Research Lab., MO.
T. P. Boyle.
Environmental Pollution (Series A), Vol 21, No 1, p 35-49, January, 1980. 2 Fig, 6 Tab, 27 Ref.

Descriptors: *Aquatic life, *Herbicides, *Growth, Water pollution effects, Fish, Bluegills, Phytoplankton, Algae, Chlorophyll a, Nutrients, Macrophytes, Ecological effects, Invertebrates, Zooplankton, Aquatic weed control.

In experimental ponds the dimethylamine salt of 2,4-dichlorophenoxyacetic acid (2,4-D DMA) stimulated growth of rooted macrophytes at the 5 kg per ha application rate and stimulated photosyn-

thetic uptake of C14 in natural phytoplankton communities at concentrations of 2 mg per liter. Bluegill condition factors and growth were improved at the 10 kg per ha dose. Weights of fish were 16 g vs. 10.6 g in controls, and lengths were 9.4 cm vs. 8.4 cm in controls. Initial concentrations of 0.90 mg per liter (10 kg per ha dose) and 0.35 mg per liter (5 kg per ha dose) peaked at 7 days (1.2 and 0.60 mg per liter, respectively) and both declined to the non-detectable level of 0.1 mg per liter by 56 days. Statistical analysis of covariance by path analysis revealed that gross production in 2,4-D DMA treated ponds was related to planktonic chlorophyll a and dissolved nutrients. It was believed that nutrients leaked from plants into water and stimulated phytoplankton growth. (Cassar-FRC)
W82-01949

ECOLOGICAL AND PHYSIOLOGICAL CHARACTERISTICS OF DIKEROGAMMARUS HAEMOBAPHES IN THE AREAS IN WHICH HEATED WATER IS DISCHARGED FROM THE TRIPOL'YE POWER STATION,
Akademiya Nauk URSR, Kiev. Inst. Hidrologii.
L. A. Kititsyna.
Hydrobiological Journal, Vol 16, No 4, p 61-68, 1980. 4 Fig, 3 Tab, 19 Ref.

Descriptors: *Zooplankton, *Cooling water, *Heated water, Power plants, Thermal pollution, *Environmental effects, Fish food, Water pollution effects, Gammarids, Food chains, Tripol'ye power station, USSR.

The response of Dikerogammarus haemobaphes to the heated water of Knaev reservoir was determined during the three years of reservoir construction. In the area around the district power station certain changes occurred in the species composition of the benthos. As the water became warmer, Chaetogammarus ishnus and Pontogammarus were no longer dominant, but Dikerogammarus was. Samples were collected by dredge and bottom-grab, and the calorific value of the gammarids, their metabolic rate, and other indices were determined. Dikerogammarus haemobaphes had adapted well to the heated waters in the reservoir and withstood a wide range of water temperatures. They can be introduced into other cooling facilities to provide fish food. (Small-FRC)
W82-01970

A PRELIMINARY STUDY OF THE EFFECT OF PUMPED-STORAGE PLANT OPERATION ON ZOOPLANKTON,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
Ya. Ya. Tseyeb, and G. A. Zhdanova.
Hydrobiological Journal, Vol 16, No 4, p 31-35, 1980. 2 Tab, 8 Ref.

Descriptors: *Zooplankton, *Hydroelectric plants, Powerplants, Plankton, Aquatic life, *Reservoirs, Entrainment, Hydroelectric power, Electric power production, *Kiev reservoirs, USSR, Ecological effects.

The effect of pumping water from the Kiev reservoirs on the qualitative and quantitative composition of the zooplankton in the pumped-storage facility was investigated. Attempts were also made to assess the general effect of the Kiev pumped-storage plant on the zooplankton of Kiev Reservoir. When the species and quantitative composition of the zooplankton of Kiev reservoir in the area of the water intake were compared it was noted that the upward pumping of water had a lethal effect on zooplankton. There were far fewer zooplankton species in the upper pumped-storage facility than in the reservoir, with the total number of species being reduced from 20 to 9 in the spring, and from 37 to 24 in the summer and autumn. The species which disappeared were those whose biomass was least, primarily Rotatoria. Among the crustaceans such large forms as Daphnia cucullata, D. hyalina, Leptodora kindtii and Eurytemora velox perished. The mortality of zooplankton in the downward release of the water was calculated on the basis that the figures would be equivalent to those obtained in the pumping regime of the pumped-storage station. It was established that about 1% of the initial zooplankton biomass would survive in the course of a day in the area of the water intake in the spring as a result of the successive effect of the pumping and turbine regimes of the pumped-storage plant. While the adverse effect of the Kiev pumped-storage hydroelectric plant is manifested in the almost total death of the zooplankton entering its sphere, it is ultimately very weak and cannot appreciably affect the food resources of fishes consuming zooplankton. (Baker-FRC)
W82-01971

DREDGED MATERIAL EVALUATIONS: CORRELATIONS BETWEEN CHEMICAL AND BIOLOGICAL EVALUATION PROCEDURES,
R. A. Laskowski-Hoke, and B. L. Prater.
Journal of the Water Pollution Control Federation, Vol 53, No 7, p 1260-1262, July, 1981. 1 Fig, 2 Tab, 16 Ref.

Descriptors: *Dredging, *Sediments, *Benthic fauna, Pollutant identification, Water pollution effects, Bioindicators, Bioassay, *Lake Michigan, Lake sediments, Chemical analysis, Ecological effects, Invertebrates, *Spoil disposal, Evalution.

A bulk sediment-chemistry evaluation procedure (EPA Regions V and IX) and an elutriate test (U.S. Army Corps of Engineers) were compared with a bioassay technique as a means of evaluating disposal methods for dredged material. Forty sediment samples collected in 1977 from Lake Michigan were analyzed. The elutriate process required analysis of ammonia, COD, total P, total Kjeldahl N, nitrate, nitrite, chloride, sulfate, and 8 heavy metals. The sediment-chemistry technique relied on analysis of total Kjeldahl N, total P, COD, sieve size, oil, grease, cyanide, and 11 metals. Test organisms for the bioassay were Pimephales promelas Rafinesque, Hexagenia limbata Walsh, Lirceus fontinalis Rafinesque, and Daphnia magna Straus. Statistical analysis of results indicated that a combination of bulk sediment-chemistry and sediment bioassays would be the most efficient and ecologically sound approach to evaluating the effects of dredged materials on benthic communities. (Cassar-FRC)
W82-01985

A NEW METHOD FOR ASSESSING THE LETHAL IMPACT OF SHORT-TERM, HIGH-LEVEL DISCHARGES OF POLLUTANTS ON AQUATIC ANIMALS,
Sunderland Polytechnic (England). Dept. of Biology.
P. D. Abel.
Water Science and Technology, Vol 13, No 7, p 347-352, 1981. 5 Fig, 1 Tab, 3 Ref.

Descriptors: *Water pollution effects, *Aquatic animals, *Copper, *Pesticides, *Toxicity, *Lindane, Insecticides, Chlorinated hydrocarbons, Mortality, Lethal limit, Poisons, Pesticide toxicity.

The effects of the organochlorine pesticide, lindane, and of copper on Gammarus pulex were investigated by a new method designed to evaluate the lethal impact on aquatic animals of brief exposure to high concentrations of water pollutants. Results demonstrated that animal mortality due to a brief exposure to high levels of a poison may continue for up to 3 weeks after the initial exposure. Combinations of exposure time and poison concentration which result in appreciable mortality were sometimes lower than continuous exposure mortality values of conventional toxicity test systems. The present method is considered more useful than conventional toxicity test procedures in predicting the outcome of water pollution incidents involving the brief discharge of high levels of pollutants. (Geiger-FRC)
W82-01993

TEMPERATURE TOLERANCE AND THE FINAL PREFERENDUM - RAPID METHODS FOR THE ASSESSMENT OF OPTIMUM GROWTH TEMPERATURES,
Tromso Univ. (Norway). Inst. for Fiskerifag.
M. Jobling.
Journal of Fish Biology, Vol 19, No 4, p 439-455, October, 1981. 2 Fig, 2 Tab, 138 Ref.

Descriptors: *Heated water, *Fish, Water pollution effects, Thermal pollution, Thermal water, Powerplants, Cooling water, Industrial water, Thermal stress, Growth, *Ecological effects, Literature review.

Correlations were sought between the preferred temperature, temperature tolerance, and optimum growth for some species of fish. Values for growth optima, final preferenda and temperature tolerance were extracted from the published literature, and correlations were drawn between these indicators of thermal requirements. These values are listed in a table by species. Linear regression analyses were used to show relationships among temperature requirements of fishes. The analysis of the data suggested that the final preference gives a good indication of the optimum temperature for growth. Thus the determination of the preferenda could be used as a rapid method for estimating the temperature required to promote maximum growth of fishes. A good correlation was also found between lethal temperature and optimum temperature for growth. Such information is valuable in determining possible ill effects on fish from the discharge of cooling water from power generating stations, with the resultant addition of waste heat to natural waters. (Baker-FRC)
W82-01996

DYNAMICS OF CARP GROWTH AND BIOSYNTHETIC PROCESSES IN THE LIVER OF THE CARP REARED IN CONTAINERS IN HEATED WASTE WATER FROM THEMAL POWER STATIONS,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
N. Yu. Yevtushenko, and V. D. Romanenko.
Hydrobiological Journal, Vol 16, No 4, p 58-61, 1980. 1 Fig, 7 Ref.

Descriptors: *Heated water, *Fish, Growth, *Carp, Thermal stress, Temperature effects, *Water pollution effects, Thermal powerplants, Powerplants, Thermal power, Cooling water, *Thermal pollution.

Carp were raised in containers in heated wastewater from thermal power stations to determine the effect of the heated water on the growth of the fish. The study revealed uneven accumulation of body biomass at different stages in the vegetation period in the rearing of the carp. A definite relationship was established between the growth rate of the carp and its initial mass. The relative mass increment of the body of carp of different initial mass during the first month of such rearing was slightly retarded in comparison with the following months of rearing. At the same time, the difference in the relative increments of carp of the different weight groups in the initial period of container rearing was not significant. A sharp increase in the growth rate of the carp in the containers was noted in July. The relative increase in the body mass of the first group of fish was 121.2% relative to the previous month, while in the second experimental group it had increased over this period by 160.3%. The rate of biosynthetic processes in the liver was relatively high during the initial period of rearing, one month after the stocking of the containers. Beginning in the second half of August, the rate of uptake of radiocarbon into organic compounds extractable from the liver of carp caught in August declined by comparison with the previous month by 22.1%. An even lower rate of uptake of the radioactivity was noted in autumn. The data revealed a higher growth rate of the carp in container rearing in warm water in July through August. The relative increment in the body mass of the fish declined sharply in the second half of August, in spite of the fact that the water temperature in the water used for cooling purposes remained fairly high at that time. (Baker-FRC)
W82-01998

PARASITE OVA IN ANAEROBICALLY DIGESTED SLUDGE,

Cutter Lab., Shawnee, KS. Bayvet Div.
For primary bibliographic entry see Field 5B.
W82-02018

EFFECT OF DIFFERENT WATER SALINITY LEVELS AND ORGANIC MATTER APPLICATION ON THE COMPOSITION OF WATER SOLUBLE AND EXCHANGEABLE BASES IN A BRACKISHWATER FISH POND SOIL,
Central Inland Fisheries Research Inst., Barrackpore (India).
For primary bibliographic entry see Field 2H.
W82-02027

PLANT BIOTESTS IN THE BIOINDICATION OF THE RAINFALL POLLUTION IN AN OIL REFINERY REGION,
Akademia Rolniczej, Warsaw (Poland). Inst. of Environmental Protection.
D. Zukowska-Wieszczek, and H. Zimny.
Plant and Soil, Vol 55, No 2, p 321-325, 1980. 4 Tab, 5 Ref.

Descriptors: *Rainwater, *Chemical composition, *Water pollution sources, *Acid rain, Chemical analysis, Acidity, Heavy metals, Sulfates, Nitrates, Industrial wastes, Plant growth, Cucumbers, Beans, Beetrouts, Water pollution effects, Bioindicators, Environmental effects, Oil industry, Europe.

Rainfall was collected during spring and summer at four points localized in the vicinity of the largest oil refinery in Europe. The rain water was analyzed chemically by atomic absorption spectroscopy. Sulfur was estimated by nephelometric methods, chlorine was measured argentometrically and pH, electrometrically. Beans, beetroot and cucumber were grown in the rainwater. Rainwater collected near the industrial and oil refinery regions had a pH value ranging from 2.4 to 4.4. Chemical analysis showed that the water was high in minerals and pollution by heavy metal ions as well as having increased acidity due to sulfates, nitrates and nitrites. The germination capacity of seeds treated with rain water from the refinery region was significantly decreased in comparison to those germinating on distilled water. Impairment of seed germination capacity was higher for seeds germinating on water from the summer than from the spring rainfalls. Seedling growth, while vigorous at first, soon showed signs of shortening and thickening of the hypocotyl and maceration of root-cap. Beetroot showed the most significant changes. (Baker-FRC)
W82-02033

MICROBIAL POLLUTION OF COASTS AND ESTUARIES: THE PUBLIC HEALTH IMPLICATIONS,
PHLS Centre for Applied Microbiology and Research, Porton Down, Wiltshire (England). Reference Laboratory for Environmental Hygiene.
G. I. Barrow.
Water Pollution Control, Vol 80, No 2, p 221-230, 1981. 15 Ref.

Descriptors: *Estuaries, *Pollution load, *Public health, Microorganisms, Coasts, *Effluents, Estuarine environment, Shellfish, Recreation, Water use, Swimming, *Great Britain.

Potential microbial health hazards and their relation to sewage pollution of estuaries and coastal waters in Britain are considered. The risks essentially concern the possibility of infection from bathing and from the consumption of molluscan shellfish. Rivers have traditionally been used to carry domestic sewage and industrial effluents. Even efficient sewage treatment does not remove all bacteria and other micro-organisms. The presence of any microbial pathogens in coastal waters presents potential health risks. There is no absolute relationship between the presence of a pathogen and the risks of contracting the associated disease, even in susceptible persons, and each case must be considered on its merits. Basic knowledge of the reservoir of a pathogen, its origin, mode of spread, route of infection, and the degree of susceptibility of the community or individual are all factors which need to be examined. No significant evidence has been gained linking the degree of sewage contamination of coastal or other waters with defined diseases. No public health evidence exists in the United Kingdom to suggest that either bathing or the consumption of shellfish should be prohibited solely due to non-compliance with any of the microbiological parameters specified in the EEC directives. (Baker-FRC)
W82-02051

THE EFFECTS OF MINE DRAINAGE AND ORGANIC ENRICHMENT ON BENTHOS IN THE RIVER NENT SYSTEM, NORTHERN PENNINES,
Freshwater Biological Association, Wareham (England). River Lab.
P. D. Armitage.
Hydrobiologia, Vol 74, No 2, p 119-128, September, 1980. 5 Fig, 5 Tab, 14 Ref.

Descriptors: *Zinc, *Benthic fauna, *Mine drainage, *Water pollution effects, Heavy metals, Rivers, Streams, *Nent River, Algal growth, Nutrients, Aquatic animals, Mine wastes, Acid mine drainage, Organic wastes, *England.

Lead mining in the River Nent system, northern England, reached its peak in the 18th century. Except for brief operation of a flotation plant in 1942-43, there has been no mining activity there since 1921. This paper reports the impact on the benthic fauna of zinc and other heavy metals, acid mine drainage, and organic enrichment from agricultural and domestic sources. Sites were divided into three zinc areas (low, 0.01-0.36 mg per liter; medium, 0.77-1.68 mg per liter; and high, 2.08-7.60 mg per liter) and one acid site. Zn levels were negatively correlated with numbers of taxa. At mainstream sites with Zn levels of 0.7-1.7 mg per liter massive growths of the Zn- and pollution-resistance alga Stigeoclonium tenue were associated with low faunal abundance. Chandler biotic scores showed a downward trend from the river's source to the junction with the River Tyne. No sign of improvement in the water quality was seen 8 km downstream of the major Zn input. Relationships between the acid water section, the Ca concentrations, and the Zn levels with respect to toxicity are discussed. (Cassar-FRC)
W82-02053

EFFECTS OF POLLUTION UPON THE BENTHOS OF BELFAST LOUGH,
Northern Ireland Department of Agriculture, Coleraine, Fisheries Research Laboratory.
J. G. Parker.
Marine Pollution Bulletin, Vol 11, No 3, p 80-83, March, 1980. 2 Fig, 1 Tab, 11 Ref.

Descriptors: *Benthos, *Water pollution effects, *Belfast Lough, *Northern Ireland, Benthic fauna, Salinity, Temperature effects, Bays, Path of pollutants, Harbors.

Belfast Lough, a bay lying between the North Channel and the mouth of the River Lagan, is the receiving water for the domestic and industrial wastewater from the city iof Belfast and other towns surrounding the lough. Benthic studies are being conducted to determine the effects of pollution on the spatial pattern of benthic life in the bay. Samples obtained from 41 sites resulted in the collection of about 40,000 specimens of benthic fauna. Three of the sampling sites in the harbor area yielded no benthic macrofauna. Sites within the docks area which did support benthic fauna were dominated by Oligochaeta, followed by polychaetes. The distribution of polychaetes, which dominated the fauna of 19 of the sampling sites, showed a significant positive correlation with graphic kurtosis, but not with any other environmental factor. The distribution of Oligochaeta, which were next in order of abundance and dominated 11 sampling sites, was not significantly associated with salinity, but did decrease significantly with distance from Belfast, with depth, and with surface temperature. The distribution of Isopoda, which were third in order of abundance, was not significantly associated with any of the physical or chemical parameters investigated. Amphipods, which dominated six ampling sites although they were slightly less abundant than isopods, were the only species significantly correlated with salinity. The results of this study indicate that benthic fauna in the harbor area suffers from the gross effects of pollution, while fauna in the outer lough is subjected to diffusely distributed pollutants. (Carroll-FRC)
W82-02059

SEASONAL VARIATIONS IN THE ACTUAL FECUNDITY OF DAPHNIA MAGNA IN A LABORATORY CULTURE,
Moscow State Univ. (USSR).
Ye. F. Isakova.
Hydrobiological Journal, Vol 16, No 4, p 69-71, 1980. 1 Fig, 11 Ref.

Descriptors: *Daphnia, *Cultures, *Water pollution effects, Rivers, *Moscow River, Productivity, Crustaceans, Floods, Runoff, Growth, Population dynamics, Seasonal variation, USSR.

The object of this study was to determine changes in the survival rate and fecundity of Daphnia cultivated in water from the Moscow River in different seasons. Seventy-eight consecutive generations of the parthenogenetically reproducing crustacean D. magna were investigated. Twice during the study near 100% mortalities of the Daphnia were recorded. The first occurrence was in March 1974, when water was taken from the river during the spring flood. The second time water had a lethal effect on Daphnia occurred between the middle of July and September of 1975. The summer of 1975 was one of frequent thunder storms and torrential rain. Hydrochemical analysis of the river water at this period showed that the total biological oxygen demand (BOD) was double the normal level. Ammonium content was also doubled, which indicated organic pollution of the water. It is probable that runoff from the fields and atmospheric precipitation had a lethal effect on the hydrobionts. Several alternating periods of raised or lowered fecundity were noted during the study. Seasonal variations in the abundance of plankton crustaceans are due under natural conditions both to changes in environmental factors and to interactions within an between populations. The findings allowed the conclusion that the fluctuations in the indices of the survival of Daphnia in water from the Moscow River are not governed by seasonal factors, but are dependent on the quality of the water, in particular on its content of toxic ingredients. A periodic reduction in fecundity was noted in the winter and in the summer months. (Baker-FRC)
W82-02083

WANTED: WATER FOR DEVELOPMENT,
For primary bibliographic entry see Field 6D.
W82-02088

WATER QUALITY MANAGEMENT OF LAKE NEUSIEDLER, AUSTRIA,
Federal Inst. on Water Resources Research (Switzerland).
H. Fleckseder.
Aqua, No 5, p 3-7, 1981. 1 Fig, 9 Ref.

Descriptors: *Water quality, *Eutrophication, Phosphorus, Water management, Water quality management, Water quality control, *Lake Neusiedler, *Austria, Water treatment facilities.

Lake Neusiedler, Austria, is extremely shallow, with an average depth of some 2 meters. During its history the lake has dried up completely several times. In the north, west and south, the drainage area is formed by a mountainous ridge, whereas in the east it is flat and a surface drainage line cannot be easily drawn. The sub-surface drainage area seems to be even more complicated. The total lake area varies between 250 and 300 square kilometers, with the open water amounting to 130 to 160 square kilometers. Waulka Creek is the largest permanent discharge into Neusiedler See. A marked eutrophication was noted by limnologists investigating the lake during the last decade. The cause was traced to increased input of phosphorus. Data available suggest that such a shallow area of

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water can be easily endangered by an imbalance in its water budget, an increase in the area of the reedbelt, and additional phenomena of eutrophication. One quarter of the drainage area is utilized intensively for agriculture with high nutritional dosing for growing grapes, sugar beet, vegetables and other crops. Some 15% of the drainage area consists of forest, 2% of orchards, 2% of sealed surfaces, an additional 2% occupied by Lacken (brackish ponds) and 1% by swamp. The climatic properties of the area and the large evapotranspiration of the lake are of prime importance for the microclimate in the area directly surrounding the lake. At least once a year, if possible under peak conditions, every water treatment plant is checked in a 24 hr run for load entering, load leaving, oxygen uptake, iron dosed and additional features. (Baker-FRC)
W82-02090

SOME EFFECTS OF SEWAGE DISCHARGE UPON PHYTOPLANKTON IN HONG KONG,
Fisheries Research Station, Aberdeen (Hong Kong).
G. B. Thompson, and J. Ho.
Marine Pollution Bulletin, Vol 12, No 5, p 168-173, May, 1981. 5 Fig, 22 Ref.

Descriptors: *Phytoplankton, *Wastewater disposal, *Species composition, *Chlorophyll a, *Hong Kong, Coastal waters, Estuaries, Water pollution sources, Water pollution effects.

Chlorophyll a and species composition were determined in the coastal waters of Hong Kong, December 1974 to July 1976, to survey the impact of 280 million tons of untreated sewage which is discharged into Victoria Harbor each year. Chlorophyll a in the western coastal area, characterized by estuarine conditions, was 2-6 micrograms per liter (maximum 8.3 micrograms per liter). In the central section, Victoria Harbor, site of the sewage outfalls, chlorophyll a levels were as high as 20.2 micrograms per liter. To the east, where oceanic conditions prevail, chlorophyll a reached a maximum of 2.6 micrograms per liter. Taxonomic diversity was unaffected by pollution except in summer, when Chaetoceros spp. were predominant in net phytoplankton samples. During autumn early winter, Skeletonema costatum was abundant in the polluted Victoria Harbor area. (Cassar-FRC)
W82-02095

5D. Waste Treatment Processes

COMPOSITION OF FRUIT AND VEGETABLE PROCESSING WASTES,
Orange Free State Univ., Bloemfontein (South Africa). Dept. of Microbiology.
B. A. Prior, and H. J. Potgieter.
Water SA, Vol 7, No 3, p 155-159, July, 1981. 5 Fig, 3 Tab, 13 Ref.

Descriptors: *Food-processing wastes, *Byproducts, *Carbohydrates, Effluents, Fruit crops, Vegetable crops, Waste disposal, Aquaculture.

The composition and variability of effluent produced by pineapple and fruit and vegetable canneries were investigated over a one year period. All samples were analyzed for: chemical oxygen demand, Kjeldahl nitrogen, phosphorus, carbohydrate, reducing sugars, pH, and microbial count. The effluents were found to be especially rich in carbohydrates. For pineapple effluent, the mean weekly carbohydrate concentration was 19.8 g/liter, the daily mean was 20.3 g/liter, and the hourly mean was 14.2 g/liter. The weekly mean carbohydrate concentration in effluent of the fruit and vegetable cannery was 2.1 g/liter for stream A and 1.9 g/liter for stream B. Treatment of the effluent by biological wastewater treatment methods would be difficult because of the low nitrogen and phosphorus contents relative to the high COD. Conversion of the pineapple effluent into yeast protein is feasible. An alternative would be to produce ethanol. The fruit and vegetable cannery effluent is not suitable for by-product recovery, and a traditional disposal technique such as land disposal should be considered. This effluent may have to be screened before piping, and gypsum may have to be added to counteract the sodium. (Small-FRC)
W82-01601

STEP FED PLUG FLOW REACTOR FOR BIOLOGICAL WASTEWATER TREATMENT VERSUS CONTINUOUS FLOW STIRRED TANK REACTOR (CFSTR),
Technion-Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.
M. Green, and G. Shelef.
Journal of Environmental Sciences, Vol 24, No 4, p 25-26, July/August, 1981. 1 Fig, 8 Ref.

Descriptors: *Wastewater treatment, *Plug flow, Sludge, Effluents, Flow, Continuous flow, Suspended solids, Biological oxygen demand, Activated sludge process, Activated sludge, Comparison studies.

The two general categories of continuous flow reactors in use for handling wastewater are the ideal continuous flow stirred tank reactor (CFSTR) and the ideal plug flow reactor. These two categories are compared in this paper. CFSTRs are characterized by essentially constant levels of solids, organic matter, and oxygen demand throughout the reactor. CFSTRs for biological wastewater treatment usually operate under severe substrate limiting conditions, dictated by the final effluent quality requirements. The efficiency of these systems is relatively low, as the specific substrate removal rate is proportional to the substrate concentration. The nominal sludge age is higher than the bacterial lifetime, so most of the sludge cells are dead. The ideal plug flow is defined as a laminar flow under conditions of perfect mixing in the lateral plane and no mixing in the longitudinal direction. A step fed plug flow reactor is a special case of a plug flow reactor in which the reactor receives the inflow in several points throughout its length. A higher sludge viability is achieved. A step fed plug flow reactor for biological wastewater treatment inherently has two advantages over a CSTR. The first is the possibility of working under substrate saturation conditions and hence under conditions of high specific substrate removal rates, and the second, an increase in the biomass net growth rate along the system, which results in a higher sludge viability. To achieve a maximum removal efficiency, a step fed plug flow system should be highly loaded along most of its length, while to achieve high performance the end section of the plug flow reactor should remain without feeding and allow for enough flow time to obtain highly polished effluent. Studies have shown that the use of sewage conveyance conduits for wastewater treatment by biological sludge introduction and air can give effluent of secondary quality. (Baker-FRC)
W82-01618

INFLUENCE ON GROUNDWATER FROM THE BERMED INFILTRATION POND,
Dorchester County Health Department, Cambridge, MD.
L. W. Coble, Jr.
Journal of Environmental Health, Vol 44, No 1, p 27-31, August, 1981. 6 Fig, 2 Tab, 13 Ref.

Descriptors: *Groundwater pollution, *Ponds, *Infiltration, *Wastewater disposal, Domestic wastes, Municipal wastes, Wastes, *Wastewater treatment, Bacteria, Septic tanks, Groundwater recharge, Aerobic conditions, Aerobic treatment, Water pollution sources.

The bermed (diked) infiltration pond concept involves pretreating household wastes by means of a conventional septic tank with the effluent being pumped to an open or closed sand filter, and subsequently to the pond. The household wastes may also be pretreated by an aerobic treatment unit and pumped directly to the pond. Dilution, surface area, chemical reactions, and algae action are all involved in final treatment of the pretreated wastewater in the pond. Large volumes of water enter the pond from precipitation, surface drainage from inside the berm, and the pretreated wastewater. Water leaves the pond by evaporation and infiltration. The pond excavation must expose a permeable water-bearing substratum that will transmit water. The water-bearing substratum helps to maintain the pond water level, which would otherwise be lowered by evaporation during the summer months. The bermed infiltration pond allows unconfined groundwater recharge. The large pond size provides storage capacity and adequate infiltration area to allow effective infiltration during the wet season when water tables are highest and percolation rates retarded by saturated soil conditions. The pretreatment of the household wastewater is sufficient to allow further treatment in the bermed infiltration pond without the pond becoming anaerobic. Movement of nitrate nitrogen and growth of coliform and fecal coliform bacteria are not observed in the groundwater outside the pond excavation. Movement of chlorides and phosphorus in the groundwater can be expected about 150 feet from the pond. Therefore, increased deep well separation distances from 50 to 150 feet for this source of contamination and large parcel size requirements are justified to protect the residents' and adjacent property owners' water supplies. (Baker-FRC)
W82-01622

NITROUS OXIDE EMISSION FROM SIMULATED OVERLAND FLOW WASTEWATER TREATMENT SYSTEMS,
Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.
C. J. Smith, R. L. Chen, and W. H. Patrick, Jr.
Soil Biology and Biochemistry, Vol 13, No 4, p 275-278, 1981. 3 Fig, 2 Tab, 19 Ref.

Descriptors: *Nitrous oxide, *Land disposal, *Wastewater treatment, Wastewater disposal, Waste disposal, Nitrogen, Ammonia, Overland flow, Flow, *Air pollution sources.

The contribution of overland flow wastewater treatment systems to the atmospheric concentration of nitrous oxide was investigated. A low permeability Mhoon slit loam soil from Baton Rouge, Louisiana was used in the study. Soil preparation involved air drying and sieving. About 27 kg air-dried limed or unlimed Mhoon soil was uniformly packed into each of 4 test models to a depth of 10 cm. The soil was compacted to a bulk density similar to that existing under natural conditions. The soil surface was seeded with perennial ryegrass at a rate of 100 g/square meter and watered occasionally with tapwater until germination. The models were maintained for 4 weeks by adding wastewater to establish the sod and establish a nearly constant rate of N transformations. Wastewater used was a secondary treated effluent from the Baton Rouge treatment plant. The overland flow system of wastewater disposal produced or caused a net nitrous oxide evolution to the atmosphere. Liming the soil increased the nitrous oxide evolution about 4-fold in comparison to that of the unlimed soil receiving wastewater containing 10 microg ammonium-nitrogen/ml. The rate of nitrous oxide evolution from the limed and unlimed soil systems was estimated to be 6.0 and 1.5 kg nitrous oxide-nitrogen/ha/yr, respectively. The increased rate of nitrous oxide evolution observed when the soil pH was increased from 5.8 to 7.1 is possibly due to an increase in the nitrification and denitrification rates. The mechanism for the production of nitrous oxide in the soil-plant microcosm is not known. (Baker-FRC)
W82-01624

CENTURY-OLD BOARD MILL OPERATES WITH ZERO EFFLUENT DISCHARGE,
J. C. W. Evans.
Pulp and Paper, Vol 55, No 7, p 98-99, July, 1981.

Descriptors: *Pulp and paper industry, *Waste recovery, *Recycling, *Water reuse, Performance evaluation, Wastewater treatment, Filtration, Flocculation, Clarification, Industrial wastes, Biocides, Corrosion control.

The Halltown Paperboard Company mill, located on a stream emptying into the Shenandoah River, has been recycling all effluent from its production of paperboard from wastepaper since 1969. Before

the changeover to recycling of its waste water, the mill occassionally had to close due to water shortages. To eliminate the need for freshwater in the system, some internal 'closed loops' such as liner white water from the paper machine was recirculated back to the liner pulper. An old stream bed running under the mill carries all effluent back to a pumping station. From here, the effluent is pumped to the water treatment clarifier and the fiber is recovered by Hydrasieves. Sludge is pumped from the bottom of the clarifier to the filler pulper. Clarified water is aerated and stored for use in the liner and filler pulpers. Suspended solids in the clarifier are settled by the polymer used as a drainage aid. Biocides are used to control bacteria and slime. The mill has experienced breakdowns in the clarifier, causing spills into the nearby stream, as well as many other failures in the closed system. Use of stainless steel has corrected severe corrosion problems, and the need for constant maintenance is slowly diminishing. (Geiger-FRC)
W82-01626

USING ZETA POTENTIAL TO OPTIMIZE COAGULATING AID DOSES USED TO TREAT FOOD PROCESSING WASTES,
Cornell Univ., Ithaca, NY. Dept. of Food Science.
F. W. Welsh, and R. R. Zall.
Process Biochemistry, Vol 16, No 4, p 31-33, 42, June/July, 1981. 6 Fig, 1 Tab, 13 Ref.

Descriptors: *Food-processing wastes, *Zeta potential, Monitoring, Industrial wastes, Suspended solids, *Coagulation, *Wastewater treatment, Water treatment, Chemical oxygen demand.

The purpose of this paper is to indicate a use for zeta potential analysis as a method of monitoring coagulation processes used in treating food processing liquid waste effluents. Three different kinds of food processing liquid waste effluents were studied: from a fruit juice processing operation, from a scallop shucking operation, and from an egg washing operation. Jar test results for the three wastes were compared to zeta potentials. The fruit juice processing waste effluent samples were an example of the low colloidal concentration type of waste. A small net zeta potential change, from the initial zeta potential to the optimum zeta potential, occurred with the minimization of sample turbidity. Food processing wastes containing large amounts of colloidal materials are more easily treated with coagulants. This improved coagulant treatability of the waste must also be observable from the zeta potential analysis results. The scallop shucking wastewater was an example of a colloidal type of waste. For this waste, the net zeta potential change was 15 mv. The waste parameter concentration removed from the scallop shucking waste effluent at its optimum coagulant does was significantly different from its pH adjusted counterpart. The largest net zeta potential change (30 mv) was noted with the egg washing effluent. This highly colloidal effluent also exhibited the largest suspended solids reduction. A first order relationship was noted between the changes in the colloidal solids concentration as measured by suspended solids, content of the waste and the net change in zeta potential. Thus coagulant treatability of a food processing waste effluent is a function of the zeta potential change, as it is affected by the suspended solids change of the wastewater. Zeta potential can be used to monitor coagulation processes for effluent treatment. (Baker-FRC)
W82-01627

REMOVAL OF ORGANICS FROM WATER BY GRANULAR ACTIVATED CARBON AND MICROORGANISMS,
National Coal Board, Stoke Orchard (England). Coal Research Establishment.
J. Wilson.
Process Biochemistry, Vol 16, No 4, p 9-12, June/July, 1981. 2 Fig, 38 Ref.

Descriptors: *Water treatment, *Activated carbon, Carbon adsorption, Microorganisms, Bacteria, Biological treatment, Reviews, *Wastewater treatment, *Organic compounds, Dissolved solids.

While the treatment of wastewater by biological methods is widespread, the treated water may remain contaminated and unsuitable for discharge to waterways. As an extra treatment stage to remove soluble organics that persist an obvious development is the use of granular activated carbon (GAC) along with biological treatment. Experiences of enhanced removal of organics from contaminated water by GAC as a result of adventitious biological activity on the GAC have been reported for a number of cases ranging from pilot to full-scale plants. A large advanced water treatment pilot plant at Pomona, California is cited where municipal wastewater was treated. At this plant of 45 cubic meter/hr capacity, effluent from an activated sludge plant was passed downwards through GAC columns. Removal of organics was better than expected; this was attributed to the action of biological flora that had become established adventitiously in the GAC beds. Early experience with the nuisance of sulfide emission, caused by anaerobic biological activity on sulfates in the water, was obtained at the Blue Plains Advanced water treatment plant, operating at 8 cubic meter/hour capacity on municipal wastewater. The addition of sodium nitrate to the GAC influent stopped sulfide emission and enhanced biological oxidation on GAC. The combination of ozone and GAC with biological activity is of increasing interest in wastewater treatment, especially in the US, and some case histories are cited. A method of regeneration has been developed that relies on biological activity as an alternative to thermal processes. Disadvantages of biological activity on GAC and areas needing further study include: the nature of the compounds produced by bacterial action, including toxicity; high bacterial counts in GAC effluents; and the production of polar, partly adsorbable compounds with the use of ozone. (Baker-FRC)
W82-01628

WATER REUSE: ULTRAFILTRATION OF INDUSTRIAL AND MUNICIPAL WASTEWATERS,
Wisconsin Univ.-Milwaukee. Dept. of Civil Engineering.
E. R. Christensen, and K. W. Plaumann.
Journal of the Water Pollution Control Federation, Vol 53, No 7, p 1206-1212, July, 1981. 4 Fig, 7 Tab, 19 Ref. OWRT-R-0048(7809)(1), 14-34-0001-7809.

Descriptors: *Ultrafiltration, *Water reuse, *Industrial wastes, Filtration, Wastewater treatment, Municipal wastes, Membrane filters, Performance evaluation, Organic carbon, Separation techniques.

The potential role for ultrafiltration in industrial and municipal water reuse was evaluated, working with plate-and-frame systems and wastewaters from the textile, food, pulp and paper, and general manufacturing industries, and from a wastewater treatment plant. An on-site study was performed using secondary effluent from a municipal wastewater treatment plant. The wastewaters most suitable for ultrafiltration appeared to be: textile bleach, oily waste, secondary effluent, polyvinyl alcohol, and pulp and paper waste in that order. More than 40% total organic carbon was removed using a fluoro-polymer membrane; for pulp and paper waste, 58% total organic carbon removal was obtained with a cellulosic membrane. The secondary effluent study found about 50% total organic carbon removal with fluoro-polymer, polysulfone, and polytetrafluoroethylene membranes. A typical minimum energy requirement was 4.60 k Wh/cu m for the filtration of secondary effluent with a polysulfone membrane. (Small-FRC)
W82-01652

THE EFFECTS OF SECONDARY SEWAGE EFFLUENT ON THE WATER QUALITY, NUTRIENT CYCLES AND MASS BALANCES, AND ACCUMULATION OF SOIL ORGANIC MATTER IN CYPRESS DOMES,
Florida Univ., Gainesville.
For primary bibliographic entry see Field 5G.
W82-01687

WATER PURIFICATION STUDIES WITH ACTIVATED CARBON AND FOAM FLOTATION,
Vanderbilt Univ., Nashville, TN.
N. A. K. Mumallah.
PhD Dissertation, 1980. 156 p, 19 Fig, 33 Tab, 121 Ref, Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-01683.

Descriptors: *Wastewater treatment, *Separation techniques, Water pollution control, Water purification, *Foam separation, Heavy metals, Flotation.

The floc foam flotation of chromium (III) with ferric hydroxide and NLS; the precipitate foam flotation of copper using the chelating agents dodecyldithiocarbamate and LIX-reagents; precipitate flotation of nickel, cobalt, manganese, zinc and cadmium with LIX-reagents; and precipitate flotation of copper, manganese and zinc using mono lauryl phosphate are reported. The effects of pH, ionic strength and the presence of interfering anions such as SO4(2-), HPO4(2-) and EDTA on these foam flotations have been investigated. The objectives of the work were to develop a satisfactory flotation method for chromium and to examine the abilities of some novel chelating surfactants to carry out effective flotation in the presence of ions which interfere with NLS. (Sinha-OEIS)
W82-01692

SLOWHILL COPSE SEWAGE TREATMENT WORKS.
Water Services, Vol 85, No 1025, p 335-337, July, 1981. 7 Fig.

Descriptors: *Wastewater facilities, *Wastewater treatment, Water treatment facilities, Sewer systems, Primary wastewater treatment, Advanced wastewater treatment, Sludge, *Southampton, *England.

A description is offered of the new sewage treatment works at Slowhill Copse. The new works is being built in two phases. Phase I, already operational, provides preliminary treatment and primary settlement for all present flows, which are then discharged to Southampton Water via the original works outfall. The maximum design dry weather flow for phase 1 is 23,270 cubic meters/day from a contributing population of about 45,000 persons. Phase 2 will complete the project and will provide the secondary and sludge treatment processes, with effluent to Royal Commission standard being discharged to Southampton Water via a new works outfall of 1350 mm diameter. The main structures being built for phase 2 are aeration channels, final settlement tanks, return activated sludge system, sludge consolidation tanks, sludge treatment buildings, pipelines, services and roads. The main structures of phase 1 include primary settlement tanks, storm tanks, modifications to the existing primary sedimentation tanks, the electrical and control buildings and associated pipelines and services. The works follow a conventional pattern of treatment such as screening, grit removal, primary settlement, biological treatment by surface aeration, and final settlement. The major building structure is the sludge treatment building, which comprises a deep basement housing the sludge pumping equipment and wet wells, a sludge thickening hall which houses two Komline Sanderson flotation thickener units, and the associated chemical dosing and compressed air units. (Baker-FRC)
W82-01727

PARASITE EGG AND CYST REDUCTION IN OXIDATION DITCHES AND AERATED LAGOONS,
National Environmental Engineering Research Inst., Nagpur (India).
P. V. R. C. Panicker, and K. P. Krishnamoorthi.
Journal of the Water Pollution Control Federation, Vol 53, No 9, p 1413-1419, September, 1981. 9 Fig, 3 Tab, 22 Ref.

Descriptors: *Wastewater treatment, *Oxidation, *Parasites, Oxidation ditches, Oxidation lagoons, Oxidation ponds, Ponds, Effluents, Human diseases, *Aerated lagoons, Public health, *India.

The efficiency of removal of helminth eggs and protozoan cysts in nonconventional pilot wastewater treatment systems such as the oxida-

tion ditch and aerated lagoon at the Nagpur campus of the National Environmental Engineering Research Institute was examined. Egg and cyst counts in individual raw wastewater samples varied from 122 to 860 organisms per liter. In raw wastewater, protozoan cysts (Entamoeba histolytica and Giardia lamblia) formed the majority, whereas the helminth eggs were comparatively fewer in number. The majority of protozoan cysts and helminth eggs were removed during the process of treatment in the oxidation ditch. The efficiency of the oxidation ditch as a means of removing the parasites compares favorably with that of the activated sludge process, with the removal of Ascaris in a majority of samples ranging from 95 to 100%. During this study the biochemical oxygen demand reduction ranged from 95 to 99%, and the effluent BOD was up to 10 mg/liter. With a three day detention time, the average BOD removal in the lagoon was 81.4%. BOD of the final effluent ranged between 12 and 45 mg/l, with an average of 27 mg/l. The presence of relatively large numbers of cysts and eggs in the lagoon effluents indicates improper settling. Addition of a settling tank is needed to improve the quality of the effluent. The present study did not include variability experiments. No correlation was found in this study between the removal of parasites and some operational conditions such as increased retention time, SRT, or MLVSS. Removal efficiency in the aerated lagoon was less than that of the oxidation ditch. (Baker-FRC)
W82-01733

EFFECT OF THE COPPER CONTENT OF DISTILLERY SPENT WASH ON ITS UTILIZATION FOR SINGLE-CELL PROTEIN PRODUCTION BY GEOTRICHUM CANDIDUM, HANSENULA ANOMALA AND CANDIDA KRUZEI,
New Univ. of Ulster, Coleraine (Northern Ireland). School of Biological and Environmental Studies.
For primary bibliographic entry see Field 5C.
W82-01750

EFFECT OF REAGENT MIXING RATE ON ADSORPTION PROCESS FOR AM-FE2O3.H2O,
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W82-01799

REMOVAL OF ELEMENTAL MERCURY FROM WASTEWATERS USING POLYSULFIDES,
Domtar Ltd. Research Center, Senneville (Ontario).
D. M. Findlay, and R. A. N. McLean.
Environmental Science and Technology, Vol 15, No 11, p 1388-1390, November, 1981. 1 Tab, 8 Ref.

Descriptors: *Sodium polysulfide, *Mercury, *Chloralkali plants, Sulfides, Polysulfides, *Wastewater treatment, Chemical wastewater, Industrial wastewater, Metals, Heavy metals.

Sodium polysulfides removed both elemental and ionic mercury from wastewater and sludge from a Hg cell chloralkali plant. In plant operation, addition of 20 ppm sodium polysulfide to the existing treatment (37 ppm sodium hydrosulfide and 75 ppm FeCl3) reduced Hg concentration to an average of 11 ppb, compared to 87 ppb without Na polysulfide. The sludge resulting from brine treatment contained 150 ppb elemental Hg and 5200 ppb total Hg. Various treatments reduced Hg concentrations to the following levels: 50 ppm Na hydrosulfide alone, 30 ppb elemental and 430 ppb total; Na polysulfide alone, 3 ppb elemental and 65 ppb total; and 50 ppm of each, 3 ppb elemental and 53 ppb total. In a brine sludge sample with 720 ppb elemental Hg and 1390 ppb total Hg polysulfide alone reduced concentrations of Hg to 1 ppb and 20-30 ppb, respectively. Best results are obtained when pH is maintained at 9-12, polysulfide solution is less than 1 week old, chlorine or hypochlorite are removed, and 75-100 ppm FeCl3 is added as a flocculant. (Cassar-FRC)
W82-01800

PRECIPITATE FLOTATION STUDIES WITH MONOLAURYL PHOSPHATE AND MONOLAURYLDITHIOCARBAMATE,
Vanderbilt Univ., Nashville, TN. Dept. of Chemistry.
N. A. Mumallah, and D. J. Wilson.
Separation Science and Technology, Vol 16, No 3, p 213-228, 1981. 1 Fig, 6 Tab, 35 Ref.

Descriptors: *Chemical precipitation, *Flotation, *Metals, *Ions, Copper, Zinc, Magnesium, Monolauryl phosphate, Lauryldithiocarbamate, Chelating agents, *Wastewater treatment, Industrial wastes, Separation techniques.

The precipitate flotation of copper(II), manganese(II), and zinc(II) with monolauryl phosphate was investigated at various pH's and ionic strengths. Also, the potential of lauryldithiocarbamate to chelate copper(II) and remove it by foam flotation was evaluated at various pH's and in the presence of various anions which show interference in the removal of Cu(II) by flotation. At pH's of 7-10, very good removal of Cu(II) precipitated as the hydroxide followed flotation, but below pH 7 removal was difficult. When Cu(II) was coprecipitated with ferric hydroxide and floated with lauryl phosphate, good removal was also obtained in the pH range 1-10. Mn(II) was removed successfully by flotation with lauryl phosphate in less than 10 min, and Zn(II) removal was successful when Zn(II) was coprecipitated with ferric hydroxide in the ratio Fe:Zn of 2 or more and at pH's of 8.5-10. Lauryl phosphate was much better than sodium lauryl sulfate, dithiocarbamate, or other commercial reagents in removing transition metal ions from aqueous solution. (Small-FRC)
W82-01863

DETROIT'S WWTP: ONE OF THE WORLD'S BIGGEST,
Detroit Dept. of Water Supply, MI. Water and Sewer Treatment.
A. C. Davanzo.
Water/Engineering and Management, Vol 128, No 9, p 38-41, September, 1981.

Descriptors: *Wastewater treatment, *Secondary wastewater treatment, *Sludge disposal, Sewage systems, Phosphorus removal, Water pollution prevention, Remote control, Effluent limitations, Water quality standards, Aeration, Incineration, Waste disposal, *Wastewater facilities, Detroit.

The Detroit wastewater treatment plant, which provides treatment for over 76 communities, is described. An extensive sewage collection network with monitoring devices forms the backbone of the system. Work to build interceptors to collect the flow of perpendicular trunk sewers was delayed until 1940. At present the plant processes an average of 650 mgd, with peaks to 900 mgd. Pumping, primary treatment and solids disposal capacities were expanded in the 1950's and 1960's to meet increased loads from an increasing population. In the 1960's plans were made to improve effluent discharges by phosphorus removal. An oxygen aeration system was also adopted in the early 1970's. Some effluent quality problems arose in the latter part of this decade, which were handled by increased staff and better training of plant personnel. Solids disposal is still a problem. Fourteen multiple hearth incinerators are used to handle solids; however, measures to meet air pollution standards are still being studied. Industrial wastes contribute large amounts of grease, which is handled by landfilling. Inlet modifications have solved the problems of the peripheral inflow/outflow clarifiers. (Geiger-FRC)
W82-01865

SIMPLE RETENTION TIME ANALYSIS IN TRICKLING FILTERS USING CONDUCTIVITY,
Trinity Coll., Dublin (Ireland).
N. F. Gray.
Effluent and Water Treatment Journal, Vol 21, No 8, p 345-347, August, 1981. 3 Fig, 12 Ref.

Descriptors: *Trickling filters, *Conductivity, *Tracers, *Retention time, Sodium chloride, Performance evaluation, Costs, *Wastewater treatment.

A comprehensive assessment was performed of all the non-radioactive tracers available for the measurement of retention time in trickling filters. Sodium chloride was the most convenient. The rate of adsorption of the chloride by the biological film was relatively constant, especially over short periods of time. Also, it had only an extremely slight effect on the treatment process, and consequently a low environmental impact. Sodium chloride has a low bulk cost when compared to other possible tracers. A simple conductivity meter and cell can be used to monitor the chloride. The method is simple, rapid, reproducible, and economical, making it possible to include the regular measurement of retention time in the routine assessment of trickling filter efficiency. (Small-FRC)
W82-01876

A MULTILEVEL MODEL AND ALGORITHM FOR SOME MULTIOBJECTIVE PROBLEMS,
Chiyoda Chemical Engineering and Construction Co. Ltd., Yokohama (Japan).
For primary bibliographic entry see Field 6A.
W82-01884

ACTIVATED SLUDGE NICKEL TOXICITY STUDIES,
Chulalongkorn Univ., Bangkok (Thailand). Inst. of Environmental Research.
S. Sujarittanonta, and J. H. Sherrard.
Journal of the Water Pollution Control Federation, Vol 53, No 8, p 1314-1322, August, 1981. 7 Fig, 1 Tab, 30 Ref.

Descriptors: *Activated sludge process, *Nickel, *Toxicity, Heavy metals, Metals, Nitrification, Wastewater treatment, Biological treatment, Microorganisms, Aerobic digestion, Organic loading.

The effects of nickel on the activated sludge process were studied in three laboratory experimental units and a control and found to depend on COD:Ni(2+) ratio, microorganism concentration:Ni(2+) ratio, and operating mean cell residence time. The feed solutions contained: (1) 1 mg per liter Ni(2+) and 396 mg per liter COD, (2) 5 mg per liter Ni(2+) and 391 mg per liter COD, and (3) 1 mg per liter Ni(2+) and 787 mg per liter COD. In all three feed solutions Ni reduced COD removal efficiency slightly as compared to the control, indicating that activated sludge performance was not influenced by metal ion concentration alone but was also dependent on wastewater strength and mean cell residence time. Nitrification was significantly inhibited by solutions (1) and (2) but not by solution (3). Nitrifying organisms were much more sensitive to Ni than were heterotrophic organisms. Both COD removal efficiency and toxicity to nitrifiers appeared to be dependent on the ratio of COD:Ni(2+) rather than on the concentration of Ni(2+) alone. Values of Y max (microorganism cell yield) and b (maintenance energy coefficient) were higher in solutions (1) and (2) than in the control. This was attributed to a shift in microbial species as a response to Ni or to the stimulatory effects of Ni on microbial activity. Microorganism concentration increased with increased mean cell residence time, and toxicity was related to the ratio of Ni concentration to biomass concentration. (Cassar-FRC)
W82-01895

EXTRACTION OF COPPER WITH LIQUID SURFACTANT MEMBRANES,
Kyushu Univ., Fukuoka (Japan). Dept. of Organic Synthesis.
F. Nakashio, and K. Kondo.
Separation Science and Technology, Vol 15, No 4, p 1171-1191, 1980. 13 Fig, 23 Ref.

Descriptors: *Wastewater treatment, *Copper, *Surfactants, Separation techniques, Heavy metals, Chelating agents, *Membrane filters, Solvents, Hydrogen ion concentration, Metallurgy, Metals, Metal complexes.

Interest in the application of solvent extraction for the recovery of metals has increased, especially in

industrial resource recycling, hydrometallurgical processing and waste water treatment. The extraction of copper using liquid surfactant membranes containing a mobile carrier was conducted in a stirred transfer cell. The resistance of the diffusion step in the liquid surfactant membrane was negligible when compared with that of the diffusion step along with chelating complex formation in the extraneous aqueous solution. Initial rates of copper extraction varied inversely as the 0.5 power of hydrogen-ion concentration at low pH levels, but were not affected by hydrogen-ion concentrations at high pH levels. In the low pH range, the initial rate of copper extraction was proportional to the level of benzoylacetone, the mobile carrier in the membranes. At high pH and high benzoylacetone levels, the initial rate of copper extraction was affected very little by the concentration of the mobile carrier. The batch-type stirred tank findings support a model of liquid surfactant membranes which is presented. Further work is needed on the effects of emulsion breakdown which may occur after longer treatment periods. (Geiger-FRC)
W82-01896

OXYGEN BLEACHING SHOWS POTENTIAL FOR REDUCING COSTS, EFFLUENT PROBLEMS,
MoDo-Chemetics, A. B., Ornskoldsvik (Sweden).
L. Almberg, A. Jamieson, and S. Waldestam.
Pulp and Paper, Vol 54, No 3, p 92-95, March, 1980. 4 Fig, 6 Tab, 5 Ref.

Descriptors: *Bleaching wastes, *Oxygen, *Pulp and paper industry, Biological treatment, Economic aspects, Cost, Performance evaluation, Wastewater treatment, Industrial wastes.

A comparative economic analysis was made of oxygen bleaching vs. biological treatment at a mill making fully bleached softwood kraft pulp. Two cases were examined: one where the mill already exists and the pollution abatement process is added, and the other where a more extensive investment is contemplated. Installation of an oxygen stage in an existing bleach line will permit reduction in pollution quantities by 42-79% while saving up to $1/ton of pulp after allowing for depreciation. The capital cost would be about $8.8 million. In a new plant, installation of an oxygen bleaching sequence instead of a non-oxygen sequence would reduce pollution by 35 to 60%, while saving about $5/ton of pulp after allowing for depreciation. The extra capital costs would be about $4.9 million. Energy costs are an area of current concern, and mills can generate much or all of the direct energy required from waste liquor or wood. Sequence plays a major role in making the mill less sensitive to future oil prices. (Small-FRC)
W82-01899

SELECTIVE REMOVAL OF HEAVY METAL IONS FROM AQUEOUS SOLUTIONS BY DIAFILTRATION OF MACROMOLECULAR COMPLEXES,
Forschungsinst. Berghof G.m.b.H., Tuebingen (Germany, F.R.).
H. Strathmann.
Separation Science and Technology, Vol 15, No 4, p 1135-1152, 1980. 11 Fig, 3 Tab, 5 Ref.

Descriptors: *Heavy metals, *Membrane filters, *Ultrafiltration, *Industrial wastes, Separation techniques, Ion exchange, Waste water treatment, Filtration, Chelating agents, Mathematical equations, Precipitation, Metal complexes.

A method for selectively removing heavy metal ions from aqueous solutions by a combined process of ultrafiltration and treatment with macromolecular chelating agents or emulsified liquid ion exchange materials is described. The macromolecular complex should have high selectivity, water solubility and binding capacity, and narrow molecular weight distribution. The membrane should exhibit high flux and a sharp molecular weight cut-off. Mathematical equations for determining the enrichment factor, complex capacity and polymer solubility are given, and fractional losses of metal due to incomplete rejection of the complex are discussed. Necessary conditions for polarization, polymer precipitation, and the emulsified liquid ion exchanger are outlined. Chelating agents are evaluated in terms of their selectivity, capacity, and load factor. The selective removal of heavy metal ions from industrial effluents was examined in laboratory tests. (Geiger-FRC)
W82-01900

ENVIRONMENTAL DESIGN AND OPERATION OF NANTICOKE THERMAL GENERATING STATION,
Ontario Hydro, Toronto. Central Thermal Services.
P. M. Wiancko.
Journal of Great Lakes Research, Vol 7, No 2, p 96-104, 1981. 5 Fig, 2 Tab, 8 Ref.

Descriptors: *Industrial wastes, *Thermal powerplants, *Monitoring, *Environmental effects, Water pollution sources, *Lake Erie, Canada, Wastewater treatment, *Nanticoke Thermal Generating Station.

The various systems of the Nanticoke Thermal Generating Station which interface with the environment are described, and monitoring activities designed to monitor possible environmental effects are outlined. The 4,000 MW fossil-fueled plant is located on the north shore of Long Point Bay on Lake Erie. Up to 150 cu m/sec of cooling water is used: 60% for condenser cooling and 40% for discharge tempering. Chemical-laden wastes, fly ash and bottom ash, treatment plant wastes, coal pile drainage, and sewage are retained in a 76 ha lagoon for about forty days. The lagoon drains constantly into the lake at a rate of 0.4 cu m/sec. The station monitors all water processing and waste systems, air quality (for SO2), fugitive coal dust, fish impingement, and seasonal stack impingement of migrating birds. To date, the aquatic environment in the area has remained relatively stable. (Small-FRC)
W82-01907

TECHNOLOGY AND PERFORMANCE OF THE HI-CAPACITY THICKENER,
Envirotech Corp., Salt Lake City, UT.
R. C. Emmett, and R. P. Klepper.
Mining Engineering, Vol 32, No 8, p 1264-1269, August, 1980. 4 Fig, 3 Tab, 3 Ref.

Descriptors: *Mine wastes, *Flocculation, *Clarification, *Wastewater treatment, Industrial wastewater, Coal, Uranium, Iron, Ores, Coagulation, High capacity thickener, Pilot plants, Thickeners, Separation techniques.

The high capacity thickener (HCT) for clarifying mining wastes was studied on the pilot plant scale using wastewaters from coal, uranium, and iron ore processes. Feeds from 4 coal preparation plants (3 producing refuse tailings from froth flotation, and 1 producing a -28 mesh size fraction of coal and refuse) containing 2-15% solids were treated in the HCT with 1-30 ppm anionic thickener. Underflow solids concentrations of 25-39 weight % were produced at 10 times the conventional loading rate. Iron ore concentrate and acid soluble precipitate from a uranium process were successfully treated in a pilot plant with little operator attention. Using iron ore tailings, the HCT also performed comparably to conventional thickeners at the same flocculation dosage. The HCT produced underflow concentrations as high as 63% from a feed containing neutral uranium ore without any difficulty. Maximum benefits from flocculation may be obtained by: mechanical flash mixing of flocculant and pulp, staged addition (at least three stages) of flocculant, introduction of flocculated slurry beneath the pulp level, damping feed fluctuation by inclining the plate zone in the region above the feed inlet, sufficient compression volume beneath the feed inlet, higher than normal raking torque, and reliable instrumentation and control systems. (Cassar-FRC)
W82-01929

SUBSTRATE FLUX INTO BIOFILMS OF ANY THICKNESS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
B. E. Rittmann, and P. L. McCarty.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE4, p 831-849, August, 1981. 8 Fig, 2 Tab, 20 Ref.

Descriptors: *Bacteria, *Substrates, *Fluctuations, Mathematical models, Biomass, Films, *Wastewater treatment, Biological wastewater treatment, Nutrients, Water treatment.

Bacteria which grow as fixed films may have a significant influence on many biological processes in nature and in water and wastewater treatment plants. Steady-state biofilms are defined as those which are not growing or decaying over time. The substrate flux and thickness of a steady-state biofilm can be predicted from the substrate concentration and fundamental biofilm parameters and are based on the kinetics and energetics of substrate utilization and biofilm growth. A model has been developed for estimating the substrate flux into a biofilm of any thickness. The inclusion of mass-transport resistance in the model causes the flux to become a direct function of the bulk substrate concentration. This model can be used to predict the flux of a single, rate-limiting substrate when the biofilm thickness is independently known, even though the biofilm thickness can be nonsteady-state. This may happen when a biofilm at varying bulk substrate concentrations is exposed to fluctuations in wastewater. In such a situation, biofilm thickness might be determined based on longer-term average utilization rates. Experiments with short-term changes in substrate loading demonstrated that removal of substrates to levels below the minimum concentration of rate-limiting substrate able to sustain steady-state biofilm can be accomplished in the short term by nonsteady-state biofilms which undergo net decay and that the model can successfully predict substrate utilization from independently derived parameters if reasonable estimates of the biofilm thickness are available. (Carroll-FRC)
W82-01964

HYDRAULIC MODELING FOR WASTE STABILIZATION PONDS,
Princeton Univ., NJ. Dept. of Civil Engineering.
R. A. Ferrara, and D. R. F. Harleman.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE4, p 817-830, August, 1981. 9 Fig, 1 Tab, 14 Ref.

Descriptors: *Hydraulic models, *Stabilization ponds, *Wastewater treatment, Performance evaluation, Mathematical models, Simulation analysis, Water quality, Flow characteristics.

The hydraulic transport and the biological and chemical transformation processes within a waste stabilization pond determine the treatment performance. Efforts were made to identify the appropriate hydraulic design of waste stabilization ponds using dye tracer studies and model simulations to indicate the efficiency of various pond geometries and inlet and outlet configurations. Some of the test ponds were found to have treatment efficiencies well below that of completely-mixed flow, and avoidance of these configurations is recommended. None of the ponds tested achieved the efficiency of plug flow. Evaluation of hydraulic models for water quality simulation in waste stabilization ponds showed that treatment efficiencies predicted by the completely-mixed flow model compared well with those determined by analysis of dye tracer studies. This comparison was based on treatment efficiency for first-order decaying substances at steady state. The development of a return flow model which realistically represents the transport process is reported. The model uses three input parameters: the dispersion coefficient in the active zone, the size of the active zone, and the dilution ratio. (Carroll-FRC)
W82-01965

MANAGING WATER AT HELICOPTER PLANT,
B. Rose.

LIBRARY U. OF I. URBANA-CHAMPAIGN

Industrial Finishing, Vol 56, No 1, p 34-36, January, 1980.

Descriptors: *Reclaimed water, *Water costs, *Metal-finishing wastes, Water management, Wastewater treatment, Boiler water, Water reuse, Industrial wastewater, Aircraft, Chromium, Metals.

The use of reclaimed water has saved $60,000 a year in water and waste treatment costs and $20,000 a year in fuel costs for the Bell Helicopter Textron plant. The chromate rinse waters plus other selected wastes are routed to a surge tank, where the pH is adjusted to 6-7, if necessary. Wastewater is pumped into the reduction unit at the rate of 50 gpm. Here hexavalent chromium at concentrations of 50-60 mg per liter is continually reduced to the trivalent state by an electrochemical process using consumable iron electrodes. Further treatment involves a lamella separator, addition of polyelectrolytes, and sand filtration. The treated water, of higher quality than city or well water, is used as boiler feed water. Concentrated wastes from other processes are treated prior to discharge to the municipal sewer system. The $330,000 reclamation system has paid for itself 3 times over in about 2 years by reducing city water consumption and sewer charges, allowing boiler water to be recycled less often, and lessening the demand on the waste treatment system. (Cassar-FRC)
W82-01974

MODELING STORMWATER STORAGE/ TREATMENT TRANSIENTS: THEORY,
Duke Univ., Durham, NC. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W82-01980

MODELING STORMWATER STORAGE/ TREATMENT TRANSIENTS: APPLICATIONS,
Duke Univ., Durham, NC. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W82-01981

COMBINING SEWER WATER PURIFICATION PROCESSES TO TREAT EFFLUENTS PRODUCED BY TRANSIENT POPULATIONS,
Limoges Univ. (France). Fondation de L'Eau Limoges.
G. Casteignau.
Water Science and Technology, Vol 13, No 7, p 315-329, 1981. 5 Fig, 4 Tab, 3 Ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Combined treatment, *Chemical treatment, *Population dynamics, Pilot plants, Organic carbon, Phosphorus, Nitrogen, Nitrification, Nutrient removal, Chemical coagulation, Coagulation, Flocculation, France.

The added sewage produced by transient populations, especially in leisure resorts of coastal areas, sometimes exceeds the purification capacity of biological wastewater treatment processes. Comparative studies carried out in the field and in pilot plants demonstrate the value of adding coagulation-flocculation treatment to the biological treatment of sewage in areas of transient populations. The transfer of nitrogen, phosphorus and carbon charges was analyzed to evaluate the effectiveness of combined chemical and biological treatment. The production of sludge and sludge treatment by various processing patterns are compared, along with management strategies for operating combined units for the biological/physicochemical treatment of increased loadings of wastewater due to transient populations. (Geiger-FRC)
W82-01992

CONTROL OF BARK LANDFILL LEACHATES WITH AN ANAEROBIC TREATMENT SYSTEM,
Stora Kopparberg-Bergvik, Skutskar (Sweden).
S. Rydin, and P. Haglund.
Tappi, Vol 64, No 8, p 59-62, August, 1981. 7 Fig, 1 Tab, 4 Ref.

Descriptors: *Pulp and paper industry, *Wood wastes, *Leachates, Anaerobic conditions, *Wastewater treatment, Industrial wastes, Landfills, Bark, Methane, Water pollution control.

A pulp mill developed a bark landfill to treat bark leachates, reducing BOD by 90% and COD by 60%. The landfill itself acted as an aerobic filter, on which a stable methane-forming bacteria developed. In the present full-scale system, leachate from the landfill is collected in ditches, sent to a buffer pond (3000 cu meters), and pumped over the bark at 1 cu meter per min. Although the process is pH-dependent, it has not been necessary to adjust the pH, probably because some lime sludge is present. Stopping the recycling for any reason causes a temporary drop in COD removed. Heavy rain or snowmelt has not interfered, and the heat produced evaporates excess water. The installation cost $150,000, one-tenth the cost of other alternatives. (Cassar-FRC)
W82-02006

THE FLOWERING OF WASTEWATER TREATMENT,
Utah State Univ., Logan. Coll. of Engineering.
E. J. Middlebrooks, and S. C. Reed.
Water/Engineering and Management, Vol 128, No 6, p 51-54, June, 1981. 2 Tab.

Descriptors: *Wastewater treatment, *Aquatic plants, Water treatment facilities, Design criteria, Nutrients, Biological oxygen demand, Suspended solids, *Water hyacinth.

The use of aquatic plants in wastewater treatment systems to reduce the concentration of contaminants to levels equivalent to secondary, advanced secondary and tertiary effluents has been proposed and tried on a small scale over the past 10 years. The water hyacinth plant in particular appears to have potential for application in small community wastewater treatment facilities. Most commonly a stabilization pond is incorporated, followed by a series of water hyacinth culturing tanks which can produce an advanced secondary effluent. A properly designed facility is efficient, economical, and requires very little energy input. There should be no odor problem and it can be impractical in cold regions. Thus far all operations using the water hyacinth cover less than 4 hectares in area, and most are smaller than one hectare. Hyacinth systems processing a secondary effluent can be designed to handle about 2,000 cubic meters/ha/day if the principal objective is to control BOD 5 and suspended solids in the effluent. If nutrient removal is the most important consideration, the best hydraulic loadin ragte has not yet been established. Most systems have been designed to operate with three cells in series. If the purpose is to remove nutrients, it is necessary to maontain the hyacinth culture in an active growth phase, requiring that harvesting be conducted frequently. (Baker-FRC)
W82-02015

LIMNOLOGY AND PERFORMANCE OF WASTE TREATMENT LAGOONS,
Technische Univ., Dresden (German D.R.).
D. Uhlmann.
Hydrobiologia, Vol 72, No 1/2, p 21-30, July, 1980. 8 Fig, 12 Ref.

Descriptors: *Ponds, *Lagoons, *Wastewater lagoons, Wastewater treatment, *Limnology, Daphnia, Biological oxygen demand, Phytoplankton, Zooplankton, Bacteria, Sewage bacteria, Dissolved oxygen.

Sewage treatment lagoons arranged in series sever some of the connections between parts of the food web. Generally the first cell is the main site of bacterial activity, which decomposes solid and dissolved organic matter to form methane. In the second cell phytoplankton and associated bacteria operate under aerobic conditions. If the BOD load of the third cell does not exceed 5 g per cu meters per day and temperatures are not too low, high concentrations of Daphnia and other filter feeding zooplankton further reduce bacterial counts to 99% of the count in the first cell inflow. This water can be used for irrigation. Temporal fluctuations in bacteria, phytoplankton, zooplankton, and dissolved oxygen can range over two orders of magnitude. Even after upsets due to weather conditions and unusual growths, systems return to a clear water state. These ponds are usually resistant to mixing, except in tropical lowlands with warm nights, where short-circuiting is the normal situation. A chart depicts the BOD removal as a function of BOD load and residence time of the water. For example, the rate coefficient of BOD removal is 0.21 per day for 10 days residence time and BOD load of 25 g per cu meter per day. (Cassar-FRC)
W82-02026

POLLUTION FROM FARMS,
Thames Water Authority, London (England).
R. P. Wheeler.
Effluent and Water Treatment Journal, Vol 20, No 2, p 61, 63-65, February, 1980. 3 Tab, 12 Ref.

Descriptors: *Farm wastes, *Animal wastes, *Waste treatment, Water pollution sources, Hogs, Dairy industry, Wastes, Manure, Organic wastes, Farm lagoons, Lagoons, Land application, England, Wales.

In 1977 warnings were issued on 1293 cases of farm waste pollution in England and Wales. The largest percentage of these violations were concerned with dairy and yard washings and overflowing or breaking banks of manure stores. The same situations were responsible for most of the total of 76 violations in the Thames Water Authority area in 1978. A table lists the types of farm wastes and their BOD in mg per liter: silage, 40,000; piggeries, 10,000; cowstalls, 3,000; dairy produce, 1,800; and poultry processing, 1,000. Many methods of waste treatment have proved uneconomical for the farmer. A compromise is minimal partial treatment to consolidate solid material, aeration, and storage in tanks or lagoons. After six months storage, the waste can be land applied. One Berkshire pig farmer used a centrifuge to separate the solids, sprayed the aerated effluent on land, and sold the dry wastes as fertilizer. (Cassar-FRC)
W82-02039

THE SEWERAGE POLICY OF THAMES WATER,
Thames Water Authority (England).
For primary bibliographic entry see Field 6E.
W82-02040

POLLUTION SOLUTIONS--THE WIRE DRAWING INDUSTRY.
Effluent and Water Treatment Journal, Vol 20, No 6, p 299, 301, 303, June, 1980. 1 Fig, 2 Tab.

Descriptors: *Wire industry, *Heavy metals, *Sedipac clarifier, Wastewater treatment, Metal finishing industry, Industrial wastewater, Effluent standards, Metals, Clarifiers.

The Sedipac clarifier, a high performance tilted tube separation system, is used in the Tinsley Wire (Sheffield) Limited plant for removing metal hydroxides from neutralized mixed effluent. The automatically monitored and controlled system operates at surface loadings of 6-7 cu m per sq m per hour. A mixing tank allows for buffering in case of a highly polluted flow. Sludge is discharged to a thickening and holding tank for subsequent filtration. Since the plant's startup early in 1980, 92% of the total effluent volume has conformed to river discharge standards. It is expected that 99% compliance will be reached after the staff gains more experience. The raw untreated rinsewater contains (in ppm) 734 Fe, 112 Zn, 5 Cu, 39 Pb, 1 Cd, and 45 N. Treated effluent mean levels are well below consent levels. Only the maximum Cu and Pb concentrations slightly exceeded standards on occasion. (Cassar-FRC)
W82-02041

DEVELOPMENTS IN INSTRUMENTATION AND AUTOMATION IN SEWAGE TREATMENT,

Thames Water Authority, London (England). Metropolitan Public Health Div.
R. A. R. Drake, and H. R. S. Page.
Water Pollution Control, Vol 80, No 2, p 231-242, 1981. 21 Ref.

Descriptors: *Wastewater treatment, *Automation, Planning, Water treatment facilities, Operation, Management decisions, Computers. Design criteria.

The strategy for development and implementation of automation in sewage treatment facilities should be coordinated and operating guidelines established for those who are responsible for designing and specifying control systems. The reliability of instrumentation, sensors and control systems is a vital factor, and should be given additional attention in system design. Optimization of treatment processes, quality control, energy savings and better use of existing facilities will become increasingly important as improvements in these areas are made by the correct use of automation. Significant advances have been made in recent years on instrumentation for measurement of flow, sludge blanket level, dissolved oxygen and filtrability. Adequate preventive maintenance is necessary to prevent sensors from being damaged by prolonged exposure to sewage. Specific applications of automation in British water treatment plants are presented. Persistent impediments to complete wastewater treatment plant automation are the lack of a raw influent quality sensor, insufficient sensor reliability, and need for better understanding of sewage treatment processes. (Baker-FRC)
W82-02043

TECHNICAL AND ECONOMIC IMPLICATIONS OF INSTALLING AN INDUSTRIAL WASTE-WATER PRETREATMENT PLANT,
Environmental Control Consultancy Services Ltd., London (England).
D. Anderson.
Water Pollution Control, Vol 80, No 2, p 292-305, 1981. 6 Fig, 7 Tab, 9 Ref.

Descriptors: *Wastewater treatment, *Design criteria, Industrial wastes, Economic aspects, Dye industry wastes, Yorkshire Water Authority, *Great Britain, *Wastewater facilities.

Technical and financial problems that face industry in regard to meeting the standards and limitations imposed by regulatory bodies in installing an industrial wastewater pretreatment plant are described. The system discussed was for a medium-sized multi-product dyestuffs company, discharging 4.5 tcmd of wastewater. The effluent had an average pH value of 1.5 and could produce 100-150 tons/week of neutralized sludge. The most difficult technical problem was to remove, to acceptable levels, various metals used in the company's processes. Methods of treatment included precipitation, precipitate flotation, cementation, liquid-liquid extraction, adsorption, ion-exchange, electrolysis, evaporative distillation and electrodialysis. A comprehensive laboratory experimentation program was begun, encompassing both flotation and precipitation techniques. The results indicated that satisfactory reductions could be achieved, but that equipment availability and the pressing time schedules dictated that a precipitation process should be employed. The development work indicated that a stepped precipitation process was desirable and that to ensure efficient removal of metals a minimum total retention period of 2.5 hr was mandatory within the reactors, and a similar time within the thickener. Sludge dewatering was accomplished using one rotary vacuum filter plus one filter press of the variable chamber type. Capital and operating costs are noted. (Baker-FRC)
W82-02044

KINETICS AND DIFFUSION PROCESSES IN COLOUR REMOVAL FROM EFFLUENT USING WOOD AS AN ADSORBENT,
Queen's Univ., Belfast (Northern Ireland). Dept. of Industrial Chemistry.
G. McKay, and V. J. P. Poots.
Journal of Chemical Technology and Biotechnology, Vol 30, No 6, p 279-292, 1980. 7 Fig, 4 Tab, 19 Ref.

Descriptors: *Color removal, *Wood, *Dyes, Wastewater treatment, Adsorption, Sawdust, Activated carbon, Diffusion coefficients, Boundary layers, *Textile mill wastes, Industrial wastewater.

The adsorption of a basic dye, Astrazone Blue, and an acidic dye, Telon Blue, on sawdust made from Sitka spruce, Picea sitchensis, was studied. The process was controlled by intraparticle diffusion, except for some boundary layer resistance in the early stages of adsorption. The activation energies for adsorption of Astrazone Blue and Telon Blue on the sawdust were 16.8 kJ per mole and 9.6 kJ per mole, respectively. Diffusion coefficients were 6 to 18 times 10 to the minus 13th power sq cm per sec for Astrazone Blue at 18 degrees C and 3 to 8 times 10 to the minus 13th power sq cm per sec for Telon Blue at 18 degrees C. This variation in diffusivities is attributed to boundary layer effects. Agitation increased the rate of color removal. An increase in temperature produced an increase in the rate of adsorption for both dyes in the early stages. After that, the rate increased with the basic dye and decreased with the acid dye. Costs for removing Telon Blue with sawdust were 1.5% that of activated carbon; Astrazone Blue, 8.2%. (Cassar-FRC)
W82-02047

PRODUCTION OF AROMATIC ACIDS DURING ANAEROBIC DIGESTION OF CITRUS PEEL,
Commonwealth Scientific and Industrial Research Organization, North Ryde (Australia). Div. of Food Research.
A. G. Lane.
Journal of Chemical Technology and Biotechnology, Vol 30, No 6, p 345-350, 1980. 2 Tab, 11 Ref.

Descriptors: *Citrus fruits, *Anaerobic digestion, *Organic acids, Biological treatment, Food processing wastes, Aromatic compounds, Organic compounds, Acids, Benzoic acid, Phenylacetic acid, Phenylpropionic acid, Limonene, *Wastewater treatment, Toxicity, Flavonoids, Coumarins.

The aromatic acids, benzoic, phenylacetic, and phenylpropionic, were found in liquors after failure of the anaerobic digestion of commercially prepared citrus oils, distilled citrus oils, limonene, and the nonvolatile residue of lemon oils. The aromatic acids themselves were not toxic to the digestion process. When they were added to feedstocks, they degraded rapidly. Materials as yet unidentified were responsible for the toxicity. Experiments showed that phenylpropionic acid was probably derived from flavonoids and benzoic acid, and phenylacetic acid from courmarins. Hand-prepared orange albedo with 2 mg oil per 100 g was not toxic to the digestion process during 21 days of study; no aromatic acids were detected. (Cassar-FRC)
W82-02049

A MECHANISTIC MODEL OF A PACKED-BED ELECTRODE CELL TO REMOVE METAL IONS FROM DILUTE EFFLUENT SOLUTIONS,
University of the Witwatersrand, Johannesburg (South Africa). Dept. of Chemical Engineering.
A. W. Bryson, and K. A. Dardis.
Journal of Chemical Technology and Biotechnology, Vol 30, No 1, p 14-19, 1980. 2 Fig, 1 Tab, 13 Ref.

Descriptors: *Cathodes, *Metal-finishing wastes, *Packed beds, Wastewater treatment, Industrial wastewater, Electrodes, Nickel, Chromium, Zinc, Copper, Electroplating.

A pilot plant for treating electroplating waste effluents was designed with the aid or a mathematical model of a porous cathode cell. Copper, zinc, nickel, and chromium were reduced by greater than 90% (influents 13.5-37.5 mg per cu dm, effluents 0.9-1.5 mg per cu dm) using acid copper wash and zinc cyanide wash (flow rate 360 cu dm per hour) and nickel and chromium wash (flow rate 180 cu dm per hour). Dimensions of the cell's packed section were 1.9 m x 0.35 m x 5 mm. Packing was crushed graphite, size range 1.2-1.7 mm. (Cassar-FRC)
W82-02050

5E. Ultimate Disposal Of Wastes

GEOLOGIC AND HYDROLOGIC IMPLICATIONS OF HAZARDOUS WASTES MANAGEMENT RULES ON SITING IN NORTH CAROLINA,
Ebasco Services, Inc., Greensboro, NC.
G. L. Bain, and P. Hansen.
Bulletin of the Association of Engineering Geologists, Vol 18, No 3, p 267-275, August, 1981. 7 Fig, 18 Ref.

Descriptors: *Land disposal, *Waste management, *Waste storage, Waste disposal, Environmental effects, Model studies, Mathematical studies, Groundwater movement, Geohydrology, *North Carolina, Economic aspects, *Site selection.

Having to predict the ultimate fate of disposed wastes may make site evaluation for waste disposal expensive. To accurately predict the effects of sorption, mechanical dispersion, ionic diffusion, and osmosis on the concentration of waste species, good groundwater flow models and simulations of solute transport are needed. The ideal disposal zone should also contain flat-lying, homogeneous, non-fractured silt-stone, clay or silty sandstone situated well above the water table. Most waste disposal sites in North Carolina do not meet these criteria. Under the Resource Conservation and Recovery Act, federal and state laws may enforce the use of presently accepted safe disposal practices and monitoring techniques. The financial and environmental impact of these regulations on the generation of wastes will depend on the extent to which they address geohydrologic complexities. (Geiger-FRC)
W82-01630

PERSPECTIVE ON MANAGEMENT AND DISPOSAL OF HAZARDOUS WASTES,
North Carolina State Univ. at Raleigh. Dept. of Marine Earth and Atmospheric Sciences.
H. S. Brown, and H. E. LeGrand.
Bulletin of the Association of Engineering Geologists, Vol 18, No 3, p 231-235, August, 1981. 1 Fig, 2 Ref.

Descriptors: *Hazardous materials, *Waste disposal, *Graphical analysis, *Groundwater pollution, Waste management, Model studies, Site selection, Geohydrology, Hydrologic aspects, Water pollution effects, Graphical methods, Mathematical studies.

The overall problem of managing and disposing of hazardous wastes is compounded by the polarized ideas of regulatory officials, geologists and hydrologists, design engineers, and owners and operators of waste management facilities. Added complifications arise from the negative views held by various sectors of the public. A standardized system for surveying waste disposal sites and their contaminant input is sought that can use either in-depth derived data or general site data. The system should include concise descriptions and evaluations of all existing and planned hazardous waste sites. The standardized evaluations should identify the hydrogeological characteristics of a site on a scale of various aquifer sensitivities to contamination spread. A scale of severity of contamination identifies a particular waste's toxicity, concentration, volume and persistence, four parameters which are integrated into a graphical matrix showing the potential for groundwater pollution. This sytem allows for the development of acceptance or rejection standards based on the natural setting and on engineering modifications to the site. (Geiger-FRC)
W82-01635

ROLE OF THE GEOTECHNICAL CONSULTANT IN SITING SUITABLE AREAS FOR HAZARDOUS WASTE DISPOSAL,
Soil and Material Engineers, Inc., Raleigh, NC.
E. W. Glover, Jr.

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Bulletin of the Association of Engineering Geologists, Vol 18, No 3, p 227-230, August, 1981.

Descriptors: *Waste disposal, *Hazardous materials, *Site selection, *Geohydrology, Hydrologic aspects, Systems analysis, Leaching, Waste management, Land disposal, Waste dumps, Engineering geology, Leachates, Solid wastes.

The geotechnical consultant can be of valuable assistance in choosing a hazardous waste disposal site. The consultant may suggest areas more appropriate to disposal and carry out preliminary site evaluations based upon the available literature. Utilizing this data, the consultant may rank the sites in order of preferences to select the best site and develop plans for test borings and for field and laboratory monitoring of well installations. When the field work is completed, engineering studies are conducted to evaluate seepage from the storage area, the potential for leaching, the appropriate collection system for leachates, and flood level designs. The final report is considered as part of the permit documents to support licensing of the site as a proper disposal area for hazardous wastes. (Geiger-FRC)
W82-01636

FLOW CALCULATIONS FOR HOUSEHOLD EFFLUENT DISPOSAL IN ELEVATED SAND MOUNDS,
Environmental Protection Agency, Ann Arbor, MI.
T. D. Mott, D. D. Fritton, and G. W. Petersen.
Journal of Environmental Quality, Vol 10, No 3, p 311-314, July-September, 1981. 4 Fig, 15 Ref. OWRT-B-098-PA(4).

Descriptors: Flow, *Mathematical equations, *Soil absorption capacity, *Land disposal, *Wastewater disposal, Domestic wastes, Sand, *Sand mounds, Hydraulic conductivity, Design flow, Rural areas, Household wastewater.

On-site disposal and renovation of household wastewaters present serious problems in many urban fringe and rural areas. About half of all on-site systems fail to perform satisfactorily over their entire design life of 15 to 20 years. Elevated sand mound disposal systems have been used in Pennsylvania, since the soil is generally not suitable for conventional on-site effluent disposal systems. However, about 40 percent of these systems malfunctioned in less than 5 years. Since the malfunctions were associated with observations of surface discharges of effluent, this study investigated the ability of the soil to transmit effluent from an elevated sand mound to the groundwater system. It was assumed that both the infiltration surfaces and the groundwater system were able to accept the effluent. The flow calculation method used was predicated upon separation of the effluent flow into horizontal and vertical flow components. Darcy's law written in cylindrical coordinates was used to calculate horizontal flow. Vertical flow was calculated, assuming that flow was limited by a single, slowly permeable layer of known thickness. The calculations demonstrate that the lateral plus vertical flow capacity of the soil must exceed the anticipated effluent input if the disposal system is to perform satisfactorily. Data requirements for evaluation of the suitability of a specific site for disposal of household wastewater using a mound system are identified. Calculations made using data representative of many of the failing mound systems in Pennsylvania indicate that these failures result from the inadequacy of the combined lateral and vertical flow capability. (Carroll-FRC)
W82-01660

INDUSTRIAL WASTE DUMPING AT DEEP-WATER SITES IN THE GULF OF MEXICO,
National Ocean Survey, Rockville, MD. Ocean Dumping and Monitoring Div.
E. R. Meyer, and C. E. Warsh.
In: Proceedings of a Symposium on Environmental Research Needs in the Gulf of Mexico (GOMEX), Key Biscayne, Florida, 30 September - 5 October 1979, Volume IIC, May, 1981. p 211-239, 2 Fig, 6 Tab, 29 Ref. National Oceanic and Atmospheric Administration, Miami, Florida.

Descriptors: *Industrial wastes, *Ocean dumping, *Sludge disposal, *Environmental effects, Biological wastewater treatment, Chemical wastes, Organic compounds, Microorganisms, *Gulf of Mexico.

About 10 different kinds of industrial wastes were dumped at two deepwater sites in the Gulf of Mexico between 1973 and 1978. The Western Gulf site, south of Galveston, Texas, was used during the study exclusively by the Shell Chemical Company of Deer Park, Texas. The material dumped at the site was a biological sludge consisting of living and dead microorganisms (primarily bacteria and protozoans), inorganic salts, and a large variety of organic compounds in suspension and solution, produced by a biological waste water treatment system. Results of the dump site study program indicate that the overall environmental consequences of discharging the biosludge produced by the Shell Chemical Company plant were negligible. Both the liquid and solid portions of the waste samples examined during the program had deleterious effects upon all test species during laboratory tolerance experiments when the wastes were of sufficiently elevated concentration. The results of waste tracking experiments indicated that waste concentrations of that magnitude probably do not persist in the field more than a few hours during dumping episodes. The wastes, at low concentrations, actually seemed to increase rates of growth in green algae species and reproduction in the amphipod Amphithoe valida. In view of the depauperate nature of the dumping area, the actual long-term biological impacts of dumping there appear to have been minimal. (Moore-SRC)
W82-01903

CENTRIFUGAL DEWATERING,
Pennwalt Ltd. (England).
J. E. Remfry.
Water and Waste Treatment, Vol 24, No 9, p 23-24, September, 1981. 4 Fig, 1 Tab.

Descriptors: *Sludge drying, *Centrifugation, *Sludge disposal, Sludge cake, Alum sludge, Performance evaluation, Costs, *United Kingdom.

Municipal and industrial effluent treatment sludges can be dewatered using the decanting centrifuge. Mechanical dewatering has many advantages, including the avoidance of large lagoons and the production of a readily disposable cake. The centrifuge can treat all types of sludge and can be made mobile and moved from plant to plant. Also, installation is compact and operation is non-labor intensive. Performance figures are presented for the main types of sludge that are centrifuged: alum, ferric, and lime. Characteristics of the raw water, especially turbidity, influence the nature of the sludge produced. There are now centrifugal sludge dewatering installations at almost all of the British water authority areas. (Small-FRC)
W82-01912

A TEST UTILIZING SEDIMENT TRAPS, SURVEY RODS, AND RADIOGRAPHS TO MONITOR SEDIMENT ACCUMULATION FROM A DREDGING DISPOSAL OPERATION,
NALCO Environmental Sciences, Northbrook, IL.
For primary bibliographic entry see Field 7B.
W82-01950

GEOLOGIC ASPECTS OF WASTE DISPOSAL SITE EVALUATIONS,
Law Engineering Testing Co., Marietta, GA.
D. G. Miller, Jr., and W. J. Alexander.
Bulletin of the Association of Engineering Geologists, Vol 18, No 3, p 245-251, August, 1981. 3 Fig, 9 Ref.

Descriptors: *Waste disposal, *Geohydrologic units, *Groundwater hydrology, *Fate of pollutants, Land disposal, Site selection, Hydrologic aspects, Waste management, Hydrologic systems, Geomorphology, Path of pollutants, Groundwater movement, Geohydrology, Planning.

In response to increasingly stringent regulatory standards and variations in site-specific guidelines, the evaluation of waste disposal sites is becoming more comprehensive. Since greater attention is being given to the fate of pollutants at each site, studies of groundwater movement and the effects of various subsurface materials on the dispersal of contaminants are required. Some relevant hydrologic conditions and site-specific variations are reviewed for Coastal Plain, Piedmont, Valley and Ridge areas of the eastern United States. Multiphased evaluations of waste disposal sites are practical when such diverse physiographic sections are considered. For existing waste disposal facilities, the initial phase of evaluation combines knowledge of area geology and operational information. Subsequent studies include a detailed assessment of localized hydrogeologic units and the availability and suitability of existing soil and rock formations as construction materials. In siting new facilities, the most suitable geologic area of the province is initially defined. (Geiger-FRC)
W82-02011

WASTE DISPOSAL--CHOOSING AND LICENSING SITE,
Severn Trent Water Authority, Birmingham (England).
For primary bibliographic entry see Field 5G.
W82-02035

POLLUTION FROM FARMS,
Thames Water Authority, London (England).
For primary bibliographic entry see Field 5D.
W82-02039

5F. Water Treatment and Quality Alteration

PLANNING WITH GREAT UNCERTAINTY: A REVIEW AND CASE STUDY OF THE SAFE DRINKING WATER CONTROVERSY,
Livingston Coll., New Brunswick, NJ. Dept. of Urban Studies.
For primary bibliographic entry see Field 5A.
W82-01606

COPPER(II)- AND CADMIUM(II)-BINDING ABILITIES OF SOME NEW HAMPSHIRE FRESHWATERS DETERMINED BY DIALYSIS TITRATION,
New Hampshire Univ., Durham. Dept. of Chemistry.
R. E. Truitt, and J. H. Weber.
Environmental Science and Technology, Vol 15, No 10, p 1204-1208, October, 1981. 1 Fig, 2 Tab, 21 Ref.

Descriptors: *Adsorption, Inorganic compounds, *Heavy metals, Water quality control, Chemical properties, Binders, Separation techniques, *Copper, *Cadmium, Cations, Drinking water, Ions, Potable water, Pollutants, Water supply, Water quality management, Anions, New Hampshire.

Processes such as adsorption to particulates, complexation by naturally occurring ligands, and precipitation all act to regulate the aquatic levels of free heavy metal ions which may be toxic to aquatic life and to man. The ability of seven New Hampshire freshwater samples to sequester divalent copper and cadmium ions was studied by a dialysis titration technique in laboratory tests. Five samples, three from rivers and two from reservoirs, were representative of local drinking water supplies. Pond and swamp samples were included for comparison. The potential binding levels (PBL) were calculated as indicators of the copper- and cadmium-binding properties of the water samples. Copper cation PBL values ranged from 1.1 to 15.1 micromolar, while cadmium cation PBL values ranged from 0.0 to 9.7 micromolar. Alkalinity, pH, dissolved organic carbon, hardness, conductance and UV absorbance were correlated with copper ion and cadmium ion PBL values in six of the seven samples analyzed. Copper ion PBL values were significantly correlated with the inorganic

properties, but not the organic properties of the samples at the 90% confidence level. Nonunity slopes of copper experiments suggested complexing of copper ions with the inorganic anionic constituents of the water samples. No significant trends at the 90% confidence level were found for the cadmium ion PBL values. (Geiger-FRC)
W82-01632

THE REMOVAL OF ORGANIC MATTER FROM SURFACE WATER SUPPLIES BY ANION EXCHANGE RESINS,
C. A. Macko.
PhD Thesis, 1980. 227 p, 66 Fig, 30 Tab, 102 Ref, Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-19545.

Descriptors: *Water pollution, *Water quality control, *Organic matter, *Anion exchange, Pollutant identification, Surface waters, Resins, *Mississippi River, Heavy metals, Amberlite IRA-904.

This investigation focused on the nature of naturally occurring organics and their removal from water supplies by the strong base anion exchange resin, Amberlite IRA-904. Mississippi River water was ultrafiltered to determine the molecular size distribution of the organic carbon and for anion exchange removal studies. Results indicated that dissolved organic carbon (DOC) concentrations in the Mississippi River varied seasonally. Anion exchange of river water involves a multicomponent system in which competition plays a major role. All experiments were done with the resin originally in the chloride form and at the natural pH of the river water. Regeneration of columns was done with 1.0 M NaCl with DOC recovery at 77-95% with 3 empty bed volumes of regenerant. Besides organics, the regenerant was found to contain significant quantities of trace inorganics and metals indicating uptake of these ions by the resins. Fe, Ca, B, and Zn were found in concentrations of 100-1000 times their value in an equal volume of river water. Al, P, Mn and Ni were found to be concentrated to a lesser extent. Amberlite IRA-904 showed significant removal of high molecular weight organics from surface water supplies, producing an effluent of as low as 0.5 mg/L DOC (bed depth 31 cm). Removal and subsequent recovery of trace metals in the regenerate brine indicated an additional advantage to the use of resins in water treatment. (Sinha-OEIS)
W82-01697

DRINKING WATER AND ITS TREATMENT: AN INTERVIEW WITH PROFESSOR SONTHEIMER,
S. Miller.
Environmental Science and Technology, Vol 14, No 5, p 510-512, 514, May, 1980.

Descriptors: *Drinking water, *Water treatment, *Germany, Chlorination, Ozonation, Ozone, Chlorine, Wells, Rivers, Percolation, Groundwater.

In Germany 50% of the drinking water supplies come from surface water, but practically all river waterworks use some sort of ground filtration. Water is drawn from wells along the rivers at distances from 50 to 100 meters so that the retention time in the ground is from 30 to 100 days. This practice reduces the organics concentration in the water about 75% from what was originally present in the raw river water. Thus activated carbon can be used in the treatment train with a much greater efficiency than would otherwise be possible. Biological treatment is used extensively because of its cost effectiveness. Slow sand filters are used where river bank filtration is not possible. Breakpoint chlorination is not used in Germany today; instead, ammonia is removed biological. Ozone is used for special purposes including enhancement of biological treatment. A small dose of ozone improves flocculation in difficult conditions. While consideration is being given to establishing guidelines for permissible trihalomethane concentrations in drinking water, such guidelines are not being considered for Germany, as chlorination is not used in water treatment there. (Baker-FRC)
W82-01728

EFFECT OF REAGENT MIXING RATE ON ADSORPTION PROCESS FOR AM-FE2O3.H2O,
Stanford Univ., CA. Dept. of Civil Engineering.
A. R. Appleton, Jr., and J. O. Leckie.
Environmental Science and Technology, Vol 15, No 11, p 1383-1386, November, 1981. 5 Fig, 7 Ref.

Descriptors: *Mixing, *Coagulation, *Heavy metals, *Adsorption, Metals, Cadmium, Water treatment facilities, Flocculation, Ferric chloride, Wastewater treatment, Water treatment.

There was no significant variation in physicochemical surface characteristics in freshly precipitated or 1 hour aged amorphous Fe2O3(H2O) coagulant in a well-mixed system with mean residence times from 5 to 30 sec. Cd(2+) at a trace level was used as a diagnostic tool. The removal of trace metals by adsorption onto Fe(3+) flocs in water or wastewater treatment systems is not affected by mixing conditions as long as complete dispersion of the flocculant takes place within 30 sec. (Cassar-FRC)
W82-01799

ALUMINUM SULFATE TREATMENT: SHORT-TERM EFFECT ON COMPLEX PHOSPHORUS COMPOUNDS IN A EUTROPHIC LAKE,
Michigan State Univ., Hickory Corners, Kellogg Biological Station.
D. A. Francko, and R. T. Heath.
Hydrobiologia, Vol 78, No 2, p 125-128, March, 1981. 2 Fig, 11 Ref.

Descriptors: *Eutrophic lakes, *Phosphorus compounds, *Alum, Hypolimnion, *Water treatment, Orthophosphates, Lake restoration, Epilimnion, West Twin Lake, Ohio, Nutrients, Phosphorus removal, Process efficiency.

Previous studies have demonstrated that hypolimnetic application of liquid aluminum sulfate (alum) may accelerate lake reclamation by removing phosphorus from the water column and by sealing anoxic sediments to reduce the release of nutrients. This study was designed to investigate the effectiveness of alum applications to the hypolimnion in removing various complex phosphorus compounds occurring in eutrophic lakes. These complex phosphorus compounds include phosphomonoesters, polyphosphates, and ultraviolet-sensitive phosphorus compounds. Alum was applied to the hypolimnion of West Twin Lakes, a culturally eutrophic hardwater lake in northeastern Ohio. Orthophosphate was effectively removed from the lake by this treatment, but complex phosphorus compounds were not. Potentially available phosphomonoesters comprised a considerable proportion of the complex phosphorus fraction in the lake water both before and after the alum treatment. Most of the complex phosphorus compounds remaining in the lake water after the alum treatment were capable of releasing orthophosphate on treatment with alkaline phosphatase. These results indicate that aluminum sulfate treatment may be ineffective in removing all biologically available phosphate compounds from the lake water. Further research is required to determine the overall applicability of alum treatment as a nutrient inactivation method. (Carroll-FRC)
W82-01833

TACKLING THE NITRATE PROBLEM.
Effluent and Water Treatment Journal, Vol 21, No 7, p 313, July, 1981.

Descriptors: *Water treatment, *Nitrates, Ion exchange, Water treatment facilities, Municipal water, Industrial water, Food processing industry, Water quality, *Nitrate removal.

Nitrate removal units are available for the removal of high nitrate levels from public water supplies. These high nitrate levels are of particular concern to the flood processing industry. Nitrate concentrations in excess of 1 ppm have a depolarizing effect on the half-cell corrosion reaction, resulting in accelerated deterioration of food cans. High nitrate concentration can also lead to the staining of cans and the discoloration of certain meats. The automatic nitrate removal units employed in the industry operate at flow rates from as low as 30 liters/hour up to 10,000 liters per hour, and will reduce nitrate levels to between 5 and 10 mg/liter. The units operate by absorbing nitrates on to an ion exchange resin, which releases an equivalent quantity of chloride. A counterflow regeneration ion exchange technique which effectively halves the salt consumption during regenerations and produces significant process cost savings has been developed for large scale operations. In a major cannery complex with a throughput of 5,000 gal per hour, nitrate nitrogen levels were reduced from 10-12 to 0.2 ppm. Another successful operation involves the treatment of nitrate bearing borehole water. However, nitrate removal from municipal water, a costly process, appears to be a long way from implementation. (Baker-FRC)
W82-01874

SUBSTRATE FLUX INTO BIOFILMS OF ANY THICKNESS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W82-01964

A NATIONAL SURVEY OF TRI(HALOALKYL)-, TRIALKYL-, AND TRIARYLPHOSPHATES IN CANADIAN DRINKING WATER,
Environmental Health Directorate, Ottawa (Ontario).
For primary bibliographic entry see Field 5B.
W82-01989

EXPERIENCE WITH LAKE AND RESERVOIR RESTORATION TECHNIQUES IN THE GERMAN DEMOCRATIC REPUBLIC,
Institut fuer Wasserwirtschaft, Berlin (German D.R.).
For primary bibliographic entry see Field 2H.
W82-02054

DISINFECTION OF DRINKING WATER IN DEVELOPING COUNTRIES,
Omnium de Traitment et de Valorisation, Courbevoie (France). Water Dept.
J. Sibony.
Aqua, No 5, p 21-27, 1981. 2 Fig, 6 Tab, 15 Ref.

Descriptors: *Potable water, *Disinfection, Chlorination, Ozonation, Drinking water, Water quality, Human diseases, Chlorine, Ozone, Microorganisms, *Developing countries.

Various means of achieving disinfection of drinking water in developing countries are reviewed. In many outbreaks of human disease, drinking water has carried the pathogenic agent. When water has been treated and then filtered, the effectiveness of disinfection will directly depend on the quality of clarification. In hot countries, treatment without filtration will always lead to suspicions that the water is carrying organisms that do not respond significantly to the normal disinfectants used. The effectiveness of chlorination is affected by the water acidity, presence of ammonia, temperature levels, and retention time. The presence of dissolved organic matter in the water to be disinfected is harmful in several ways. First, more chlorine will be consumed. Second, the treated water will taste of chlorine due to the flavor of the organochlorinated compounds. As a means of control to test the amount of total chlorine present, the orthotolidine test can be used. However, the preferable method is to use the diethyl-p-phenylene-diamine test, which measures only the free chlorine. A level of free chlorine equal to 0.1 ppm maintained throughout the network provides an excellent guarantee that the water is properly disinfected against bacteria, provided that the water has been cleared of suspended solids. The benefits of ozone disinfection over and above chlorination are considered. The preparation of the water for ozonation, contact time and concentration, significance of pH, temperature, ammonia, and means of control are all considered. Use of post-chlorination after ozone disinfection is briefly considered. (Baker-FRC)
W82-02091

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5G. Water Quality Control

PROTECTING VIRGINIA'S WATERWAYS,
J. Josephson.
Environmental Science and Technology, Vol 15, No 10, p 1125-1127, October, 1981. 1 Fig, 2 Tab.

Descriptors: *Water quality control, *Water pollution prevention, *Pesticide residues, *Kepone, Water pollution treatment, Waste water treatment, Water pollution control, Heavy metals, Chlorine, Pesticides, Fluvial sediments, Environmental effects, Dredging, *James River, Virginia, Shellfish farming.

The Virginia Environmental Endowment engaged the National Wildlife Federation to study the Kepone incident, which caused extensive pollution of the James River, and examine strategies to prevent future episodes of environmental pollution by toxic substances. The Federation recommended careful screening of discharges from publically owned treatment works through the National Pollutant Discharge Elimination system and by application of the Cairns matrix. The federation also recommended new dredging procedures to minimize disturbances of Kepone-containing sediments. Highest priority for sediment cleanup should be given to areas for shellfish farming and public water supply sources. Screening for heavy metals, chlorine and chloramines was suggested along with research to identify effective, nonhalogenated waste water treatment processes. More sophisticated chemical residue detection methods for water and living tissue was called for and more research on depuration mechanisms was suggested. Problems in the implementation of the federations report and reaction to its findings are discussed. (Geiger-FRC)
W82-01608

PUBLIC OPINION AND INTEREST GROUP POSITIONS ON CHESAPEAKE BAY ISSUES: IMPLICATIONS FOR RESOURCE MANAGEMENT,
Maryland Technical Advisory Service, College Park.
For primary bibliographic entry see Field 6B.
W82-01642

DESTRATIFICATION AND REAERATION AS TOOLS FOR IN-LAKE MANAGEMENT,
Salford Univ. (England). Dept. of Civil Engineering.
B. Henderson-Sellers.
Water SA, Vol 7, No 3, p 185-189, July, 1981. 1 Fig, 2 Tab, 19 Ref.

Descriptors: *Destratification, *Lake restoration, *Aeration, Aerators, Mixing, Rehabilitation, Lakes, Reservoirs, Reservoir operation, *Thermal stratification prevention, Evaporation, *South Africa.

Methods to prevent or destroy thermal stratification and/or to aerate lake water are described. Many devices used for the destratification of reservoirs or lakes can also be used for hypolimnetic reaeration, including diffusers, bubble guns, and Helixors. No theoretical basis has been developed for most of these methods and devices. The Helixor is based on small bubbles kept in contact with the water for comparatively long periods by circulation around a helix as the bubbles rise. Oxygen is dissolved in the water in the body of the Helixor. The total volume of water moved by the Helixor per day in one application was 1% of the total volume of the reservoir. Helixor models are presented which simulate destratification. Helixors are best at preventing stratification. In addition to aiding destratification, the surface temperature is reduced in summer, which results in a decrease in the rate of evaporation. In an area where the annual evaporation is 1800 mm per year, this reduced evaporation yields a total water savings of about 50 mm. Trial runs for these devices are planned in South Africa. (Small-FRC)
W82-01648

BIOLOGICAL AND PHYSICAL INVESTIGATIONS OF BODIES OF WATER BENEATH DENSE WATER HYACINTH POPULATIONS BEFORE AND AFTER CHEMICAL TREATMENT,
Florida Univ., Gainesville. Dept. of Botany.
For primary bibliographic entry see Field 5B.
W82-01678

A LIMNOLOGICAL INVESTIGATION OF A TROPICAL FRESH-WATER ECOSYSTEM: THE BELIZE RIVER, BELIZE, CENTRAL AMERICA,
Western Michigan Univ., Kalamazoo.
V. J. B. Gonzalez.
PhD Dissertation, 1980. 221 p, 11 Fig, 20 Tab, 137 Ref, 6 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-25554.

Descriptors: *Water quality control, *Ecosystems, Freshwater, Rivers, *Belize, Central America, River ecology.

At present the water supply system for the country of Belize is from both groundwater and surface water sources. With increasing demands being placed on the water resources of Belize, adequate management programs for such resources must be developed. The study described herein aims at approaching a comprehensive understanding of the ecosystem of the Belize River. To avoid a severe degradation of the water quality in the Belize River, a continuing effort should be made to assess the ecological relationships that exist within it. Bacterial counts, chemical analyses, biota assessments, and other parameters that are necessary in the determination of water quality should be the major aspects of the continuing effort. The information so gained will provide the fundamental environmental data that are necessary for the development and reassessment of management programs. Evidence gathered in this investigation supports the conclusion that the major portion of the Belize River is currently of a high quality. It is recommended that every effort be made to limit the pollution of the river in the regions of Stations 1 and 2 where the water is already of low quality. Adequate sewage treatment and specific legislation governing the dumping of industrial waters need to be implemented. It is also recommended that continuous monitoring of the river be undertaken. Finally, the need to protect waterways should be brought to the attention of the Belizean public. This task may be accomplished primarily through the educational system. (Sinha-OEIS)
W82-01682

PETROLEUM DEGRADATION BY NATURALLY OCCURRING POPULATIONS OF MARINE BACTERIA FROM MIDDLE ATLANTIC OUTER CONTINENTAL SHELF WATERS,
College of William and Mary, Williamsburg, VA. Dept. of Marine Science.
A. E. Maccubbin.
PhD Dissertation, 1980. 169 p, 28 Fig, 13 Tab, 96 Ref, 11 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-03585.

Descriptors: *Bacteria, *Microbial degradation, *Biodegradation, *Oil pollution, Water pollution, Petroleum, Oil industry, Oil spills, Pseudomonas, Middle Atlantic Ocean, Hydrocarbons.

Bacterial populations indigenous to surface (1 m) waters of the Middle Atlantic Outer Continental Shelf were sampled at seasonal intervals to determine the abundance and distribution of petroleum-degrading (HC) and 'total' heterotrophic (HET) bacteria. Simultaneously, unweathered South Louisiana crude oil (SLCO) was added to aliquots of surface water samples to evaluate rates and patterns of degradation of hydrocarbon. Degradation was studied using selected nutrient and temperature regimes in both closed flask and prototype 'open' or continuous dilutions systems. HET bacterial levels generally decreased with distance from land. HC bacteria were most abundant in the coastal boundary layer. Changes in values of HC/HET often were not directly related to the abundance of petroleum-degrading bacteria. In closed flasks the composition of bacterial populations changed slightly in response to SLCO addition; Pseudomonas predominated after 48 days. Pseudomonas isolates exhibited the greatest ability for petroleum degradation in pure culture. Degradation of SLCO in closed flasks characteristically resulted in removal of n-alkanes and selected aromatics at rates related to season, sampling location, and nutrient regime. Aromatic compounds were often removed concomitantly with n-alkanes. Although maximum rates of degradation were observed at 15 degrees C using coastal water inocula and inorganic nutrient enrichment, all shelf waters sampled contained bacteria capable of petroleum degradation. (Sinha-OEIS)
W82-01683

THE EFFECTS OF SECONDARY SEWAGE EFFLUENT ON THE WATER QUALITY, NUTRIENT CYCLES AND MASS BALANCES, AND ACCUMULATION OF SOIL ORGANIC MATTER IN CYPRESS DOMES,
Florida Univ., Gainesville.
F. E. Dierberg.
PhD Dissertation, 1980. 324 p, 67 Fig, 38 Tab, 267 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-05570.

Descriptors: *Water quality, *Nutrients, *Organic matter, Sewage effluents, Nitrogen, Wetlands, Tertiary treatment, *Florida, *Cypress domes, Secondary sewage.

The capability of cypress domes to act as efficient nutrient traps has been demonstrated for a natural and sewage-enriched cypress dome. Mass balance models indicated that 87% of the nitrogen and 92% of the phosphorus loadings were retained within a cypress dome receiving secondary sewage effluent, removal efficiencies that are among the highest reported for any wetland ecosystem receiving treated sewage. Thus, cypress domes seem to be effective natural tertiary treatment systems. Field data and laboratory investigations demonstrated that denitrification was a major nitrogen sink in both natural and sewage-enriched domes. Bulk precipitation was the most important factor in supplying new minerals and nutrients (except nitrogen) to the natural cypress dome. Analyses of standing waters of natural and sewage-enriched cypress domes near Gainesville, Florida, over a 4.5-year period showed that discharge of secondary sewage effluent altered the soft, acid water found in natural domes to a neutral, moderately hard condition. Furthermore, the absence of dissolved oxygen, high levels of phosphorus, nitrogen, biochemical oxygen demand, and the presence of hydrogen sulfide mean that treated sewage effluent has a substantial impact on water quality. Water samples from shallow wells, ceramic soil moisture tubes, and laboratory percolation columns indicated that the underlying organic matter and sands were serving as an effective barrier to the transport of sewage pollutants to the shallow aquifer immediately below. (Sinha-OEIS)
W82-01687

REGULATING THE QUALITY OF DRINKING WATER: AN ECONOMIC ANALYSIS OF THE SAFE DRINKING WATER ACT OF 1974,
Wisconsin Univ.-Madison.
R. L. Raucher.
PhD Thesis, 1980. 342, p 22 Fig, 42 Tab, 44 Ref, 6 Append, University Microfilms International, Ann Arbor, MI; Order No GAX 81-05294.

Descriptors: *Economic feasibility, *Water quality control, Regulations, Legislation, Potable water, *Economic analysis, *Drinking water, Safe Drinking Water Act.

The first half of the thesis provides a framework with which to investigate whether or not the market failure associated with imperfect information can justify government intervention in general, and the imposition of regulations such as those embodied in the Safe Drinking Water Act in specific. The second portion of the thesis pertains to the economic impacts of the regulations. It consists mainly of the presentation and analysis of empirical results generated by two microdata simulation models. Nonmodel analyses are also provided, as

are policy recommendations and conclusions. The focus of the study then shifts to the indirect effects of the transfer of funds from water consumers to producers of treatment supplies. The model used to simulate the output, employment, and distributional consequences of interregional trading and production relationships is described, and regional shares of the changes in the level and composition of economic activity are then presented and analyzed. (Sinha-OEIS)
W82-01691

POLLUTION PERMITS AND MARKETS FOR WATER QUALITY,
Wisconsin Univ.-Madison.
For primary bibliographic entry see Field 6A.
W82-01699

CONTROLLING RUNOFF FOR LIVESTOCK FEEDLOTS; A STATE OF THE ART,
Science and Education Administration, Lincoln, NE.
C. B. Gilbertson, J. C. Nye, R. N. Clark, and N. P. Swanson.
Agricultural Research Service, Agriculture Information Bulletin Number 441, October, 1981. 21 p, 7 Fig, 1 Tab, 50 Ref.

Descriptors: *Feedlot wastes, *Feedlot runoff, *Livestock, *Water pollution control, Water pollution sources, Rainfall, Storms, Waste characteristics, Design criteria, Irrigation, Land disposal, Evaporation.

Runoff from livestock feedlots is a recognized water pollution source, which is now controlled by the Federal Water Pollution Control Act Amendments. Feedlots are included in the industrial category and are identified as a point source. Runoff resulting from storm events less severe than a 24 hour, 10-year storm must be controlled; in 1983 the limit will be a 24 hour 25-year storm. Feedlot runoff can be estimated from equations relating runoff to storm rainfall and the surface of the lot. In northern latitudes, snow melt must be considered. The chemical and solid constituents of feedlot runoff vary widely, with highest levels of total solids, volatile solids, and chemical oxygen demand being found in snow melt. Designs for runoff control have the following features: diversion of runoff from outside the feedlot area; provision of proper feedlot drainage; use of debris basins; use of detention or holding ponds; and provision of proper techniques for land application. Ultimate disposal of the runoff depends on the local soil, climate and the size of the feedlot. The runoff may be used for irrigation, allowed to evaporate, or be run onto the land. Knowledge of the groundwater is needed before a disposal system is planned, and proper cleaning and maintenance of the facility is essential. (Brambley-SRC)
W82-01769

TYING UP TCE,
Ayres, Lewis, Norris and May, Inc., Ann Arbor, MI.
A. E. Singhal.
Water/Engineering and Management, Vol 128, No 9, p 56, 58, 60, 63, September, 1981. 2 Fig, 3 Tab.

Descriptors: *Organic compounds, *Activated carbon, *Water treatment, *Groundwater pollution, Water pollution control, Separation techniques, Adsorbents, Drinking water, Cost analysis, Pilot plants, Design criteria, Water pollution, Packed beds, Filters, Adsorption, *Trichloroethylene.

A groundwater supply contaminated with trichloroethylene (TCE) was used as a study site to investigate the removal of organic compounds from water. To remove TCE, purging the aquifer, aeration and adsorption were suggested. Carbonaceous or activated carbon adsorption by itself or in conjunction with aeration showed the best potential for meeting EPA drinking water standards. Granular activated carbon (GAC) proved very effective in the removal of TCE in both laboratory and pilot studies. A cost/effectiveness analysis was performed on GAC removal with on-site regeneration, GAC after aeration plus off-site carbon regeneration, and removal by Ambersorb XE-340 following aeration and on-site regeneration of the adsorbent. The latter two TCE removal techniques yielded total annual costs within 1% of each other. Pilot plant studies using Filtrasorb 300 high activity carbon columns were set up to determine design criteria for effective TCE removal. Two contactors in series each providing 8-10 minutes of contact time appeared suitable for meeting the criteria of 20 microg/liter in the effluent. A third backup unit was suggested to allow maintenance and service of the two main units. If a packed bed system is used, pre-filtration minimizes the amount of backwashing of the carbon beds. Design parameters for a treatment system capable of handling a flow of 450 gpm are summarized. (Geiger-FRC)
W82-01866

THE VALUE OF ECOLOGICAL MONITORING IN THE MANAGEMENT OF PETROLEUM INDUSTRY EFFLUENT DISCHARGES: EXPERIENCE IN ESSO PETROLEUM COMPANY U.K. REFINERIES,
Esso Petroleum Co. Ltd., London (England).
J. S. Lemlin.
Water Science and Technology, Vol 13, No 7, p 437-464, 1981. 17 Fig, 2 Tab, 10 Ref.

Descriptors: *Oil pollution, *Monitoring, *Ecological effects, Water pollution effects, Water pollution sources, Water pollution control, Wastewater treatment, Water quality control, *United Kingdom, Cooling water, Process water, Ballast, Industrial wastewater, Oil refineries, Salt marshes, Wastewater disposal, Fawley Refinery, Milford Haven Refinery, Aquatic life.

Uses of water, potential pollution sources, effluent treatment processes, and ecological monitoring in two United Kingdom Esso petroleum refineries are described. Ecological monitoring programs have been successfully integrated into the management of refinery effluents. Fawley Refinery, capacity 19.2 million tons per year, is a complex installation using large quantities of water. Milford Haven Refinery, capacity 15 million tons per year, is almost exclusively air cooled. After treatment, Fawley effluents are discharged through two outfalls into a salt marsh. Average effluent quality is (in mg per liter): oil, 10.0; phenols, 0.4; sulfides, 0.3, ammonia, 3.0; and BOD, 30.0. The salt marshes had suffered significant oil pollution damage by the late 1960's. Therefore, an ecological monitoring system was set up. The average Milford Haven effluent contains (in mg per liter): oil, 16; phenols, 0.45; sulfides, 0.3; ammonia, 1.0; and BOD, 35. It discharges through a single outfall into a rocky bay. Increasing the residence time of effluent in lagoons and general tightening of procedures decreased the pollution levels in the 1970's. Ecological monitoring has pointed out the most cost-effective strategies for reducing environmental damage for each site. (Cassar-FRC)
W82-01913

THE HAZARDS OF HAZARDOUS WASTE MANAGEMENT,
Maryland Dept. of Natural Resources, Annapolis.
For primary bibliographic entry see Field 6E.
W82-01940

A PROPOSAL FOR RECLAMATION BY DILUTION OF IRRIGATION WATER,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 3C.
W82-01943

UPLAND MARSH FOR WATER QUALITY CONTROL,
Agricultural Research and Education Center, Lake Alfred, FL.
For primary bibliographic entry see Field 5B.
W82-01962

WATER QUALITY IMPACTS EXCHANGING WATER BETWEEN SEA AND A CLOSED ESTUARY,
Ministry of Transport and Public Works, Middelburg (Netherlands). Environmental Research Div.
C. P. de Vos, J. S. L. Vink, B. A. Bannink, and J. Leentvaar.
Water Science and Technology, Vol 13, No 7, p 271-285, 1981. 9 Fig, 5 Ref.

Descriptors: *Water quality management, *Estuaries, *Dams, *Destratification, *Salinity, Water quality control, Sluices, Mixing, Stratification, Lakes, Salt water, Polders, Oxygen balance, Grevelingen, *Netherlands.

The estuarine branch, Grevelingen, in the Netherlands was dammed off from the North Sea in 1971 to create a large salt water lake for nature conservation, recreation, and fisheries development. The salinity level decreased during excess precipitation and polder water discharges. To remedy problems of salinity regulation, a water exchange sluice was completed in the dam by 1978. The new exchange of water between the lake and the North Sea was accompanied by a permanent salt-stratification in the lake. In the summer of 1979, oxygen consumption in the hypolimnion was greater than the replenishment, while in June and July, oxygen levels near the bottom decreased to less than 1 milligram/liter. The exchange of sea and lake water during the summer did not prevent stratification of the lake. Oxygen balance problems were solved after the increased inflow of oxygen-saturated seawater into the hypolimnion due to density differences late in July. The sluice was closed during the 1980 summer period. (Geiger-FRC)
W82-01991

WATER QUALITY INDICES: AN ADDITIONAL MANAGEMENT TOOL,
Middlesex Polytechnic, London (England).
M. House, and J. B. Ellis.
Water Science and Technology, Vol 13, No 7, p 413-423, 1981. 8 Fig, 15 Ref.

Descriptors: *Water quality management, *Classification, Management planning, Planning, *United Kingdom, Rivers, Water pollution, Scottish Development Department, *Water quality indices.

A comparison of the geometric weighted formulation of the Scottish Development Department (SDD) water quality index with the National Water Council (NWC) and Thames Water Authority (TWA) classifications showed 76% and 81% agreement, respectively. This suggests that, with modifications, the SDD could be successfully used to monitor changes in water quality. In its present form it is most accurate in good quality waters and less accurate in low quality waters. There are several advantages to adopting a water quality index: (1) it reduces a large amount of data to a single index, (2) it reduces subjective judgments, (3) it provides more information on water quality, (4) it allows greater detail in describing specific river reaches and in showing small changes in quality, (5) it reports specific quality rather than qualitative approximations, and (6) it is more easily understood by laymen. (Cassar-FRC)
W82-01994

REVIVING THE RIO RECONQUISTA,
Thames Water Advisory Service (England).
P. Borrows.
Water, No 38, p 24-26, May, 1981. 1 Fig.

Descriptors: *Water pollution control, *Planning, Water pollution prevention, Rivers, Industrial wastes, Effluents, Food-processing wastes, *Argentina, *Odors, *Hydrogen sulfide.

The polluted condition of the Rio Reconquista in Argentina gave rise to the generation of hydrogen sulfide to such an extent that in the summer many stretches of the river could not be approached. The Rio Reconquista rises in the grass lands to the west of Buenos Aires. The pollution in the river has been caused by uncontrolled discharges of domestic sewage and industrial wastes, with the latter arising from a variety of sources, either from food processing plants or petrochemical industries. One of the first steps taken to correct the situation involved the establishment of a pollution control

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authority with adequate powers to stop the major sources of pollution from entering the river. Work was designed to take place in two stages. First, an initial three months were needed to tender documents and undertake a further study of the pollution. Second, a longer period extending over several years was set to build and commission the sewerage system extension and possibly another treatment works built on the river Matanza. Groundwater and resource planning would also be undertaken. (Baker-FRC)
W82-02014

WASTE DISPOSAL--CHOOSING AND LICENSING SITE,
Severn Trent Water Authority, Birmingham (England).
K. Selby.
Water, No 30, p 11-13, January, 1980. 1 Tab.

Descriptors: *Waste disposal, *Groundwater pollution, *Water pollution prevention, Site selection, Licensing, Legal aspects, Underground waste disposal, Water quality, *Great Britain.

Water authorities in Great Britain are responsible for ensuring the protection and proper use of all inland water, including water in the underground strata. The Control of Pollution Act of 1974 includes a waste disposal site licensing procedure which for the first time provides for proper control of waste disposal operations and for the involvement of water authorities in the licensing of sites. Factors affecting the degree of risk to water quality from waste disposal operations include the chemical and physical nature of the wastes, the quality and volume of leachate produced, the geology and hydrogeology of the disposal site, and the existing and desired quality of the water resource which is at risk. The aquifer protection policy developed by the Severn Trent Water Authority is based on identification of the resource vulnerability in hydrogeological terms and classification of activities considered to present a risk of groundwater pollution in each resource risk area. The four risk areas or protection zones range from high risk areas within one kilometer of public water supply boreholes, within which no waste disposal sites are permitted, to areas not located over either major or minor aquifers, in which there are few restrictions on the establishment of waste disposal sites unless surface water protection is needed. This policy allows for the identification of clearly acceptable or clearly unacceptable proposals, allowing limited resources to be concentrated on the marginal and more important proposals. Conditions which the water authority has recommended be included in some licenses for the protection of water quality have covered the type and volume of waste to be deposited, the inclusion of facilities at the site to prevent the formation and movement of leachate, leachate treatment and disposal facilities and other drainage provisions, and monitoring arrangements. Of recommendations made with respect to 879 licenses, only 6 have resulted in appeals. (Carroll-FRC)
W82-02035

WATER POLLUTION: A RISK TO THE FUTURE IN THE CASE OF THE RHINE (EAUX POLLUEES' AVENIR EN DANGER DANS LE CAS DU RHIN),
Zurich Service des Eaux (Switzerland).
M. Schalekamp.
Aqua, No 6, p 126-136, 1980. 56 Fig.

Descriptors: *Water quality control, *Chemical wastes, Water pollution control, Industrial wastes, Fish, *Rhine River.

Measurements made in 1978 by the International Committee of Rhine Basin Water Supply Undertakings show that water quality in the Rhine River has improved. For example, the level of lignosulfonic acid has fallen considerably. Although fish can now live in the river, they are still inedible because chemical pollution levels and salt content are high. Concentrations of toxic substances are 14.5 times higher in the lower Rhine than in Lake Constance. Prompt implementation of the Salt Convention, a treaty on chemical pollution, and better treatment of industrial wastes will further improve water quality in the Rhine, which serves as the water supply for 20 million people. This report urges that the health of the Rhine should not be judged by the fact that fish are returning, but rather in terms of water quality and human health. (Cassar-FRC)
W82-02067

WATER QUALITY MANAGEMENT OF LAKE NEUSIEDLER, AUSTRIA,
Federal Inst. on Water Resources Research (Switzerland).
For primary bibliographic entry see Field 5C.
W82-02090

POLAND: COMING TO GRIPS WITH POLLUTION,
D. Hinrichsen.
Ambio, Vol 10, No 1, p 40-41, 1981. 1 Tab.

Descriptors: *Industrial wastes, *Water pollution sources, *Water pollution control, Air pollution, Environmental effects, Acid rain, *Poland.

Groundwater pollution by coal mining operations and subsidence of groundwater and river levels are among the problems caused by industrialization in Poland's Silesian Triangle. Steel mills, coal-fired power stations, coal mines, chemical plants, and metallurgical and engineering companies are highly concentrated in this area; many use outdated technologies. Acid rain is a serious problem, affecting soil and vegetation. The Vistula River in this area is polluted beyond all acceptable limits, and its water level has been dropping by 10 cm a year. The Polish Academy of Sciences Research Center for Nature Protection and Natural Resources in Krakow and the Institute of Environmental Engineering, Zabrze, are working to improve the environment. However, they are understaffed and underfinanced and must consider tradeoffs between the country's need for more and cheaper energy and environmental improvement. (Cassar-FRC)
W82-02092

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

LAND-USE CONFLICT IN WILDLAND WATERSHED MANAGEMENT: A MULTIPLE OBJECTIVE ECONOMIC ANALYSIS,
California Univ. Davis.
W. C. Kinney.
PhD Dissertation, 1980. 270 p, 16 Fig, 23 Tab, 107 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-05389.

Descriptors: *Land use, *Watersheds, Model studies, Mathematical models, Economics, Multiobjective planning, Forest management, *Resources management, Multiple use of resources.

Economically efficient wildland watershed management requires a means of determining the relative value of noncommensurable forest outputs. This study develops a multiple objective mathematical programming model for determination and analysis of marginal economic tradeoffs between these outputs. These inputed tradeoffs are used to analyze alternative forest management activities, each of which produce a specific combination of joint forest outputs. Using a study area watershed in the Los Padres National Forest in California, the analysis first attempts to define the watershed's efficient production possibilities for these joint outputs. Successive parameterization of objective constraint levels generates the watershed's efficient production possibilities frontier. The Los Padres Forest has no commercially productive timber lands, and exists primarily for watershed protection. The predominant vegetation is chaparral, a group of bushy species which are highly susceptible to fire at certain times. Alternative management activities analyzed include prescribed rotational burning and vegetative type conversion. The joint production process is defined by the level of water runoff, sediment erosion, wildfire output, wildlife habitat potential, and visual resource impact for a given level of investment in intensive fuel management activities. The programming model identifies a relevant subset of all possible efficient output vectors, and provides the rates of product transformation betwen them. The economic analysis of these watershed management alternatives indicates that present vegetative conditions are generating significant inefficiencies in the management of public resources. (Sinha-OEIS)
W82-01675

WATER MANAGEMENT IN THE COLORADO RIVER BASIN: AN APPLICATION OF NON-LINEAR TRANSPORTATION ALGORITHMS,
Arizona Univ., Tucson. Dept. of Economics.
K. E. Boles.
PhD Dissertation, 1980. 110 p, 7 Fig, 2 Tab, 67 Ref, 2 Append, University Microfilms International Ann Arbor, MI; Order No GAX-17769.

Descriptors: *Model studies, *Water management, *Water resources, *Colorado River basin, Land use, Treatment, Flow augmentation, Recharge, Reclamation, Recycling, Desalination, Transportation algorithms.

Recent developments in transportation algorithms and a decomposition strategy are utilized to develop a comprehensive water resources management model of the Colorado River Basin which can be solved quickly. This model permits both quality and quantity levels to be considered at all points within the system. The quality and quantity requirements are used as parameters in the determination of an optimal system of piping, treatment levels, recycling, reclamation, groundwater recharge, reservoir usage, flow agmentation, land use and other management alternatives. Several optimum systems are then compared as to costs, allocations and quality of output under differing legal, economic, technological and environmental assumptions. A full analysis of the Colorado River Basin water supply and quality situation under various constraint assumptions is presented. A thorough analysis is performed of the interaction and impacts of eight Bureau of Reclamation salinity control projects. The primary emphasis is on examining the impacts and alternatives involved with the Yuma desalination project. Finally a summary of both the Colorado River Basin analysis and the success of using the model and solution technique is given along with conclusions derived from these two facets of the study. (Sinha-OEIS)
W82-01677

A STRUCTURAL SYSTEMS ANALYSIS APPROACH TO DETERMINE OPTIMUM OPERATING POLICIES FOR IRRIGATION AND HYDROPOWER GENERATION FOR WATER RESOURCES, SYSTEMS,
California Univ., Berkeley.
F. J. Gonzales-Villarreal.
Doctor of Engineering Dissertation, 1980. 233 p, 29 Fig, 17 Tab, 58 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-12930.

Descriptors: *Water resources development, *Irrigation, *Computer programs, Mathematical models, *Mexico, Powerplants, Hydropower generation.

The main contribution of this research is the development of a methodology and the implementation of the computer programs for analyzing water resources systems with a twofold purpose; irrigation and power generation. The methodology can be classified as a multilevel hierarchical approach. Special attention is given to integrating the optimization and simulation models that describe the different parts of subsystems of the whole system as well as to analyzing the stochastic nature of the streamflow and other local conditions within the framework of the targets and objectives of a national agricultural production system and a regional power generation set-up. The methodology is

applied to the case of the Yaqui River in northwestern Mexico. (Sinha-OEIS)
W82-01680

A LIMNOLOGICAL INVESTIGATION OF A TROPICAL FRESH-WATER ECOSYSTEM: THE BELIZE RIVER, BELIZE, CENTRAL AMERICA,
Western Michigan Univ., Kalamazoo.
For primary bibliographic entry see Field 5G.
W82-01682

THE MANAGEMENT OF WATER RESOURCES: A SYNTHESIS OF GOAL PROGRAMMING AND INPUT-OUTPUT ANALYSIS WITH APPLICATION TO THE IOWA ECONOMY,
Iowa State Univ., Ames.
E. K. Mensah.
PhD Dissertation, 1980. 243 p, 3 Fig, 36 Tab, 61 Ref, 2 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-06030.

Descriptors: *Water resources development, *Economics, *Iowa, Management, Model studies, *Water management, Resources management, Multiobjective planning.

This study focuses on the development of a multiobjective model combining input-output analysis and goal programming for providing guidance in the allocation of the water resources of Iowa. The model was applied in the allocation of water between the economic sectors of the state of Iowa to satisfy the state's water needs for economic and demographic projections to 2020. The 1972 input-output technical coefficients matrix of Iowa developed by Barnard was modified to include commodity-wise marginal properties to consume. This extension of the basic input-output model was aimed at capturing the income effect of consumption on production and resource utilization. It thus includes a comprehensive multiplier analysis of the effects of a shock in one sector of the economy throughout the entire economic system. The analysis has confirmed that the state of Iowa, as well as its eight major water supply areas, have enough water resources to satisfy the long term growth projections to the year 2020. This conclusion embraces only quantity of water regardless of quality demanded or quality supplied. (Sinha-OEIS)
W82-01685

RANDOM DIFFERENTIAL EQUATIONS IN WATER QUALITY MODELING,
Utah State Univ., Logan.
B. A. Finney.
PhD Dissertation, 1980. 190 p, 43 Fig, 8 Tab, 42 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-05105.

Descriptors: *Model studies, *Mathematical models, *Water quality, Biological Oxygen Demand, Equations, Probabilistic process, Differential equations, Dissolved oxygen.

A probabilistic river water quality model is developed with the capability of determining the joint and marginal probability density function of BOD and DO at any point in a river. The one dimensional steady-state model can be applied to a river system with any reasonable number of point loads and diversions and lateral surface and subsurface inflow. The model can simultaneously consider randomness in the initial conditions, inputs, and coefficients of the water quality equations. Any empirical or known distribution can be used for the initial condition. The randomness in the water quality equation inputs and coefficients is modeled as a Gaussian white noise process. The joint pdf of BOD and DO is determined by numerically solving the Fokker-Plank equation. Moment equations are developed which allow the mean and variance of the marginal distribution of BOD and DO to be calculated independently of the joint pdf. An upper limit on the coefficient noise variance parameter is presented for which the BOD-DO covariance matrix will be asymptotically stable. The probabilistic river water quality model is applied to two problems, a sensitivity problem and a hypothetical problem. (Sinha-OEIS)
W82-01688

THE TECHNOLOGY TRANSFER PROCESS IN WATER RESOURCES R&D MANAGEMENT,
Stanford Univ., CA. Dept. of Civil Engineering.
C. E. Downs.
PhD Dissertation, 1980. 217 p, 24 Fig, 13 Tab, 162 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-11627.

Descriptors: *Water resources, *Model studies, *Water policy, Technology, Planning, Research and development, Saline water.

The scope of this study, for reasons of manageability, is restricted to water resources R&D management considerations, and particularly the adaptiveness of R&D resource allocation decisions. The study is divided into two parts in order to afford an intuitive feel for the adaptive interrelationships between the technology transfer process, the R&D management function, and the public policy making process as well as a theoretical perspective for modeling and analysis. The first part is devoted to the development of the nature and context of the problem, its basis in research and the policy state space concept and model. The policy state space model has its basis in the recognition of the common cybernetic characteristics of the adaptive processes involved and suggests a first step toward a new theory of public policy evaluation. The second part is a case study of the adaptiveness of the R&D policies for the former Office of Saline Water. The objective of the case study is to illustrate the application of the policy state space model and to assess its utility both in evaluating the adaptiveness of the policy making process in water resources R&D management and its symbiotic link with the technology transfer process as well as in broader studies of the policy making process. (Sinha-OEIS)
W82-01694

POLLUTION PERMITS AND MARKETS FOR WATER QUALITY,
Wisconsin Univ.-Madison.
W. B. O'Neill.
PhD Thesis, 1980. 199 p, 17 Tab, 119 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-07851.

Descriptors: *Water pollution control, *Water quality, *Pollution abatement, Economic justification, Market value, Permits, *Model studies, Transferable discharge permits(TDP's).

The analysis begins with the development of an economic river basin model which identifies a well-defined index of water quality as a commodity subject to competing demands by polluters. The model utilizes linear programming optimization techniques to conduct a cost-effectiveness comparison of the market strategy with two commonly proposed alternative abatement plans. Comparison of the abatement costs implied by the three strategies provides information about the effect of market transactions costs on the choice of a control plan. In particular, the cost difference between the market and the alternative plans is an estimate of the maximum level of transactions costs consistent with choice of the market strategy. Initially a single period model is constructed which assumes steady-state conditions on the Fox River in Wisconsin. Simulation of a variety of market structures and river conditions provides evidence that the market strategy may be significantly less costly than the alternative plans. A multi-period model is also developed and used to analyze the choice of control strategy in the case of varying river conditions and the associated assimilative capacities. Fox River simulation results again support the cost-effectiveness of the transferable discharge permits (TDP's) market. In both sets of analyses, the market simulations also provide information on the nature of permit trading and on the type of market supervision which would be necessary if a TDP market were to be instituted. (Sinha-OEIS)
W82-01699

FLOOD CONTROL ON THE PARANA AND PARAGUAY RIVERS,
Motor-Columbus Consulting Engineers, Inc., Baden (Switzerland).
For primary bibliographic entry see Field 2E.
W82-01707

OPTIMIZATION OF WATER RESOURCES FOR IRRIGATION IN EAST JORDAN,
Southampton Univ. (England). Inst. of Irrigation Studies.
J. R. Rydzewski, and H. A-H. Rashid.
Water Resources Bulletin, Vol 17, No 3, p 367-372, June, 1981. 1 Fig, 4 Tab, 9 Ref.

Descriptors: *Irrigation, *Water allocation, *Water deficit, *Jordan, Diversion, Conjunctive use, Water resources, Agriculture, Water management, Model studies, Optimization.

Optimal allocation of water resources to three agricultural areas in the arid region east of the Jordan River was accomplished, using nonlinear programming to maximize productivity of irrigation water while allowing for crop water deficits, and linear programming to determine the cheapest alternative. The three agricultural regions are I, 14,000 ha; II, 9,000 ha; and III, 13,000 ha of Cultivable Commanded Area. The Jordan River itself becomes too saline for irrigation purposes 50 km south of its source in Lake Tiberias. The available water sources are its eastern tributaries, the Yarmouk, Zarqa, and Arab rivers and their storage reservoirs, major groundwater resources in Region III, and promising groundwater sources in Region II. The cropping pattern suggested for this frost-free region is 20% perennial (citrus, banana, and lucerne), 80% winter crops (wheat, barley, vegetables, onions, and berseem), and 50% summer crops (vegetables, sunflower, groundnut, sesame, and fodder). Yearly crop water requirements are 19,400 cu meters per ha with no rainfall and 15,800 cu meters per ha allowing for some rainfall. Annual crop demand would be at least 760 million cu meters with 70-75% efficiency. A table lists the recommended monthly water allocation for 3 years for each agricultural region from each of eight water sources, the Yarmouk River and its storage being prominent. (Cassar-FRC)
W82-01742

HYDROGEOLOGY OF WELL-FIELD AREAS NEAR TAMPA, FLORIDA, PHASE 1--DEVELOPMENT AND DOCUMENTATION OF A TWO-DIMENSIONAL FINITE-DIFFERENCE MODEL FOR SIMULATION OF STEADY-STATE GROUND-WATER FLOW,
Geological Survey, Tallahassee, FL. Water Resources Div.
C. B. Hutchinson, D. M. Johnson, and J. M. Gerhart.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Price $17.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-630, 1981. 129 p, 11 Fig, 2 Tab, 12 Ref.

Descriptors: *Geohydrology, *Model studies, *Simulation analysis, *Groundwater movement, Finite element method, Aquifer characteristics, Wells, Water table, Leakage, Pumping, Drawdown, *Florida, Tampa, Floridan aquifer, Cross Bar Ranch well field, Morris Bridge well field.

A two-dimensional finite-difference model was developed for simulation of steady-state groundwater flow in the Floridan aquifer throughout a 932-square-mile area, which contains nine municipal well fields. The overlying surficial aquifer contains a constant-head water table and is coupled to the Floridan aquifer by a leakage term that represents flow through a confining layer separating the two aquifers. Under the steady-state condition, all storage terms are set to zero. Utilization of the head-controlled flux condition allows head and flow to vary at the model-grid boundaries. Procedures are described to calibrate the model, test its sensitivity to input-parameter errors, and verify its accuracy for predictive purposes. Also included are attachments that describe setting up and running the model. An example model-interrogation

run shows anticipated drawdowns that should result from pumping at the newly constructed Cross Bar Ranch and Morris Bridge well fields. (USGS)
W82-01780

THE LAKE TAHOE BASIN: A SYSTEMS ANALYSIS OF ITS CHARACTERISTICS AND HUMAN CARRYING CAPACITY,
Energy Policy Studies, Inc., Omaha.
M. W. Gilliland, and B. D. Clark.
Environmental Management, Vol 5, No 5, p 397-407, September, 1981. 5 Fig, 1 Tab, 14 Ref.

Descriptors: *Lake Tahoe, *Carrying capacity, *Systems analysis, Public policy, Planning, Watershed management, Watershed protection, Legal aspects, Urbanization, Environmental effects, Ecological effects.

An environmental assessment of the Lake Tahoe Basin was made which was aimed at analyzing the federal role in the preservation of the area. A systems approach was utilized which is applicable to both urban and natural environments that are characterized by similar resource constraints. Urban growth in the area has been exponential and has caused significant damage to the environment. The area experiences congestion, violations of air and water quality standards, losses in wildlife, and degradation of visual resources (views). Full protection for the area requires the definition of a carrying capacity for the basin and management of the growth process. An environmental thresholds standards analysis was performed, using three threshold levels of sediment and nutrient inputs into the lake. The three hypothetical loading rates correspond to three levels of lake water quality, and thus to three possible perceptions of ecological damage. Available mitigation funds also influence the calculated carrying capacity of the basin. (Small-FRC)
W82-01807

LONG-RUN EFFECTS OF ENVIRONMENTAL REGULATION,
International Bank for Reconstruction and Development, Washington, DC. Policy Planning Div.
R. G. Ridker, and W. D. Watson.
Natural Resources Journal, Vol 21, No 3, p 565-587, July, 1981. 3 Fig, 7 Tab.

Descriptors: *Long-term planning, *Water pollution control, *Regulations, *Economic aspects, Environmental effects, Planning, Water policy, Population growth, Effluent standards, Social costs, Cost-benefit analysis.

The relationship between the generation of pollutants, environmental regulations, and economic growth over a 50-year period is examined. It appears that pollution can be substantially improved without undue interference with the national economy as long as fiscal and monetary policy brings about increases in savings and as long as disadvantaged sectors are helped. On the negative side, there is profound ignorance on the environmental consequences of past and future human activities or the results of using different forms of energy. Five quality factors should be considered in judging the conclusion: Policies analyzed were based on uniform national emissions standards, which do not account for overcontrol or undercontrol in some areas. Pollutants were considered as an aggregate. Investments for pollution abatement and for energy-efficient capital may reduce economic growth if there are not sufficient savings to finance the extra capital requirements. Constraints of local requirements and decisions could seriously reduce growth. Uncertainty about future environmental pressures may also slow economic growth; for example, at some point acid rain, loss of topsoil, or rapid population growth may produce acute pressure. A table shows the indexes of per capita economic welfare for relaxed controls, strict controls, least-cost controls, and controls at 1975 levels for the years 1975, 1985, 2000, and 2025. The least-cost policy would lead to the highest per capita welfare index (3.22) by the end of the 50-year period vs. 3.20 for relaxed controls, 3.17 for strict controls, and 3.14 for 1975 controls. (Cassar-FRC)
W82-01848

SIMULATING EFFECTS OF COMBINED SEWER OVERFLOWS,
Lozier Engineers, Inc., Rochester, NY.
H. M. Shapiro, J. B. Blenk, and M. P. Allen.
Water/Engineering and Management, Vol 128, No 9, p 79-80, 82, 84, September, 1981. 3 Fig.

Descriptors: *Wastewater treatment, *Storm-overflow sewers, *Wastewater pollution, *Model studies, *Project planning, Simulation analysis, Mathematical studies, Sewers, Storm sewers, Storm runoff, Hydraulic models, Cost analysis, *Chemung County, New York.

Chemung County, New York, has taken measures to upgrade its waste water treatment facilities. A simulation study was organized to determine the cost effectiveness of overflow storage with subsequent treatment, the effect of combined dry weather and treated or untreated overflow on stream standards, and the effects of increased plant efficiency on the reduction of combined sewer overflow (CSO). A STORM-WQRRS (Water Quality River-Reservoir) continuous simulation model was selected to predict the quantity and quality of storm water and dry weather flow. The three major steps involved in these predictions entailed computations of runoff quantity and quality and storage, treatment and overflow of runoff. The WQRRS modeling concept is based on fundamental laws of conservation and kinetics as they apply to studies of continually-stirred-tank reactors and is structured of three separate but interchangeable modules: a reservoir module, a stream hydraulic module, and a stream quality module. The CSO impact on the Chemung River was determined by application of the STORM model to data obtained from a site 5 miles above the CSO source. The WQRRS model yielded results of little value in the evaluation of CSO impact. The WQSTAT statistical program was employed to reduce the output of CSO impact. The WQSTAT statistical program was employed to reduce the output to more usable form. After the simulation analysis was complete, the consultant recommended no additional CSO abatement work at the present time. However, design of a regional treatment facility is currently underway. (Geiger-FRC)
W82-01864

A MULTILEVEL MODEL AND ALGORITHM FOR SOME MULTIOBJECTIVE PROBLEMS,
Chiyoda Chemical Engineering and Construction Co. Ltd., Yokohama (Japan).
N. Takama, and D. P. Loucks.
Water Resources Bulletin, Vol 17, No 3, p 448-453, June, 1981. 1 Fig, 2 Tab, 13 Ref.

Descriptors: *Decision making, *Chemical wastewater, *Multiobjective planning, *Wastewater treatment, Industrial wastewater, Optimization, Planning, Algorithms.

An interactive decision making model is presented to aid in solving multiobjective problems associated with large scale convex multilevel systems. At each step the decision maker carries out pairwise comparisons, which are reflected on higher level decision variables. The procedure is applied to the design of a wastewater treatment system for a chemical manufacturing plant. The performance of the system is evaluated by three criteria: efficiency of the waste treatment process, system reliability, and cost. The treatment system is decomposed into two subsystems, each with a treatment efficiency and a cost criterion. The first subsystem consists of a number of treatment units which are evaluated to obtain the minimum pollutant discharge for a given cost. The second subsystem consists of control units to produce maximum system reliability at a given cost. (Cassar-FRC)
W82-01884

THE ECONOMICS OF COOPERATION OVER COLLECTIVE BADS,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Economics.
J. B. Braden, and D. W. Bromley.
Journal of Environmental Economics and Management, Vol 8, No 2, p 134-150, June, 1981. 5 Fig, 29 Ref.

Descriptors: *International agreements, *Pollution taxes, Economic aspects, *Theoretical analysis, Water quality control, Water pollution control, Taxes, Model studies, Nonstructural alternatives.

Pollution released in one country frequently produces damages in other nations; for example, both Canada and the U.S. are affected by contaminants in the Great Lakes. This paper adapts concepts of trade in public goods to present a theory of cooperation over reciprocated collective bads. Similar techniques are used for analysis of public goods and exchanged collective bads. Both theories conclude that joint actions involving efforts greater than the sum of those undertaken independently can produce Pareto-superior results, some of which are optimal. The two theories differ in the meaning attached to the trade region and in incentives to cooperate. Since collective bads are damaging to a nation's welfare, cooperation is much more urgent than working out economics in supplying public goods. Although tax policies are useful in studying cooperative arrangements, they present many obstacles in practice. Among the obstacles involved in making agreements between reciprocating polluters are costs of negotiations and enforcement, deception, self-interest, and blackmail. Overcoming these problems may involve acquiring accurate information on the physical system and on consumer preferences, agreement on principles of cooperation, and correction of misinformation. (Cassar-FRC)
W82-01909

LOGISTICS OF FARM WATER SUPPLY.
New Zealand Journal of Agriculture, Vol 140, No 6, p 38-39, 41, 43, July, 1980. 6 Fig.

Descriptors: *Water conveyance, *Farming, Water supply development, Water resources development, Rivers, Wells, Pumps, Pipes, Costs, Financial considerations, *New Zealand.

Factors involved in establishing a good water supply system for a farm are reviewed in the form of a case study. The farm site was Massey University's Riverside farm, located five miles south of Mount Bruce in Wairarapa, New Zealand. Originally the farm depended on two small pumps drawing water from the river, which proved to be inadequate for stock watering, farm work and domestic purposes as well as being subject to breakdowns due to flooding in the river. Sound initial planning is needed to build a system. This planning should include an aerial photograph of the farm and a topographical map of the area, an estimate of water requirements for present and future needs, full details and level and flow rate of all available water sources, and the location and level of all outlets, troughs, houses, etc. In this case, with head available on the hills, a pumped gravity system was a natural choice. The system chosen involved drawing water from the river and pumping it into a ring main, the two sides of which join towards the top of the farm to feed a 22,000 liter concrete tank acting as a reservoir. Pipe choices depend on the pressures expected. Pressure is a function of the topography. (Baker-FRC)
W82-02037

6B. Evaluation Process

PUBLIC OPINION AND INTEREST GROUP POSITIONS ON CHESAPEAKE BAY ISSUES: IMPLICATIONS FOR RESOURCE MANAGEMENT,
Maryland Technical Advisory Service, College Park.
P. S. Florestano, and P. A. Rathbun.
Coastal Zone Management Journal, Vol 9, No 1, p 19-39, 1981. 2 Fig, 1 Tab, 11 Ref.

Descriptors: *Resources management, *Public policy, *Policy making, *Chesapeake Bay, Water

management, Water policy, Administrative decisions, Surveys, Recreation, Commercial fishing, Environmental policy, Environmental protection, Nuclear powerplants, Water pollution.

A twofold methodological approach was employed to review public opinion on a number of environmental topics concerning the use and management of the Chesapeake Bay and determine if policies advocated by various public interest groups reflect the preferences of Maryland citizens. Data collected addressed water pollution, government regulation of private land, waterfront construction, and recreational boating, nuclear powerplants, oil spills, responsibility for discharge of toxic substances, dredging of bay channels and port expansions, and preferential treatment for the seafood industry. Telephone surveys of a random sample of state residents, mail surveys of interest groups, and personal interviews with interest-group leaders were conducted to identify policy stands on Chesapeake Bay issues. The findings revealed that interest group policies, in general, reflect the public's attitude on environmental and Bay-related issues. Citizens and interest groups alike did not seem to place more importance on the increased need for energy than for the protection of the environment. (Geiger-FRC)
W82-01642

RIVER THERMAL STANDARDS COSTS IN THE UPPER MIDWEST,
Iowa Univ., Iowa City. Dept. of Civil Engineering.
T. E. Croley, A. R. Gianquinta, and R. A. Woodhouse.
Journal of the Energy Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EY1, p 65-77, May, 1981. 2 Fig, 4 Tab, 15 Ref. OWRT-B-061-IA(2).

Descriptors: *Electric powerplants, *Cost-benefit analysis, *Thermal pollution, *Temperature effects, Powerplants, Thermal powerplants, Environmental effects, Water resources development, Thermal stress, Standards, Water quality standards, Costs, Rivers, Mathematical studies.

An evaluation was made of the marginal (incremental) changes in cooling-related water consumption (evaporative loss) and power-plant cooling costs which result from unit changes in river temperature standards along the Upper Mississippi and Missouri Rivers in the MAPP region. Some hypothetical river thermal standards for powerplants were examined including the extreme cases of free thermal discharge and no thermal discharge. Various restrictive levels for standards are studied for their probable impact on the MAPP region. One way of representing thermal standards is by trade-off relationships which are based on cost/benefits analyses. Environmental objective functions were difficult to define due to the noncommensurable nature of the benefits of fish and wildlife preservation and the costs of meeting certain thermal standards. Decision makers may have difficulty in determining future thermal standards when the costs of providing different levels of environmental protection are considered in the cost/benefit evaluation. (Geiger-FRC)
W82-01655

THE NATIONAL COMMISSION ON WATER QUALITY: A CASE STUDY IN CONGRESSIONAL POLICY ANALYSIS,
Texas Univ. at Dallas, Richardson.
R. B. Outen.
PhD Dissertation, 1980. 335 p, 118 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-13925.

Descriptors: *Water quality, *Water policy, Legislation, Behavior, United States, *Case studies, *Congressional policy, National Commission on Water Quality.

This analysis of the National Commission on Water Quality has been structured around a series of propositions concerning the behavior of the National Commission on Water Quality and the Congress. The analysis has demonstrated that the stated propositions concerning 'normative behavior' were not borne out. To a very large degree, they failed to predict the behavior of the National Commission on Water Quality or the Congress in responding to the Commission's reports and recommendations. The data suggest, therefore, that the original goal model was invalid. The Congress-dominated, mixed membership structure of the Commission institutionalized powerful political tensions which subsequently exerted a strong influence on the way the Commission behaved. Through individual personalities and political events peculiar to the issue area provided a unique texture and color, the underlying fabric of behavior was the result of the dominant presence of Congressional members on the Commission. (Sinha-OEIS)
W82-01669

WATER MANAGEMENT IN THE COLORADO RIVER BASIN: AN APPLICATION OF NON-LINEAR TRANSPORTATION ALGORITHMS,
Arizona Univ., Tucson. Dept. of Economics.
For primary bibliographic entry see Field 6A.
W82-01677

THE MANAGEMENT OF WATER RESOURCES: A SYNTHESIS OF GOAL PROGRAMMING AND INPUT-OUTPUT ANALYSIS WITH APPLICATION TO THE IOWA ECONOMY,
Iowa State Univ., Ames.
For primary bibliographic entry see Field 6A.
W82-01685

AN ECONOMIC AND INSTITUTIONAL ASSESSMENT OF THE WATER PROBLEM FACING THE TUCSON BASIN,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
A. H. Griffin.
PhD Dissertation, 1980. 407 p, 14 Fig, 52 Tab, 127 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-28529.

Descriptors: *Water supply, *Groundwater, *Water users, *Economics, Arizona, Water rights, Water levels, Mining, Agriculture, Urbanization, Multiple use of resources, *Tucson.

The occurrence and use of water in the region is examined in order to determine the real nature of Tucson's water problem. The institutions governing the use of water in the Basin are described and the disputes between the local water users are discussed. An account is given of the use of water by businesses and residences in Tucson, by the copper mines to the south of Tucson, and by the farms in the Basin. The effect of changes in the cost and availability of water on each of these classes of water user is investigated and the effect that changes in water use could have on the region's economy is discussed. The occurrence of groundwater is described and the merits of the proposed Central Arizona Project are investigated. Various ways of balancing the region's water budget are described and an assessment is made of the effect that curtailing the use of water in the region would have upon the local water users and the region's economy. The principal conclusions are as follows: There is no danger of the supply of water in the Basin becoming exhausted in the near future. The economic and physical effects of the continuing fall in the level of the water table are unlikely to be serious. The region's water budget could be balanced very economically by retiring all agriculture in the region and making modest reduction in the amount of water consumed by urban water users and the copper mines. Given suitable institutional arrangements, curtailing the use of water in the Basin would be a much more economical way of balancing the region's water budget than building the Central Arizona Project. The final conclusion is that the real water problem is an institutional problem. (Sinha-OEIS)
W82-01698

INTEGRATED AGRICULTURAL DEVELOPMENT IN THE PHILIPPINES,
Asian Development Bank, Manila (Philippines). Agriculture and Rural Development Dept.
K. Takase.
International Water Power and Dam Construction, Vol 33, No 8, p 22-24, August, 1981. 2 Fig.

Descriptors: *Irrigation programs, *Resources development, *Philippines, Irrigation, Rural areas, Rural sociology, Cost analysis, Financing, Agricultural engineering.

The Asian Development Bank has approved 81 loans amounting to $1261 million in the area of irrigation and rural development projects. In 1966 the government of the Philippines placed highest priority on rice self-sufficiency centered on irrigation development, which was the prerequisite for growth of the new high yielding varieties of rice. The World Bank proposed the construction of a storage dam on the basis that water resources should first be secured. The Pantabangan dam in Nueva Ecija was completed in August 1974 with the aim of irrigating 83,000 ha. In 1968 the National Irrigation Administration selected a 140 ha pilot area within the Angat River Irrigation System to tackle the problem of ditches and drainage. The design and construction of farm ditches for irrigation and drainage was undertaken, and a number of measuring stations were established in the area. A series of demonstrations and educational campaigns was also conducted. A year after the project began, the density of farm ditches had increased from 16 to 62 m/ha, systematic water application became effective, high yielding varieties were planted, and fertilizers were applied, causing a jump in the pilot scheme paddy yields from 2.3 t/ha in 1968 to 3.1 t/ha in 1969. This project pioneered not only the improvement and rehabilitation of irrigation, drainage and service roads, but also the inegration of land reform, compact farm associations, supervised credit, and the training of staff and leading farmers. Additional attention is needed on cost effectiveness and socio-economic benefits as well as project implementation and loan administration. (Baker-FRC)
W82-01725

ADDENDUM TO: SOURCES OF POWER-PLANT COOLING WATER IN THE DESERT AREA OF SOUTHERN CALIFORNIA--RECONNAISSANCE STUDY,
Geological Survey, Menlo Park, CA. Water Resources Div.
J. H. Koehler, and M. J. Mallory.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Price: $4.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-527, June, 1981. 28 p, 9 Fig, 5 Tab, 14 Ref.

Descriptors: *Evaluation, *Groundwater availability, *Groundwater basins, *Water cooling, *Powerplants, Aquifers, Pumping, Deserts, Water quality, *California, Southern California.

A hydrologic reconnaissance study was made in five basins in southern California previously classified as suitable for providing sufficient ground water for cooling a 1,000-megawatt electric-power generating plant. The criteria used to evaluate the basins were (1) theoretical aquifer response to pumping, (2) alternative sources of water, and (3) chemical quality of water. The basins were ranked relative to each other for the three criteria and in overall suitability. On the basis of subjective analysis, the basins were ranked in the following order for overall suitability: (1) Calzona-Vidal Valley, (2) Middle Amargosa Valley, (3) Chuckwalla Valley, (4) Soda Lake Valley, and (5) Caves Canyon Valley. (USGS)
W82-01773

STATIONARY SOURCE POLLUTION POLICY AND CHOICES FOR REFORM,
Resources for the Future, Washington, DC.
For primary bibliographic entry see Field 6E.
W82-01847

LONG-RUN EFFECTS OF ENVIRONMENTAL REGULATION,

International Bank for Reconstruction and Development, Washington, DC. Policy Planning Div.
For primary bibliographic entry see Field 6A.
W82-01848

SIMULATING EFFECTS OF COMBINED SEWER OVERFLOWS,
Lozier Engineers, Inc., Rochester, NY.
For primary bibliographic entry see Field 6A.
W82-01864

GULF OF MEXICO: A SOCIOECONOMIC VIEW OF COMPETING RESOURCES,
C. O. French.
In: Proceedings of a Symposium on Environmental Research Needs in the Gulf of Mexico (GOMEX), Key Biscayne, Florida, 30 September - 5 October 1979, Volume IIA, May, 1981. p 1-40, 2 Fig, 16 Tab, 59 Ref. National Oceanic and Atmospheric Administration, Miami, Florida.

Descriptors: *Social aspects, *Economic aspects, *Water pollution, *Environmental effects, Competing use, Industrial wastes, Water use, Wetlands, Habitats, Waste disposal, Oil industry, Fisheries, Agriculture, *Coastal waters, *Gulf of Mexico States, Water demand.

The socioeconomic environment of the coastal region of the Gulf of Mexico is highly varied in terms of human quality. Although specific data are essentially unavailable, sound policy development and effective management are dependent upon correct assessment of these factors. The socioeconomic activities that effect the greatest alteration in the Gulf of Mexico region include: demographic changes; industrial development (petroleum, waterborne transportation, and ocean dumping); and commercial fishing. The five states covered by the study are Texas, Louisiana, Mississippi, Alabama, and Florida. The primary ways in which socioeconomic sectors interact with coastal processes are: generation of industrial and domestic wastes that are discharged into the environment; habitat modification such as impounding, draining, polluting, and filling wetlands; and natural resource exploitation, including water use. Various socioeconomic sectors may generate the same kinds of activities, so the environmental impact of one sector is often difficult to distinguish. In general, there has been rapid population growth in the South during the last decade, with the greatest rates of increase occurring in the coastal belt. Increasing industrial development and employment have paralleled urban growth and rural decline. Commercial and industrial resource uses in the Gulf are most closely associated with petroleum and petrochemical production, commercial fishing, recreation, and agriculture. (Moore-SRC)
W82-01901

A COMPREHENSIVE METHODOLOGY FOR PROJECT APPRAISAL AND ENVIRONMENTAL PROTECTION IN MULTINATIONAL RIVER BASIN DEVELOPMENT,
Polytechnic Inst. of New York, Brooklyn. Dept. of Civil and Environmental Engineering.
C. Yapijakis, and A. H. Molof.
Water Science and Technology, Vol 13, No 7, p 425-436, 1981. 5 Fig, 19 Ref.

Descriptors: *River basin development, *Decision making, *Alternative planning, Project planning, Planning, *Cost-benefit analysis, Environmental effects, Social aspects, Political aspects, Water resources development, *International waters.

A decision making method for evaluating alternatives for multinational river basin development is presented. This method intended as a tool, not as a panacea. Factors considered are benefit-cost ratio, capital outlay, environmental and social impacts, and manageability/technology level. Each government creates a coordinating group, a weighting panel, and a rating panel, each composed of specialists and experts. The coordinating group lists project alternatives, defines the factors in terms of its government's policies, and chooses the rating and weighting panels. The weighting panel establishes a weighting scheme for each of the aspects. Each member of the rating panel judges the alternatives in their field of expertise by any method--model construction, experiments, point assignment procedures, etc. Final selection of an alternative is done by one of 2 methods: ranking the alternatives from all countries in a single matrix on an equal weight basis, or producing a single list from the combined project ratings from each country. (Cassar-FRC)
W82-01914

OPTIMAL DESIGN OF BORDER IRRIGATION SYSTEMS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 3F.
W82-01977

TECHNICAL AND ECONOMIC IMPLICATIONS OF INSTALLING AN INDUSTRIAL WASTE-WATER PRETREATMENT PLANT,
Environmental Control Consultancy Services Ltd., London (England).
For primary bibliographic entry see Field 5D.
W82-02044

SEVERN BARRAGE SCHEME GETS FAVOURABLE RESPONSE.
International Water Power and Dam Construction, Vol 33, No 9, p 48-50, September, 1981. 4 Fig.

Descriptors: *Tidal powerplants, *Severn River, *Electric power production, Tidal energy, Tides, Costs, Feasibility studies, United Kingdom, Water use, Cost-benefit analysis.

The configuration for the Severn tidal scheme with the highest cost-benefit ratio is a single basin, with electricity being generated in the ebb mode only. It would have an installed capacity of 7.2 MW and a 19 km-long barrage. It would produce about 13 TWh/year or about 6% of the United Kingdom's electricity demand, and would cost $10,640 million to build. The major benefit of the tidal scheme would be to reduce the amount of coal burnt by 5 to 8 times 10 to the 6th power tons. In the preferred scheme, the optimized number of turbines would be 160, each rated at 25 MW and 9 m in diameter. The economic justification for a barrage is dependent upon the cost of coal and the availability and cost of nuclear power. At the least, tidal power should be viewed as a valuable supplementary source of electricity, and is the leading renewable source. The environmental consequences of a barrage would be wide ranging. (Small-FRC)
W82-02089

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

STANDARDS AND CHARGES IN THE CONTROL OF TRADE EFFLUENT DISCHARGES TO PUBLIC SEWERS IN ENGLAND AND WALES,
York University, Heslington (England). Institute of Social and Economic Research.
M. G. Webb, and R. Woodfield.
Journal of Environmental Economics and Management, Vol 8, No 3, p 272-286, September, 1981. 6 Fig, 5 Tab, 6 Ref.

Descriptors: *Effluents, *Economic aspects, *Industrial wastes, Discharge measurement, Standards, Regulations, Pricing, *Effluent charges, *England, Wales.

The revised charging scheme for discharges of trade effluent to public sewers introduced by the new water authorities in England and Wales are described. The charge scheme has been applied to effluent discharges from industries. The impact of these charges on the dischargers, the instruments used for the control of trade effluents to public sewers, and the relationship between optimal levels of trade effluent charges and levels of capacity at collective sewage works are considered. The revised charging schemes were based on a charging formula as recommended by the National Water Council. The primary aim of the charges is to allocate to the dischargers the costs incurred by the water industry for the reception, conveyance, treatment and disposal of waste products produced by industry. However, there is a total lack of empirical evidence to justify the chosen formula. Other problems involved in the use of the trade effluent charging scheme in combination with the consent standards include the determination of optimal collective treatment capacity, the optimal allocation of consent standards for given capacity, and the determination sample of discharges in the Southern Division of the Yorkshire Water Authority. One of the greatest problems was the use of regionally equalized charges based on historic accounting costs, which give dischargers inaccurate price signals. The study demonstrated that although the charging formula is related to volume, biological and sludge strengths of effluent treated, in practice the major determinant of a discharger's charge is the volume of effluent discharged. (Baker-FRC)
W82-01717

CHARGING FOR WATER SUPPLY IN ENGLAND AND WALES IN THE 1980S,
National Water Council, London (England).
D. Kinnersley.
Aqua, No 3, p 7-9, 1981.

Descriptors: *Water metering, *Water rates, Water policy, Water distribution, *England, *Wales.

Water meters are scheduled for installation in England and Wales beginning April 1981. At present only 5% of consumers, mainly industrial and agricultural, are metered. This system replaces the property tax type of charge in force since Victorian times. Not many shops and businesses have responded to the opportunity for metering, since water is one of their minor concerns. It is expected that only 20% of households will be metered by 1990, because installation and maintenance costs are the responsibility of the consumer. (Cassar-FRC)
W82-01722

CHARGING POLICIES FOR WATER SERVICES,
Leicester Univ. (England). Dept. of Economics.
P. R. Herrington, and M. G. Webb.
Water Services, Vol 85, No 1025, p 341-344, 346-347, July, 1981. 13 Ref.

Descriptors: *Water policy, *User charges, *Marginal costs, Public policy, Costs, Economic aspects, Legal aspects, *United Kingdom.

The objectives for nationalized industries set out in White Papers are applied to the water industry in this consideration of charging policies. The Water Act of 1973 set April 1981 as the date by which water authorities in England and Wales were to levy chages that are non-discriminatory and related to supply costs. Charging policies based on marginal costs are suggested to generate revenues which exceed costs and depreciation. Some of the difficulties with such a project include the problem of measurement of marginal costs, the metering of consumers not now metered, and the satisfaction of externally imposed financial objectives. The present charges are based on the rateable value of consumer's premises and are generally unrelated to the costs which consumers impose on water authorities. Thus, a transition period would be required before the policy based on marginal costs was fully implemented. Customers who would be adversely affected by the policy change would have time to adjust during this transition. (Small-FRC)
W82-01734

THE CALIFORNIA STATE WATER PROJECT--CURRENT ACTIVITIES AND FUTURE MANAGEMENT PLANS.
California State Dept. of Water Resources, Sacramento.
For primary bibliographic entry see Field 6E.
W82-01851

REGULATION FOR ENVIRONMENTAL PROTECTION: THE NANTICOKE INDUSTRIAL COMPLEX, ONTARIO, CANADA,
Waterloo Univ. (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 6E.
W82-02024

WATER: A LOW-PRICED BUT HIGH-COST RESOURCE,
Murdoch Univ. (Western Australia).
C. D. Ditwiler.
Search, Vol 12, No 3/4, p 73-77, 1981. 10 Ref.

Descriptors: *Water policy, *Social aspects, *Pricing, Water allocation, Water conservation, Water resources development, Water resources management, Water law, Planning, Economic aspects, Population dynamics, *Australia, Urban sociology.

In Australia, a dry continent, the government controls the development and allocation of water supplies. The price of water is low relative to its cost. Water conservation, recirculation, and transfer schemes receive little attention. Factors influencing water development strategies are population and economic growth and the trend toward the urban-oriented quality of life. Public concern over water will likely emerge in an indirect way. Problem areas may include the social impacts (financial and nonfinancial) of water supply and sewer system construction and pricing on urban development, the social costs of a uniform price for water of all qualities and at all periods of use (pea and off peak), and the social costs of ignoring declining groundwater tables. The water supply must be managed in an integrated manner on a regional basis in connection with other physical resources such as land and air. (Cassar-FRC)
W82-02061

6D. Water Demand

WATER REQUIREMENTS AND MAN-INDUCED CLIMATE CHANGE,
Utah State Univ., Logan. Dept. of Agriculture and Irrigation Engineering.
For primary bibliographic entry see Field 2D.
W82-01633

A STRUCTURAL SYSTEMS ANALYSIS APPROACH TO DETERMINE OPTIMUM OPERATING POLICIES FOR IRRIGATION AND HYDROPOWER GENERATION FOR WATER RESOURCES, SYSTEMS,
California Univ., Berkeley.
For primary bibliographic entry see Field 6A.
W82-01680

AN ECONOMIC AND INSTITUTIONAL ASSESSMENT OF THE WATER PROBLEM FACING THE TUCSON BASIN,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 6B.
W82-01698

MOROCCO'S LARGEST MULTIPURPOSE SCHEME,
Ministere des Travaux Publics et des Communications, Rabat (Morocco). Direction de l'Hydraulique.
For primary bibliographic entry see Field 8A.
W82-01724

SUSTAINING THE GROWTH OF PROVENCE.
International Water Power and Dam Construction, Vol 33, No 8, p 28-29, August, 1981.

Descriptors: *Irrigation programs, *Water supply development, Provence, *France, Drought, Water demand, Water shortage, Water supply, *Water resources development, Civil engineering.

The Provence Canal Company's attempts to meet the various water demands of the Mediterranean region of France are described. The problem of water is especially crucial in areas bordering on the Mediterranean Sea. The Provence area has always suffered a lack of water, due to geographical and climatic conditions. Tourists were met with a water shortage in the hotels in the area, brought about by a severe drought. Fortunately water is close at hand, coming from the Alps or from the peaks in the Basses-Alps region. The conduit is the Verdon river, which joins with the Durance river in the plains at the bottom of the Rhone valley. Since the Verdon runs from east to west, its water must be artificially channelled toward the coastal region. Shortly after the Second World War, the regional development policy in France took concrete form in a series of five-year plans to provide modern facilities in poorer areas of France. The Provence Canal was built; its first major aim was to halt the economic decline of the rural areas of France, caused by water shortages. The Provence Canal Company won the concession to build a canal in 1963 as part of the overall plan to develop the basin of the Durance river. Swift growth of industry around Marseilles in the past decade has emphasized the need for adequate water supplies. The needs of agriculture are equally extensive, and farming happens to be one of the most essential functions of the region from an economic, social and ecological point of view. Between 1969 and 1976 additional canals were constructed to link Rians to coastal regions situated to the east and west of Toulon. The third section, scheduled for completion in 1985, will consist chiefly of two branches, the Marseilles-East branch and the Var branch leading to the Arcs, and the irrigation of 27,000 additional ha of farmland. (Baker-FRC)
W82-01738

OPTIMIZATION OF WATER RESOURCES FOR IRRIGATION IN EAST JORDAN,
Southampton Univ. (England). Inst. of Irrigation Studies.
For primary bibliographic entry see Field 6A.
W82-01742

IRRIGATION FOR BRAZIL'S POLIGONO DAS SECAS,
Themag Engenharia Ltda., Sao Paolo (Brazil).
For primary bibliographic entry see Field 3F.
W82-01744

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING: ALLEGHENY RIVER BASIN; PENNSYLVANIA-NEW YORK.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-00444, Price codes: A02 in paper copy, A01 in microfiche.
Planning Status Report FERC-0083, Revised March, 1981. 16 p, 3 Fig, 7 Tab.

Descriptors: *Hydroelectric plants, *Water resources development, *Allegheny River basin, Navigation, Reservoirs, Water use, Wild rivers, Flood control, Water pollution control, Planning, Pennsylvania, New York.

This revised report presents updated information on the water resources of the Allegheny River Basin, and information on new and planned developments. There are two existing Federal navigation projects on the river, one for open channel improvement and the other for slack-water improvement. There are 19 reservoirs with storage capacities of over 5,000 acre-feet. Two of these reservoirs are used for hydroelectric power production, and there are nine steam-electric generating plants drawing a total of 792 mgd of water from the Allegheny and its tributaries. There are six outstanding preliminary permits and 13 preliminary permit applications pending for nine hydroelectric projects. Sections of the Allegheny and Clarion Rivers have been disqualified for inclusion in the National Wild and Scenic Rivers System, but an additional section of the Allegheny is being considered. There are about 30 potential hydroelectric project sites in the Allegheny River Basin. Additional needs in the basin addressed by recent studies include flood control, pollution control, water supply and wastewater management. (Brambley-SRC)
W82-01751

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING; COLORADO RIVER BASIN, TEXAS.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Planning Status Report FERC-0079, Revised February, 1981. 17 p, 3 Fig, 6 Tab.

Descriptors: *Hydroelectric plants, *Water resources development, *Colorado River basin, Texas, Reservoirs, Water storage, Cooling water, Water supply, Flood control, Irrigation, Water quality.

This revised report presents updated information on the water resources of the Colorado River Basin, Texas, and information on new and planned developments. There are 32 reservoirs in the basin with storage capacities over 5,000 acre feet constructed or under construction. Six are associated with hydroelectric power generation, while they and the remainder provide for water supplies, flood control, irrigation and steam-electric cooling. There are nine steam-electric plants which use water for cooling, drawing a total of 521 mgd. One steam-electric plant is under construction in the basin. Studies are being conducted to identify sources for additional municipal and industrial water supplies, and to evaluate the needs of the area for enhancing water quality, fish and wildlife, and recreation. Fifteen sites have been identified as potential reservoirs for storage, hydroelectric and flood control purposes, and a further five could be developed as hydroelectric projects. There is one retired hydroelectric plant in the basin. Cooling water requirements are expected to reach 9,000 mgd for electricity production of 213,160 GWh in the year 2000. (Brambley-SRC)
W82-01752

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING; MENOMINEE RIVER BASIN; MICHIGAN, WISCONSIN,
Federal Energy Regulatory Commission, Chicago, IL. Chicago Regional Office.
S. Sawar, and J. Gage.
Available from the National Technical Information Service, Springfield, VA 22161 as FERC-0048, Price codes: A02 in paper copy, A01 in microfiche.
Planning Status Report FERC-0048, Revised August, 1980. 14 p, 2 Fig, 5 Tab.

Descriptors: *Water resources development, *Hydroelectric plants, *Cooling water, River basins, Licensing, Planning, Utilities, *Menominee River basin, Michigan, Wisconsin.

The Menominee, Peshtigo, Oconto, and Escanaba Rivers, along with the smaller Cedar, Ford, and White Fish Rivers, all discharge into the Green Bay portion of Lake Michigan. The average annual rainfall in the basin is about 30 inches, and the average runoff is approximately 12 inches. The river is not subject to destructive floods, and irrigation in the basin is unnecessary. The Menominee River and its tributaries are important water power streams having 20 developments with a total installed capacity of 107,177 kw. A considerable degree of natural flow regulation is provided by the large number of swamps and small lakes in the upper part of the watershed. There are 33 existing hydroelectric projects, with a total installed capacity of 145,271 kw in the basin. Included in the total are 2 plants that belong to non-Federal, publicly-owned utilities, 7 industrial plants, and 24 privately-owned utility plants. There are also two retired hydroelectric projects. There are five fossil-fueled steam-electric generating stations in the basin, all of which employ once-through cooling. There are five potential hydroelectric development sites in the basin and three potential additions to existing hydroelectric powerplants. There are no rivers in the basin area included in the Federal Wild and Scenic River Act, but some of the rivers fall within State wild river programs. There are no pumped storage projects or potential sites in the basin area. There are also no known steam-electric generating

plants proposed for future construction. (Moore-SRC)
W82-01753

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING; LOWER RED RIVER BASIN; ARKANSAS, LOUISIANA, OKLAHOMA AND TEXAS,
Federal Energy Regulatory Commission, Fort Worth, TX. Fort Worth Regional Office.
P. McKee.
Planning Status Report FERC/DOE-0045-6, Revised 1980. 14 p, 3 Fig, 5 Tab.

Descriptors: *Water resources development, *Cooling water, *Hydroelectric power, *Water use, Reservoirs, Consumptive water use, Navigation, Channel improvement, *Red River basin, Arkansas, Louisiana, Oklahoma, Texas.

The Lower Red River basin excludes the Little River and the Ouachita-Black River basins, and is the remainder of the Red River drainage area from below Denison Dam to the Red River juncture with the Mississippi River. Average annual precipitation varies from about 37 inches in the west portion to over 59 inches in the lower east portion. Thirteen major reservoirs, each with a total storage capacity in excess of 70,000 acre-feet, exist or are under construction in the basin. There is no existing hydroelectric capacity in the basin. There has been considerable development in the basin, other than reservoirs, in the interest of flood control, drainage, and bank stabilization. There are 12 fossil-fueled steam-electric generating plants, with capacities of 25 mw or greater, in the basin. The estimated condenser cooling water withdrawn from the sources totaled 29 mgd and the estimated consumption was 13 mgd. Six preliminary permit applications are pending for hydroelectric projects in the basin. There are 12 potential storage reservoirs in the Lower Red River basin. The River and Harbor Act of 1968 authorized the Red River Waterway. The 5 locks downstream from Shreveport are designed to provide a slack water channel 9 ft deep and 200 ft wide from the Mississippi River to Shreveport. The existing channel will be realigned and stabilized as necessary to develop and maintain an efficient navigable channel. Projected steam-electric generation cooling water needs in the basin for 1985 are 57 mgd withdrawn and 33 mgd consumed. (Moore-SRC)
W82-01754

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING; KENNEBEC RIVER BASIN, MAINE.
Federal Energy Regulatory Commission, New York. New York Regional Office.
Planning Status Report FERC-0045/3, Revised 1980. 15 p, 2 Fig, 4 Tab.

Descriptors: *Water resources development, *Hydroelectric power, *Water use, *Reservoirs, Recreation, Industrial water, Water pollution sources, Pulp and paper industry, Navigation, *Kennebec River basin, Maine.

The Kennebec River basin is located in the west central portion of Maine. The total area of the watershed is approximately 5,900 sq mi and constitutes about 18% of the total area of Maine. Annual precipitation over the basin averages about 42 in. with over 50 in. at the higher headwater elevations. Forest products production activities such as logging, wood transportation, and pulp and paper manufacturing dominate land and water use in this area. The Kennebec River basin is a multiple water use area with impoundments used for power generation, industrial water supply, and recreation. There are 17 existing water power installations in the basin with a total installed capacity of 215,620 kw. There are no existing Federal reservoir projects in the Kennebec River basin and none are authorized. Commercial navigation is carried on in the 45 mile tidal portion of the Kennebec River. Pulp and paper mills, the prime cause of water quality degradation, are presently constructing pollution abatement facilities throughout the basin. There are no steam-electric plants located in the area. There are 20 potential hydroelectric developments in the Kennebec River basin, but none is authorized for construction. There are 32 retired hydro plants in the basin with a total capacity of 7,300 kw. (Moore-SRC)
W82-01755

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING; CUMBERLAND RIVER BASIN; KENTUCKY-TENNESSEE.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Planning Status Report FERC-0077, Revised February, 1981. 19 p, 3 Fig, 6 Tab.

Descriptors: *Water resources development, *Hydroelectric plants, *Cumberland River basin, Reservoirs, Flood control, Recreation, Water quality control, Wild rivers, Cooling water, Planning, Kentucky, Tennessee.

This revised report presents updated information on the water resources of the Cumberland River Basin, and information on new and planned developments. There are 10 reservoirs used for hydroelectric power generation, although they also have flood control and recreation functions, and there are eight smaller reservoirs used for flood control, recreation and water quality control. The total hydroelectric installed capacity is 945,860 kw. There are four steam-electric generation plants in the basin, withdrawing 1,645 mgd of cooling water from the Cumberland River. Studies are being conducted on additional flood control, water supply, water quality, erosion control, harbors and waterways, conservation and recreation measures on the Cumberland and its tributaries. There are eight potential hydroelectric power sites and seven retired sites. Designation of segments of the Cumberland River and its tributaries as a National River and Recreation Area or Kentucky Wild Rivers will preclude some of the potential developments. Projected cooling water requirements are estimated to be 1,846 mgd by 2000. (Brambley-SRC)
W82-01756

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING; TOMBIGBEE-WARRIOR RIVER BASIN; ALABAMA-MISSISSIPPI.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Planning Status Report FERC-0078, Revised February, 1981. 17 p, 3 Fig, 7 Tab.

Descriptors: *Water resources development, *Hydroelectric plants, Tombigbee River, Warrior River, Locks, Dams, Reservoirs, Recreation, Water supply, Flood control, Storage capacity, Cooling water, Wild rivers, Planning, Navigation, *Tombigbee-Warrior River basin, Alabama, Mississippi.

This revised report presents updated information on the water resources of the Tombigbee-Warrior River Basin, and information on new and planned developments. All but four of the 18 locks on the rivers have been eliminated or replaced by a series of dams and locks. Construction on the Tennessee-Tombigbee Waterway project is continuing. There are 8 existing storage reservoirs, primarily for recreation and water supply, but three have hydroelectric powerplants which have an installed capacity of 242,625 kw. One of the storage reservoirs also provides flood storage capacity. The six steam-electric generating plants withdraw 1,801 mgd of water from the rivers for cooling purposes. There are six hydroelectric projects with preliminary permits outstanding. The West Fork of the Sipsey Fork and its tributaries have been included in the National Wild and Scenic Rivers System, and other rivers are being considered for inclusion. Seven potential water resource developments have been identified which would provide an additional 271,000 kw of installed capacity. Projected cooling water requirements are estimated to be 878 mgd by 2000. (Brambley-SRC)
W82-01757

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING; BLACK RIVER BASIN, NEW YORK.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Planning Status Report FERC-0081, Revised March, 1981. 14 p, 3 Fig, 5 Tab.

Descriptors: *Hydroelectric plants, *Water resources development, *Black River basin, New York, Reservoirs, Water storage, Wild rivers, Flood control, Water pollution control, Recreation, Planning.

This revised report presents updated information on the water resources of the Black River Basin, and information on new and planned developments. There are 11 major reservoirs in the basin, with a total storage capacity of 183,000 acre-feet. The usable storage is diverted to the New York State Barge Canal via the Black River Feeder Canal System, or used for downstream hydroelectric power generation. There are 25 existing hydroelectric power installations in the basin having an installed capacity of 103,375 kw. Ten potential hydroelectric project sites have been identified and there are 21 retired hydroelectric projects which have potential for redevelopment. While none of the rivers in the basin are included in the National Wild and Scenic Rivers System, two river segments are included in the Nationwide Rivers Inventory, and these segments are included in the New York State Wild and Scenic Rivers System, and other segments are being studied for inclusion. Other needs of the Black River Basin have been identified as pollution abatement, flood control, recreation, and storage for streamflow regulation. (Brambley-SRC)
W82-01758

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING; GRAND RIVER BASIN, MICHIGAN,
Federal Energy Regulatory Commission, Chicago, IL. Chicago Regional Office.
W. Pawlikowski.
Available from the National Technical Information Service, Springfield, VA 22161 as FERC-0065, Price codes: A02 in paper copy, A01 in microfiche.
Planning Status Report FERC-0065, Revised November, 1980. 12 p, 3 Fig, 4 Tab.

Descriptors: *Water resources development, *Hydroelectric plants, *Grand River basin, Michigan, Lake Michigan, Cooling water, Groundwater, Flood control, Financial feasibility, Reservoirs, Nonstructural alternatives, Planning, Navigation, Diversion.

This revised report presents updated information on the water resources of the Grand River Basin, and information on new and planned developments. There are seven hydroelectric plants in the basin with a total installed capacity of 6,134 kw, and another 28 retired plants with an installed capacity of about 12,000 kw. The four steam-electric plants in the basin withdraw 140.3 mgd of water for cooling purposes. Three mgd is drawn from wells; the remainder is drawn from the Grand River. Studies have shown that while flood control by use of reservoirs is feasible in the basin, and that significant flood control benefits would result, reservoirs built solely for this purpose are not economically feasible. Public opinion is against multiple-use reservoirs, so flood control will be achieved by nonstructural measures: flood forecasting, flood plain regulation, floodproofing, and permanent evacuation of flood plains. There are four potential hydroelectric power sites in the basin, and one which could be enlarged, to add 18,700 kw of installed capacity. Studies are being conducted to determine the effects of increased Lake Michigan diversions at Chicago, and the feasibility of extending navigation year round. (Brambley-SRC)
W82-01759

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING; POTOMAC RIVER BASIN; PENNSYLVANIA, MARYLAND, WEST VIRGINIA, VIRGINIA, AND DISTRICT OF COLUMBIA,

Federal Energy Regulatory Commission, New York. New York Regional Office.
C. Goggins.
Planning Status Report FERC-0047, Revised 1980. 15 p, 3 Fig, 6 Tab.

Descriptors: *Water resources development, *Hydroelectric plants, *Potomac River basin, Storage reservoirs, Flood control, Water supply, Recreation, Water quality, Cooling water, Wild rivers, Strip mine wastes, Planning, Mine drainage, Pennsylvania, Maryland, West Virginia, Virginia, District of Columbia.

This revised report presents updated information on the water resources of the Potomac River Basin, and information on new and planned developments. There are 12 water storage reservoirs in the basin with capacities of over 5,000 acre-feet, used for water supply, flood control, recreation and water quality, and there are many smaller flood protection projects. The nine existing hydroelectric installations have a total installed capacity of 11,522 kw. Surface water provides the 2.6 billion gal of cooling water withdrawn daily by the 11 steam-electric plants in the basin. Segments of the Potomac and its tributaries are being considered for inclusion in the National Wild and Scenic Rivers System. Studies are being conducted on the effects of strip mining operations on the rivers, and on possible solutions to abandoned mine drainage problems. Fourteen potential hydroelectric sites have been identified, three of which will also function as storage reservoir sites. An additional 12 sites have been identified for storage reservoirs. Cooling water withdrawals are estimated to be 2.55 billion gal/day in 2000. (Brambley-SRC)
W82-01760

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING: UPPER ARKANSAS RIVER BASIN; COLORADO, KANSAS, AND NEW MEXICO.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Available from the National Technical Information Service, Springfield, VA 22161 as FERC-0060, Price codes: A02 in paper copy, A01 in microfiche.
Planning Status Report FERC-0060, Revised August, 1980. 19 p, 3 Fig, 6 Tab.

Descriptors: *Water resources development, *Hydroelectric plants, *Arkansas River basin, Reservoirs, Flood control, Water supply, Irrigation, Diversion structures, Dams, Cooling water, Wells, Colorado, Kansas, New Mexico.

This revised report presents updated information on the water resources of the Upper Arkansas River Basin, and information on new and planned developments. Reservoir development in the basin has been primarily for flood control with some hydroelectric development. The Trinidad Lake project for flood control, and the Pueblo Dam and Reservoir for flood control, hydroelectric power, water supply, and irrigation are completed. There are five hydroelectric projects in the basin, complete or under construction, with a total installed capacity of 207,310 kw. The Pueblo Reservoir is the terminal reservoir of the Fryingpan-Arkansas project which consists of facilities designed primarily to divert water from the Western Slope of the Rocky Mountains to the water-short areas on the Eastern Slope. The major facilities are six storage dams and reservoirs, 16 diversion structures, and nine tunnels. There are 15 steam-electric plants in the basin, with an installed capacity of 2,921,000 kw, which withdrew 66 mgd of water from the rivers or wells for cooling purposes. This volume is expected to rise to 69 mgd in 2000. There are nine potential sites for hydroelectric power development, with a total installed capacity of 269,200 kw. There is potential for pumped storage development, and potential for further flood control measures. (Brambley-SRC)
W82-01761

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING; WESTERN GREAT LAKES TRIBUTARIES; MICHIGAN, WISCONSIN, INDIANA AND ILLINOIS.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Planning Status Report FERC-0045-1, Revised 1980. 17 p, 3 Fig, 7 Tab.

Descriptors: *Water resources development, *Hydroelectric plants, *Great Lakes tributaries, Water pollution, Lake Michigan, Reservoirs, Cooling water, Navigation, Planning, Water pollution sources, Wilderness areas, Natural waters, Rivers, Michigan, Wisconsin, Indiana, Illinois.

This revised report presents updated information on the water resources of the Western Great Lakes Tributaries, and information on new and planned developments. Pollution is becoming a problem in the water resources of the area, with Lake Michigan most seriously affected. Domestic and industrial wastes are the prime pollutant source, but agricultural and urban runoff are significant. There are 16 hydroelectric projects in the area and six reservoirs for storage purposes only. There are 24 steam-electric plants with an installed capacity of 11,421 MW, which withdraw a total of 6,826 mgd of water for cooling purposes. Studies are being conducted to determine the feasibility of extending navigation year-round in the Great Lakes, and on a number of channel and harbor improvements. Seven sites have been identified as potential hydroelectric sites, and there are 23 retired sites which may have potential for redevelopment. Federal and State Natural Areas, State Wilderness Areas and State Natural Rivers designations, actual and potential, will preclude hydroelectric power development. Cooling water requirements are expected to be 2,296 mgd by 2000. (Brambley-SRC)
W82-01762

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING: PENOBSCOT RIVER BASIN, MAINE,
Federal Energy Regulatory Commission, New York. New York Regional Office.
M. Janiszewski.
Available from the National Technical Information Service, Springfield, VA 22161 as FERC-0056, Price codes: A02 in paper copy, A01 in microfiche.
Planning Status Report FERC-0056, Revised August 1980. 14 p, 2 Fig, 5 Tab.

Descriptors: *Water resources development, *Hydroelectric power, *Cooling water, Water demand, Water use, Water storage, Consumptive water use, Planning, *Penobscot River basin, Maine.

The Penobscot River basin is the largest in Maine and the second largest in New England. The average annual precipitation in the basin is 41 inches. There is an abundance of water storage facilities in the basin in the form of lakes, reservoirs, and ponds. There are 20 existing hydropower developments in the basin including five storage projects that regulate streamflow for the benefit of downstream hydropower generation. The developments have a total installed capacity of 152,227 kw. The capacity includes 30,870 kw as the equivalent of 41,388 horsepower in mechanical drive units. The oil-fired Graham Station is the only steam-electric plant located in the basin. The average amount of water withdrawn for 1977 was 1.4 mgd with negligible consumption. There are no potential reservoirs or power projects in the basin which have been authorized for Federal construction. There are significant potentials for hydroelectric power developments. In addition, the 21 retired hydroelectric projects have potential for redevelopment due to changing economic and environmental considerations. The Allagash Wilderness Waterway is a component of the Wild and Scenic Rivers System, but affects no known potential hydroelectric power development. The East and West Branches of the Penobscot River have been under study for inclusion in the system, which would preclude future development of hydroelectric power in the East and West Branches. In 1985, the cooling water withdrawn by Graham Station is estimated at 19 mgd with negligible consumptive use. The estimated annual cooling water withdrawal for steam electric generation in 2000 is estimated at 111 mgd and consumptive use at 1 mgd. (Moore-SRC)
W82-01763

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING: ALTAMAHA RIVER BASIN, GEORGIA,
Federal Energy Regulatory Commission, Atlanta, GA. Atlanta Regional Office.
R. Crisp, and W. Duke.
Planning Status Report FERC-0055, Revised August, 1980. 13 p, 2 Fig, 9 Tab.

Descriptors: *Water resources development, *Hydroelectric power, *Cooling water, *Water demand, Water supply, Industrial water, Flood control, Consumptive water use, Water use, Waste disposal, *Altamaha River basin, Georgia.

The Altamaha River, which drains an area of 14,564 sq mi entirely within Georgia, is formed by the confluence of the Ocmulgee and Oconee Rivers 137 mi above the mouth. The average annual precipitation over the basin is approximately 48.9 in. Several of the basin's major industries such as pulp and paper, mineral processing, textiles, chemicals, and food processing place heavy demands upon water resources, either for supply or waste disposal. Existing water resources developments within the Altamaha basin include 17 relatively small flood prevention reservoirs developed by the Soil Conservation Service; 5.5 mi of flood protection works at Macon; the unlicensed, non-Federal run-of-river hydroelectric developments at Milstead, Juliette, Snapping Shoals, and Barnett Shoals; and four licensed non-Federal hydroelectric developments. The 8 hydroelectric projects within the basin have a total installed capacity of 389,532 kw. The four retired hydroelectric projects have a total installed capacity of 6,230 kw. Water supply for municipal use is obtained principally from surface water sources. There are two fossil-fueled and one nuclear-fueled stream-electric plants with a total generating capacity of 3,627 mw. The estimated 1978 total cooling water withdrawn is 851 mgd, and the total consumption is 23 mgd. Plant Scherer is the only steam-electric plant being constructed in the basin. The estimated total cooling water withdrawal is 29 mgd, and consumption is 19 mgd. There is substantial undeveloped hydroelectric power potential in the Altamaha River basin. Certain segments of rivers within the basin have been proposed for consideration for inclusion in the National Wild and Scenic Rivers System. (Moore-SRC)
W82-01764

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING; SANTEE RIVER BASIN; SOUTH CAROLINA-NORTH CAROLINA.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Planning Status Report FERC-0073, Revised March 1981. 17 p, 3 Fig, 7 Tab.

Descriptors: *Water resources development, *Hydroelectric plants, *Santee River basin, Diversion channels, Harbors, Shoals, Dredging, Flow rates, Cooling water, Planning, Navigation, North Carolina, South Carolina.

This revised report presents updated information on the water resources of the Santee River Basin, and information on new and planned developments. There are 39 existing hydroelectric projects in the basin, and one under construction, with a total installed capacity of 1,858,426 kw. The plant underconstruction is the St. Stephen project, part of the Cooper River Rediversion project. This project will return much of the flow of the Santee River to its original channel instead of the diverted route into the Cooper River. The aim is to reduce the shoaling problem and increased dredging of Charleston Harbor which resulted from the greatly increased flow following the diversion. There are 23 potential hydroelectric projects in the basin and 43 retired hydroelectric sites which have potential for redevelopment. Four of these sites are being investigated. There are 11 steam-electric plants which withdraw 2,182 mgd of water for cooling purposes; this volume is expected to rise to 3,074 mgd by 2000. Modifications will be made to Charleston Harbor to construct and maintain a 40 ft depth, and a 38 ft navigation channel will be

dredged and maintained on the Shipyard River. (Brambley-SRC)
W82-01765

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING: TENNESSEE RIVER BASIN; VIRGINIA-TENNESSEE-NORTH CAROLINA-MISSISSIPPI, GEORGIA-KENTUCKY-ALABAMA.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation. Planning Status Report FERC-0074, Revised March 1981. 15 p, 3 Fig, 6 Tab.

Descriptors: *Water resources development, *Tennessee River basin, *Hydroelectric plants, Flood control, Navigation, Cooling water, Water use, Wild rivers, Resources management, Virginia, Tennessee, North Carolina, Mississippi, Georgia, Kentucky, Alabama.

This revised report presents updated information on the water resources of the Tennessee River Basin, and information on new and planned developments. The estimated population of the area in 1978 was 3,600,000. There are 48 existing hydroelectric projects within the Tennessee River Basin, providing a total installed capacity of 5,333,050 kw. Twenty-nine are projects of the Tennessee Valley Authority (TVA), with a capacity of 4,794,250 kw. The TVA projects are operated primarily for flood control and navigation and produce over 16 billion kwh of electricity. There are nine steam-electric generating plants in the basin, with cooling water withdrawal rates of 4,790 mgd. There are six outstanding Federal Energy Regulatory Commission licenses covering nine developments and eight applications pending covering ten developments. The Obed River and its tributaries have been made part of the National wild and Scenic rivers System, and the Nolichucky River is being studied for inclusion. A comprehensive inventory of all water and land resource projects, complete, in progress, or proposed, is being conducted to aid in the increased coordination among the various agencies involved with water resource management. Seventeen potential water resource developments for flood control, hydroelectric power or other purposes are identified and 32 sites, now closed, are identified as potential hydroelectric power sites. The Tennessee-Tombigbee Waterway project is scheduled for completion in 1986. (Brambley-SRC)
W82-01766

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING, SAGINAW AND AU SABLE RIVER BASINS AREA, MICHIGAN.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation. Available from the National Technical Information Service, Springfield, VA 22161 as FERC-0061, Price codes: A02 in paper copy, A01 in microfiche. Planning Status Report FERC-0061. Revised 1980. 12 p, 2 Fig, 5 Tab.

Descriptors: *Water resources development, *Hydroelectric power, *Cooling water, *Wild rivers, River basins, Thermal powerplants, Licensing, *Saginaw River basin, Au Sable River basin, Michigan, Lake Huron.

The Saginaw and Au Sable River basins area lies entirely within Michigan on the west shore of Lake Huron and comprises approximately 3% of the Great Lakes drainage area. Annual rainfall in the basin averages about 28 inches. The average discharge of the Saginaw River at its mouth is about 4,000 cu ft/s, while the average discharge of the Au Sable is about 1,700 cu ft. There are 11 existing hydroelectric powerplants in the Saginaw and Au Sable River basins with a total installed capacity of 52,160 kw. All of the powerplants are owned and operated by investor-owned utilities except for the 360 kw St. Louis plant on the Pine River. There are seven fossil-fuel steam-electric generating stations in the Saginaw and Au Sable River basins, and a nuclear steam-electric plant under construction. All but two of the fossil-fueled plants employ once-through cooling. The Au Sable River is presently under study for inclusion in the National Wild and Scenic Rivers System. Four potential hydroelectric power developments and the possible addition to an existing project would be prohibited by wild and scenic river designation. The total estimated capacity foregone would be an estimated 58,700 kw and an average annual generation output of about 163,900,000 kwh. (Moore-SRC)
W82-01767

ADDENDUM TO: SOURCES OF POWERPLANT COOLING WATER IN THE DESERT AREA OF SOUTHERN CALIFORNIA--RECONNAISSANCE STUDY,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 6B.
W82-01773

HYDROPOWER VS. SALMON: THE STRUGGLE OF THE PACIFIC NORTHWEST'S ANADROMOUS FISH RESOURCES FOR A PEACEFUL COEXISTENCE WITH THE FEDERAL COLUMBIA RIVER POWER SYSTEM,
Lewis and Clark Coll. Portland, OR. Northwestern School of Law.
For primary bibliographic entry see Field 6E.
W82-01804

FOOD AND ENERGY PRODUCTION: CONJUNCTIVE WATER PLANNING,
Wright Water Engineers, Inc., Denver, CO.
For primary bibliographic entry see Field 3C.
W82-01856

PRESERVING INSTREAM FLOWS IN OREGON'S RIVERS AND STREAMS,
For primary bibliographic entry see Field 6E.
W82-01871

GULF OF MEXICO: A SOCIOECONOMIC VIEW OF COMPETING RESOURCES,
For primary bibliographic entry see Field 6B.
W82-01901

PERSEVERANCE PRODUCES COUNTY PARK,
York Water Co., PA.
W. T. Morris.
Public Works, Vol 111, No 3, p 62-63, March, 1980.

Descriptors: *Legal aspects, *Parks, Recreation facilities, Public lands, Reservoirs, Management planning, Decision making, Planning, Conjunctive use, Case studies, Pennsylvania.

Copperation between government and private enterprise produced success in the William H. Kain County Park, located in York County, Pennsylvania. An agreement was reached between the water company and the commissioners of the area which allowed the county to use free of charge the reservoir lands and waters of both lakes which serve as impoundments for the water company. The agreement specifies that although the area is to be used for recreational purposes, the prior and overriding use is for water utility purposes. No activity is permitted which would in any way interfere with that use. In return for this usage, the county agreed not to erect a dam, lake or impoundment, or otherwise obstruct the flow of the East Branch of Codorus Creek and tributaries upstream from Lake Redman. A supplemental agreement was also issued which licensed the county to use about 400 to 500 acres of other company lands for recreational purposes under the same conditions. Many problems remained involving legal language, and various suggestions were made to surmount these difficulties. Finally, acceptable agreements were reached. (Baker-FRC)
W82-01932

WATER QUALITY AND THE DEMAND FOR RECREATION,
Illinois State Univ., Normal. Dept. of Economics.
G. Blomquist, and G. Fishelson.
International Journal of Environmental Studies, Vol 14, No 4, p 317-321, 1980. 2 Tab, 12 Ref.

Descriptors: *Water quality, *Recreation demand, *Parks, Regression analysis, *Illinois, Dissolved oxygen, Coliforms, Economic aspects, Evaluation.

Weak responses in demands for recreation were detected for changes in water quality parameters. The attendance at 74 Illinois state parks and recreation areas in 1976 was analyzed. Variables employed were water quality, facilities, nonwater attributes, and distance. Regression analysis showed that the number of annual visits depends on travel costs, price of complements and substitutes, attributes of the park (museums, boating, horseback riding, and hunting), and water quality. Dissolved oxygen was not significant at any reasonable level, but fecal coliforms above 200 per ml was significant at the 90% level. The shortcomings of this analysis were: (1) length of visitor stay was not considered, (2) water quality data was not sufficiently detailed, and (3) annual median water quality was used, not seasonal values. (Cassar-FRC)
W82-01942

LOGISTICS OF FARM WATER SUPPLY.
For primary bibliographic entry see Field 6A.
W82-02037

WANTED: WATER FOR DEVELOPMENT,
P. Harrison.
Ambio, Vol 9, No 3-4, p 202, 1980.

Descriptors: *Developing countries, *Water supply development, *Sanitation, *Public health, Human diseases, International Drinking Water and Sanitation Decade, United Nations, Water pollution effects.

An investment of 140,000 million dollars will be required over ten years to meet the goals set by the International Drinking Water and Sanitation Decade. A World Health Organization survey in 1975 found that three out of every five people in poor countries were without adequate water, and two out of three had inadequate sanitation. Illness and infant mortality in the Third World is due in large part to this situation. Better water and sanitation can cut skin and eye infections and diarrhea from 50 to 100%. Schistosomiasis can cut workers' productivity by 15 to 80%, and malaria is a major cause of absenteeism at work and at school. Both of these are water related diseases. The situation in Bangladesh is improving after the installation of 50,000 tubewells, but only one house in 20 has a sanitary latrine. To reach the 1990 goal, Third World countries will have to divert more resources to rural areas, which contain two thirds of the population but have received only 17% of the investment in water and sanitation. (Small-FRC)
W82-02088

6E. Water Law and Institutions

PARISH IS NOT LIABLE FOR SUBSIDENCE.
Public Works, Vol 112, No 9, p 64-65, September, 1981.

Descriptors: *Dredging, *Legal aspects, Subsidence, Canals, Maintenance, Land tenure, Land rights, Liability, *Drainage canals, *Louisiana.

A drainage canal was dredged in Louisiana, with the result that a property owner brought suit for damages for loss to his property. The canal crossed and bounded his land. The land owner claimed that as a result of the dredging, his land was subject to both erosion and subsidence. The solid land, it was claimed, applied pressure and the silt below oozed out. The trial court entered a judgment for the defendant, finding no causal connection between the depth of the Bayou and the subsidence. Another court did find a causal connection, claiming that a relationship did exist between the piercing of the clay layer and subsidence. However, the Court could not find the Parish either negligent nor strictly liable. Proof was provided that the canal had not in fact been

dredged, but rather had only been brushed clean, without disturbing the clay layer. (Baker-FRC)
W82-01603

THE NATIONAL WATER POLICY REVIEW AND WESTERN WATER RIGHTS LAW REFORM: AN OVERVIEW,
Nebraska Univ., Lincoln.
J. D. Aiken.
Nebraska Law Review, Vol 59, No 2, p 327-344, 1980. 73 Ref. OWRT-C-80138(8412)(1).

Descriptors: *Water policy, *Water rights, *Legal aspects, Nebraska, Colorado, Washington, California, Irrigation water, Water use efficiency, Groundwater management, Water management, Groundwater mining, River regulation, Regulations, Well regulations, Water law, Judicial decisions, Legislation, Western States.

Although economic development has traditionally been accepted as a primary objective in the formulation of state and federal water policies, the achievement of most economic development objectives has resulted in increased public concern regarding the protection and preservation of natural resources. Inconsistent federal water policies have resulted from the enactment of federal environmental legislation which conflicts with existing reclamation, flood control, and hydroelectric power production programs. Water development programs are also being subjected to closer budgetary examinations than in the past. The proposed major objectives of a review and development of a national water resources management policy initiated by President Carter in 1977 included modification of state water laws to meet the environmental protection and water use efficiency objectives. Strong protests by the western states resulted in the elimination of this reform in state water rights laws as an explicit objective. However, several existing innovative water policies adopted by some western states may serve as models for state and federal officials searching for water policy alternatives. These include farm-level irrigation water use efficiency programs in Nebraska; groundwater mining regulations in Nebraska; minimum streamflow legislation in several western states; procedures for resolving conflicts between surface and groundwater users in Colorado; and policies for conjunctive management of groundwater and surface water in Washington and California. These water law developments are described, and their relevance to other western states is evaluated. Social, economic, and political objections to reform objectives constitute the major obstacle to water law reforms. Alternatives which accommodate development as well as reform objectives are both necessary and possible. Better integration of federal water programs is perhaps the most important water policy contribution the federal government could make at this time. (Carroll-FRC)
W82-01659

LEGAL CHALLENGE OF THE UNGAGED WATERSHED,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W82-01664

THE NATIONAL COMMISSION ON WATER QUALITY: A CASE STUDY IN CONGRESSIONAL POLICY ANALYSIS,
Texas Univ. at Dallas, Richardson.
For primary bibliographic entry see Field 6B.
W82-01669

REGULATING THE QUALITY OF DRINKING WATER: AN ECONOMIC ANALYSIS OF THE SAFE DRINKING WATER ACT OF 1974,
Wisconsin Univ.-Madison.
For primary bibliographic entry see Field 5G.
W82-01691

HYDROPOWER VS. SALMON: THE STRUGGLE OF THE PACIFIC NORTHWEST'S ANADROMOUS FISH RESOURCES FOR A PEACEFUL COEXISTENCE WITH THE FEDERAL COLUMBIA RIVER POWER SYSTEM,
Lewis and Clark Coll. Portland, OR. Northwestern School of Law.
M. C. Blumm.
Environmental Law, Vol 11, No 2, p 211-300, Winter, 1981. 461 Ref.

Descriptors: *Water use, *Legal aspects, *Hydroelectric power, *Fisheries, Salmon *Anadromous fish, Hydroelectric plants, Powerplants, *Columbia River, Water demand, Water supply, Resources development, Resources management.

This article documents the inherent conflicts between employing Columbia Basin water projects primarily to maximize power production and preserving the basin's depleted anadromous fish runs. The legislative history of dam authorizations was also surveyed, and no congressional intent was uncovered that hydropower should dominate project operations to the exclusion of the fisheries. There was strong evidence, on the contrary, that Congress intended that hydropower generation and fisheries preservation should coexist. However, the decision making structure in government project operations has overlooked this intent, and fish and wildlife protection has not been given equal consideration in the planning stages. A general overhaul of the decision making structure is needed. A restructing can be accomplished through compliance with the spirit and letter of the National Environmental Policy Act and the Fish Wildlife Coordination Act. Supplying sufficient streamflows to protect anadromous fish runs will necessitate changes in regional hydroelectric consumption. The fundamental issue in this regard is the lack of effective mechanisms designed to modify peak load demands placed on the hydropower resource. More systematic investigation is needed of alternative, less costly ways of simultaneously meeting hydroelectric energy demands and protecting fisheries. The economic value of the salmon produced in the Columbia River makes it essential that some solution to the problem be found before this source of income is extinguished. (Baker-FRC)
W82-01804

STATIONARY SOURCE POLLUTION POLICY AND CHOICES FOR REFORM,
Resources for the Future, Washington, DC.
W. Harrington, and A. J. Krupnick.
Natural Resources Journal, Vol 21, No 3, p 539-564, July, 1981.

Descriptors: *Water pollution control, *Regulations, *Economic aspects, Legal aspects, Political aspects, Effluent standards, Permits, Water law, Water quality standards, Water policy, Environmental effects, Air pollution, Administrative agencies, Cost effectiveness.

Proposed reforms of the water and air pollution policies formulated in the early 1970's are described. Procedural reforms change the procedures used to develop and implement environmental regulations and can reduce costs. Using 2 or 3 contractors to provide background information for a regulation would be initially more costly but, in the long run, might reduce total costs by producing more reliable information and regulations more acceptable to industry. Greater subcategorization (tailor-made regulations for individual industries) could promote competition by preserving some of the older plants and help hold down the inflation rate. On the other hand subcategorization can reduce productivity by preserving obsolete plants. Permit reform measures include extending permit life, improving coordination between federal and state agencies with respect to permits and regulations, establishing a regulatory clearing house, and initiating a one-step permitting process. Cost effectiveness standards would equalize marginal abatement costs and minimize costs of obtaining the resulting reductions in aggregate emissions; this has several problems, however. Innovation waivers could be granted to allow time to work out difficulties in new abatement technologies. Substantive reforms have begun to supplant the technology-based approach in some states and in EPA planning. These include the bubble policy, banking emissions allowances for future expansion or as an offset, marketable pollution permits, and effluent charges. Proponents of these reforms claim that desired environmental quality may be obtained at lower economic costs. Opponents fear that any change represents a retreat from the nation's commitment to environmental quality. (Cassar-FRC)
W82-01847

THE CALIFORNIA STATE WATER PROJECT--CURRENT ACTIVITIES AND FUTURE MANAGEMENT PLANS.
California State Dept. of Water Resources, Sacramento.
Bulletin 132-80, October 1980. 197 p. 12 Fig, 12 Tab, 5 Append.

Descriptors: *Water management, *Comprehensive planning, Structural engineering, Environmental engineering, Canal design, *Multiobjective planning, *Economic aspects, Canal construction, Future planning, Open channels, Legislation, Water policy, Projections, *California.

Legislation that provides a comprehensive plan for meeting the water needs of the State Water Project (SWP) through the year 2000 was approved by the California Legislature in 1980. SB200 authorizes (1) the Peripheral Canal, a proposed 43-mile-long canal to move water across the Sacramento Delta to aqueducts serving southern California; (2) construction of facilities to maintain Suisun Marsh as a habitat for birds and wildlife in the Delta; (3) ground water storage in lieu of comparable surface storage; and (4) additional storage projects in the Sacramento Valley system. Additionally, feasibility studies on enlarging Shasta Dam will be integrated into detailed studies of surface storage alternatives included in SB200. Assembly Constitutional Amendment 90, approved by the Legislature, contains Delta-San Francisco Bay guarantees and protection for the North Coast wild rivers. SWP components and implementation plans for additional segments are discussed in terms of future water supply plants, future costs of water service, negotiations for joint operating agreement of SWP and the federal Central Valley Project, the interagency drainage program, and other matters. Also discussed are future construction costs, operating costs, and project financing descriptions that include construction expenditures, capital requirements, financing, operating revenues, and power costs. Capital requirements through 2000 are estimated at $10.1 billion. Among the steps taken to ensure power supply for the SWP through the year 2000 are the development of 3 geothermal power plants, a geothermal biomass plant, 15 hydroelectric power plants, and contracting for joint ownership of a coal-fired power plant. (Garrison-Omniplan)
W82-01851

POLLUTION CONTROL: CHANGING APPROACHES,
Experimental Research and Technology, Inc., Concord, MA.
S. H. Schroeder.
Environmental Science and Technology, Vol 15, No 11, p 1286-1291, November, 1981.

Descriptors: *Legislation, *Regulations, *Water pollution control, Superfund, Clean Water Act, Federal Water Pollution Control Act, Resource Conservation and Recovery Act, Legal aspects, Permits, Liability, Water quality control, Water quality standards, Effluent standards.

The evolution of pollution control legislation in the past 10 years is discussed. A major difficulty has been the gap between regulations and the scientific knowledge necessary for implementation. Several approaches have been used in formulating pollution control programs. The Federal Water Pollution Control Act (FWPCA), 1972, was technology-based, requiring a minimum level of control according to available technology. This simplified the regulatory process, but did not consider local environmental effects. Ambient water quality standards were then added. The implementation was delegated to the EPA and the states, resulting in a regulatory tangle. In 1977 the FWPCA was

amended and its name changed to the Clean Water Act. The NRDC Consent Decree was adopted, formalizing the technology-based approach, with the exception of exemptions for thermal and publicly owned treatment works effluents in some cases. The Resource Conservation and Recovery Act requires definition of hazardous substances and cradle-to-grave standards of handling, to be implemented by permit. The Act poses great difficulties in decision making for permit writers and is concerned with all aspects of the environment (air, water, etc.). The Superfund, in contrast to previous legislation, is concerned with liabilities. Harmful releases are cleaned up and liabilities assigned to the polluters. Problems arise in assigning liability because of uncertain cause-effect relationships and because of the long time lapse between cause and observed effect in many situations. The fund covers only government cleanup effort costs, not individual damages for death, disease, or property damage. A crucial element in the success of any pollution control program is the ease of implementation, given the uncertainty of knowledge of toxic materials and their effects. The author urges participation by the technical community in legislative and regulatory processes to prevent adoption of unrealistic programs. (Cassar-FRC)
W82-01870

PRESERVING INSTREAM FLOWS IN OREGON'S RIVERS AND STREAMS,
C. C. Sherton.
Environmental Law, Vol 11, No 2, p 379-419, Winter, 1981. 247 Ref.

Descriptors: *Instream flow, *Legal aspects, Water supply development, Water resources development, Water management, Resources management, *Oregon, State jurisdiction.

The growing population and increasing demands of industry in Oregon project ever increasing water needs. However, the availability of water in that state varies greatly by geography and season. This paper examines means to preserve instream flows that are being or could be used within the general structure of Oregon's water laws. The history and basic principles of Oregon water law are reviewed, past and potential use of existing provisions of Oregon water laws in preserving instream flows are examined, several means of preserving instream flow that have been proposed or are in use elsewhere are analyzed for their potential use in Oregon, and an effective and politically feasible strategy is presented for preserving instream flows in Oregon. The current system of planning for the use of water resources in Oregon and the appropriation permit system do not provide adequate protection to instream flows for uses such as fishing, recreation, hydroelectric power, and pollution abatement. Certain administrative and minor statutory changes could improve the operation of the existing system. However, there is a need to recognize water rights for instream uses on a par with water rights for consumptive uses. The major recommendation from this study is that Oregon recognize appropriative water rights for instream uses. Recognition of such rights would in most cases be the most effective means of preserving instream flows in streams which have unappropriated water, and of returning instream flows to streams where all the water has been appropriated for consumptive use. This recognition can be achieved by amending Oregon's statutes governing water permits, and is not incompatible with the appropriations doctrine as developed in Oregon. Only certain agencies should have the power to apply for instream appropriations. (Baker-FRC)
W82-01871

PERSEVERANCE PRODUCES COUNTY PARK,
York Water Co., PA.
For primary bibliographic entry see Field 6D.
W82-01932

THE HAZARDS OF HAZARDOUS WASTE MANAGEMENT,
Maryland Dept. of Natural Resources, Annapolis.
J. B. Coulter.
Industrial Wastes, Vol 26, No 5, p 26, 28-29, September-October, 1980.

Descriptors: *Hazardous materials, *Waste management, *Water pollution sources, Wastes, Waste storage, Incineration, Waste disposal, Groundwater pollution, Organic compounds, Poisons, Toxins, Landfills, *Sharptown, Maryland.

In Sharptown, Maryland, a small business man established an operation to recycle waste oil. After the business failed, it was discovered that the waste oil contained a medley of hazardous substances such as PCBs in concentrations as high as 310,000 ppm. The man was heavily fined, and the townspeople became increasingly alarmed over the possibility of various emergencies arising out of these chemicals. Tests at that time showed no contamination of the groundwater supplies, but there was no test available to verify that contaminating materials were not presently moving through the soil on their way to the groundwater sources. Models were constructed and studies performed to determine the best course of action should any spillage or leakage of materials be noted. A federal-state response team endorsed a decision to move the wastes from Sharptown to some other location where they could be safely stored pending destruction by incineration at an EPA approved facility which would be constructed. After several legal suits and countersuits, the transfer of the hazardous materials was made, and the material is now under constant guard until the incinerators can be completed. It is suggested that hazardous waste managers should take constructive measures, which does not include downplaying the problem or understating the severity of it. Landfills should be avoided if at all possible. Actions which are dangerous must be outlawed. Safe facilities for hazardous waste must be established. A meaningful legal definition of the term hazardous waste is sought. (Baker-FRC)
W82-01940

WATER SANITATION LEGISLATION REGARDED AS THE BASIS OF WATER QUALITY MONITORING,
Institute of General and Municipal Hygiene, Moscow (USSR).
G. N. Krasovsky, N. N. Litvinov, Z. I. Zholdakova, and L. J. Vasiukovitch.
Water Science and Technology, Vol 13, No 7, p 391-392, 1981.

Descriptors: *Water quality standards, *Reservoirs, *Effluent standards, Legal aspects, Regulations, Legislation, Water supply, Standards, Drinking water, Multipurpose reservoirs, Monitoring.

A unified three-element regulatory system for water quality monitoring is suggested for guaranteeing the safety of drinking water from open reservoirs used for domestic and recreational purposes. The three parts are: drinking water standards, water reservoir quality standards, and sewage effluent conditions. Each part states a maximum allowable concentration. Toxicological, organoleptic, and epidemiological criteria must be added to the conventional water reservoir quality standards to ensure safety. (Cassar-FRC)
W82-01990

STREAMLINED REGULATIONS COULD HELP MAKE NEW STORMWATER MANAGEMENT CONCEPTS PART OF THE TRADITION,
For primary bibliographic entry see Field 4A.
W82-02000

REGULATION FOR ENVIRONMENTAL PROTECTION: THE NANTICOKE INDUSTRIAL COMPLEX, ONTARIO, CANADA,
Waterloo Univ. (Ontario). Dept. of Geography.
J. G. Nelson, J. C. Day, and S. Jessen.
Environmental Management, Vol 5, No 5, p 385-395, September, 1981. 1 Fig, 3 Tab, 41 Ref.

Descriptors: *Environmental protection, *Regulations, *Industrial plants, Monitoring, Economic aspects, Industrial wastes, Water pollution sources, Water pollution effects, *Lake Erie, Canada.

The effectiveness of the environmental protection regulatory system for the $2.2 billion iron and steel plant, oil refinery, and thermal generating station planned for the Nanticoke Industrial Complex was evaluated. Literature reviews and environmental impact studies performed by various industries and government agencies were assessed. In general, the project and its various impacts were regulated and managed reasonably efficiently and without significant known impacts to date. Industry has suggested that the costs of the environmental controls have been too high. In the future, continuous monitoring, more comprehensive research, and better overall environmental management will be required if the benefits of Nanticoke are not to be achieved at potentially avoidable costs to fishing, agriculture, and tourism. Attention must be paid to the accumulative impact of the complex. (Small-FRC)
W82-02024

THE SEWERAGE POLICY OF THAMES WATER,
Thames Water Authority (England).
J. L. Dakers.
Effluent and Water Treatment Journal, Vol 20, No 1, p 29-31, January, 1980. 2 Tab.

Descriptors: *Sewerage, *Thames Water Authority, *Water policy, *Priorities, Wastewater treatment, Capital costs, Water quality, Great Britain.

The Thames Water Authority provides water services for 12 million people over an area of 13,100 sq km. Sewerage tasks are mostly performed by the district councils under contract with the Authority. In view of limited resources, a table of priorities for capital expenditures was established. There are five classes. Class one concerns public health, expansion in housing and industry. Class two involves maintaining or replacing existing systems and allowing for increased demand by present consumers. Classes three, four, and five concern improvements in service and water quality and first time services. Details of the Water Authority responsibilities are given. Alternatives in selecting a sewage disposal system and the policies for first time sewerage are presented. (Cassar-FRC)
W82-02040

STRUCTURAL ASPECTS OF THE WATER SUPPLY IN THE FEDERAL REPUBLIC OF GERMANY,
Verband der Deutschen Gas- und Wasserwirtshchaft e.V./Deutscher Verein des Gas und Wasserfaches e.V., Bonn (Germany, F.R.).
H-J. Arens.
Aqua, No 1, p 13-14, 1981.

Descriptors: *Water management, *Political aspects, *Federal Republic of Germany, *Water supply, Water resources development, Water use, Germany.

Political and legal aspects of the water supply system in the Federal Republic of Germany are discussed, together with some general aspects of water production and water utilization. Federal German legislative power in the field of water management is limited to basic regulations. Individual Laender, or states, are charged with granting approvals and licenses for water use, protecting waters against pollution and rehabilitating polluted waters, and establishing water management plans. Local authorities are responsible for securing water supplies for their areas and disposing of waste waters. Although there are about 7,300 public water supply undertakings in the country, about 55 percent of the water quantity delivered is produced by a very few large undertakings. About 52 percent of the water is delivered by municipally-owned waterworks, with joint stock companies and private limited companies delivering the rest. There is increasing cooperation between neighboring communities in water supply management. Cooperation in the form of long-distance water suppliers is also becoming more common. Over 60 percent of the total production of the public water supply comes from groundwater, although there is a tendency to produce more surface water in congested areas. While consumption of public water

supplies by households and small businesses increased by 36 percent from 1970 to 1979, use by industry dropped by about 25 percent, largely as the result of increased recycling of water and other water conservation measures. In addition, industry produces large quantities of water for its own supply. Competition between the public water supply and industry for water resources is increasing, requiring more regional planning of water management. (Carroll-FRC)
W82-02066

STREAM POLLUTION IN HONG KONG - AN APPRAISAL,
Hong Kong Univ. Dept. of Botany.
For primary bibliographic entry see Field 5B.
W82-02084

INTERNATIONAL COOPERATION TO PROTECT THE BALTIC,
Ministry of Agriculture, Stockholm (Sweden). Environmental Div.
B. Hagerhall.
Ambio, Vol 9, No 3/4, p 183-186, 1980. 10 Ref.

Descriptors: *International commissions, *Baltic Sea, *Environmental protection, Organizations, Water pollution control, Pollution prevention, DDT, Polychlorinated biphenyls.

The Convention on the Pollution of the Marine Environment of the Baltic, one of the most comprehensive environmental agreements ever ratified, was signed by all of the Baltic states in 1974 and went into effect in 1980. The Convention covers discharges from land-based sources, including air pollution, discharges from ships, dumping of wastes, and international cooperation to combat spillages of oil and hazardous substances at sea. The Baltic Marine Environmental Protection Commission was established by the Convention. Its purpose is to recommend measures relating to the purposes of the Convention, recommend amendments to the Convention, define pollution control criteria and objectives, and promote scientific and technological research. Current goals of the Commission are to draft a prohibition of the use of DDT, to regulate or prohibit PCB discharge and use, and conduct scientific evaluations on the present state of pollution of the Baltic by PCBs, mercury, cadmium, lead, copper, zinc, and their compounds. Oil emissions and environmental quality guidelines are also areas of current concern. (Small-FRC)
W82-02087

6F. Nonstructural Alternatives

EFFLUENT FEES, AN ALTERNATIVE SYSTEM FOR ACHIEVING WATER QUALITY: A CASE STUDY,
Auburn Univ., AL. Dept. of Economics.
A. N. Link, and F. A. Scott.
Water Resources Bulletin, Vol 17, No 3, p 498-500, June, 1981. 4 Tab, 8 Ref. OWRT-A-074-ALA(2), 14-34-0001-0101.

Descriptors: *Water quality control, *Effluent charges, *Black Warrior River, *Alabama, Costs, Water pollution control, Economic aspects, Industrial wastes, Municipal wastes.

The effluent fee system and the uniform standards system of water quality control were compared for a 30-mile section of the Black Warrior River, Alabama, which receives discharges from 6 major industries and 2 municipalities. Using BOD removal as a basis and an effluent fee of $0.0587 per pound BOD discharged, the polluters would have to remove 47,593 pounds BOD er day to meet the same water quality standards as under the uniform standards system. However, 2 of 6 firms would find it cheaper to remove zero BOD, 2 firms and 1 municipality would find it cheaper to remove less BOD, and 2 firms and 1 municipality would find it cheaper to remove more BOD than under the present uniform standards system. Total daily cost for all 8 dischargers is $1224.50 under the effluent fee system and $1839.50 under the uniform standard system, a difference of $224,475 annualy to achieve the same water quality. (Cassar-FRC)
W82-01665

STANDARDS AND CHARGES IN THE CONTROL OF TRADE EFFLUENT DISCHARGES TO PUBLIC SEWERS IN ENGLAND AND WALES,
York University, Heslington (England). Institute of Social and Economic Research.
For primary bibliographic entry see Field 6C.
W82-01717

FLOODPLAIN MANAGEMENT: A FLOOD AND LAND PLANNING SYSTEM,
Vermont House of Representatives, Montpelier.
M. D. Arnold.
Environmental Conservation, Vol 8, No 2, p 97-106, Summer, 1981. 5 Fig, 21 Ref.

Descriptors: *Flood plain management, *Flood protection, *Flood damage, Legal aspects, Land use control, Political aspects.

Floodplain management, a systematic regime of land and flood management by which floodable areas are turned to uses that are compatible with flooding, is reviewed. By using floodplain management, human trauma and physical damage of floods can be reduced. Man-made developments are kept out of floodplains or are designed to resist or accommodate water damage. Floodplain management is more economic and less socially costly than structures used to control flooding. Flood management tools include: citizen intervention, regulation, property rights purchase, structures, relocation of settlements, weather forecasting and warning, government loan and guarantee activities, government flood insurance, private and government disaster aid, banking regulations, farm preservation, erosion control, and water quality management. Political reform is necessary before this approach to floods becomes more general. (Small-FRC)
W82-01872

THE ECONOMICS OF COOPERATION OVER COLLECTIVE BADS,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6A.
W82-01909

ECONOMIC INSTRUMENTS FOR CONTROLLING EFFLUENT DISCHARGES TO THE RIVER TEES ESTUARY,
Newcastle upon Tyne Univ. (England). Dept. of Economics.
For primary bibliographic entry see Field 2L.
W82-02060

INTERNATIONAL COOPERATION TO PROTECT THE BALTIC,
Ministry of Agriculture, Stockholm (Sweden). Environmental Div.
For primary bibliographic entry see Field 6E.
W82-02087

6G. Ecologic Impact Of Water Development

RELATING POPULATION GROWTH TO SHELLFISH BED CLOSURES: A CASE STUDY FROM NORTH CAROLINA,
East Carolina Univ., Greenville, NC. Dept. of Sociology and Anthropology.
For primary bibliographic entry see Field 5C.
W82-01641

A WATER QUALITY ASSESSMENT OF DEVELOPMENT IN THE SENEGAL RIVER BASIN,
Agency for International Development, Washington, DC. Bureau for Africa.
M. S. Gould.
Water Resources Bulletin, Vol 17, No 3, p 466-473, June, 1981. 8 Fig, 2 Tab, 11 Ref.

Descriptors: *Water quality, *Environmental effects, *River basin development, *Senegal River, *Africa, Model studies, Mathematical models, Aquatic life, Dams, Water resources development, Agriculture, Irrigation, Fish, Dredging, Sediment yield, Dissolved oxygen, Estuaries, Saline water barriers.

The impacts of proposed water resources development in the Senegal River basin were studied with mathematical modeling and examination of case histories. This paper concerns the water quality aspect of the environmental assessment, which also draws on nine other major disciplines. Although this basin is relatively undeveloped, analytical techniques for more highly developed basins were successfully used. It was concluded that the proposed development plans should have minor negative impact on water quality in the basin. However, the Diama Dam, built to prevent salt water intrusion into the upper river, will adversely affect spawning of marine and estuarine fish. Dissolved oxygen in the river would remain high and more uniform with the aid of flow regulation. Minimum dissolved oxygen concentrations in the estuary would be lower, reaching a projected 1 mg per liter by 2028. Other projects under consideration are the Manantali Dam for flow regulation and hydropower, irrigated agriculture, dredging for improved navigation, and industrial and municipal development. The reservoir created by Manantali Dam will initially be eutrophic due to nutrient releases and organic matter from inundation of 480 sq km of savanna forest. For the first few years aquatic vegetation could be a nuisance, and fish productivity would be high. The low dissolved oxygen concentration in the first 20 km of river below the dam would be hazardous to aquatic life. Similar lakes in Africa usually take about 5 years to evolve into a mesotrophic state. Agricultural fertilizers and pesticides will have a minor impact on water quality if proper practices are used. Dissolved solids in the river should not increase beyond 150 mg per liter with proper irrigation practices. (Cassar-FRC)
W82-01740

IMPACTS OF NAVIGATIONAL DREDGING ON FISH AND WILDLIFE: A LITERATURE REVIEW,
Fish and Wildlife Service, Washington, DC. Office of Fishery Assistance.
K. O. Allen, and J. W. Hardy.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-137853, Price codes: A05 in paper copy, A01 in microfiche. Report FWS/OBS-80/07, September, 1980. 88 p, 7 Fig, 228 Ref, Append.

Descriptors: *Dredging, *Literature review, *Fish, *Wildlife, *Environmental effects, Navigation, Water pollution, Channel improvement, Estuaries, Habitats, Hydrology, Ecosystems, Ecological effects.

This review covers impacts to fish, other aquatic organisms, and wildlife, as well as habitat enhancement opportunities, resulting from construction of new navigational channels and maintenance dredging of existing channels. The type of dredging equipment used determines, to a great extent, the viable disposal alternatives, the type and magnitude of potential impacts, and the potential for habitat development. About 99% of the dredging volume in the U.S. is accomplished by hydraulic dredges. The composition of dredged material from a particular site affects its pollution potential as well as the potential for habitat development or other beneficial uses. Dredged material from new channels or new works projects often has chemical and engineering properties which create fewer environmental problems than material from maintenance projects. Material removed during maintenance dredging of navigational channels is an accumulation of detached soil particles which have been transported by wind and water, and may contain a variety of contaminants. In coastal areas, some of the most severe long-term impacts from dredging are caused by the physical changes in

UNIV. OF ILL. URBANA-CHAMPAIGN

estuaries due to new work dredging. Maintenance dredging and dredged material disposal pose less severe threats, except where the sediments contain high levels of contaminants. Most research on river dredging was conducted in the upper Mississippi River and may only be partially applicable to other river systems. Impacts to the water column are generally slight. The alteration of river through new channel construction or deepening projects has severe direct and indirect impacts on the entire river and floodplain ecosystem. Long-term impacts include changes in hydrology and stream gradient that impact the river, swamps, backwaters, and the entire floodplain. (Moore-SRC)
W82-01768

SOME ENVIRONMENTAL AND SOCIAL IMPACTS OF THE JAMES BAY HYDROELECTRIC PROJECT, CANADA,
Brock Univ., St. Catharines (Ontario). Inst. of Urban and Environmental Studies.
F. Berkes.
Journal of Environmental Management, Vol 12, No 2, p 157-172, March, 1981. 3 Fig, 1 Tab, 14 Ref.

Descriptors: *Environmental effects, *Hydroelectric plants, *Subarctic zone, *James Bay, Canada, Social impact, Fisheries, Land tenure.

The James Bay hydroelectric project, which consists of a series of dams affecting the watersheds of several rivers in northern Quebec, is the most ambitious energy project ever attempted in Canada. Construction of the project, located in subarctic Canada, began in 1972, shortly after the project was announced. However, environmental information needed to plan mitigation measures was not available until about 1975. This pattern appears to be characteristic of large-scale development projects in remote areas, where the time lags involved in obtaining detailed environmental data are so lengthy that engineering plans proceed, for economic reasons, without the benefit of this environmental data as planning input. None of the 1975 recommendations for environmental protection measures with respect to the estuarine subsystem were adopted by the project. An environmental impact case study of the effects of the LaGrande Complex phase of the James Bay development examines the estuarine fisheries subsystem and the effects on this subsystem of changes in the flow regime of the LaGrande River, the relocation of the first dam on the LaGrande, saltwater encroachment up the river during the filling of the second dam, and the changes in the thermal regime of the river. A social impact case study discusses the effects of the road network associated with the hydroelectric project on the land tenure system of the native Cree Indians of the area. These analyses show that it is not easy for large projects in frontier areas to accommodate environmental considerations, since the lead times are too great and too little is known about the environment when the engineering decisions are being made. In addition, it is often impossible to assess the impacts of these projects after the fact due to the absence of baseline data and to the existence of a cumulative effect of relatively insignificant incremental impacts. (Carroll-FRC)
W82-01908

TRACING FOOD WEBS WITH STABLE HYDROGEN ISOTOPES,
Carnegie Institution of Washington, DC. Geophysical Lab.
M. F. Estep, and H. Dabrowski.
Science, Vol 209, No 4464, p 1537-1538, September, 1980. 1 Fig, 6 Ref.

Descriptors: *Food chains, Algae, Snails, Hydrogen, Mice, Mollusks, Chemical properties, Isotopic tracers, Boothbay harbor, Maine, Marine environment, Tidal pools, Metabolism, *Ecosystems, *Biological samples, *Biochemistry, Ecology, Food chains.

The relationship between the organically bonded hydrogen isotopic content of an animal and its food source was investigated using laboratory mice. Also investigated was the relationship between a simple, natural population consisting of snails and their possible algal food sources. The study concluded that the hydrogen isotopic content of the animal's food and not its water determine the animal's hydrogen isotopic content. Liver and muscle tissue from mice reared on a diet with a specific ratio of deuterium to hydrogen (D/H) had the same D/H ratio as in the food, not in the water. Northern Atlantic intertidal snails that feed almost exclusively on the brown alga Fucus vesiculosus have the same D/H ratio as Fucus vesiculosis and not that of the other algae made available to the snails. (Baker-FRC)
W82-02021

ENVIRONMENTAL STUDIES: THEIR IMPLICATIONS AND THE SPECIAL CASE OF EGYPT,
J. Rzoska.
Water Supply and Management, Vol 4, No 1/2, p 21-24, 1980. 2 Ref.

Descriptors: *Technical societies, *Environmental effects, Publications, Information exchange, Limnology, *Lake Nasser, *Egypt, Egyptian Society of Environmental Science, History, *Nile river, Social aspects, Economic aspects.

Integration of scientific disciplines in environmental studies is necessary, as illustrated by the efforts of the Egyptian Society of Environmental Sciences. The cultivable and inhabited land in Egypt is confined to the Nile River valley and is a product of the river. Desirable aims of water resources research in Egypt include studies of the historical succession of the land and its waters as well as the recent changes caused by the Aswan High Dam. Integrated historical and current studies are needed on Lake Qarun, the Wadi Natrun, and the delta lakes. Egypt's environmental problems are narrower in scope than in most countries, being confined to Lake Nasser, the Nile River, and its valley. Some suggestions for future consideration are a monograph on Lake Nasser (extending to old terraces, sediments, and ancient written records), and studies of the Wadi Natrun, the delta lakes, and fisheries. The Society should have a governing board of prominent scientists, a library of books on environmental subjects, information dissemination, and facilities for large and small workshops. (Cassar-FRC)
W82-02062

7. RESOURCES DATA

7A. Network Design

THE USE OF SPECIFIC CONDUCTANCE IN STUDIES OF NATURAL WATERS AND SOIL SOLUTIONS,
Lanchester Polytechnic, Conventry (England). Dept. of Geography.
I. D. L. Foster, I. C. Grieve, and A. D. Christmas.
Hydrological Sciences Bulletin, Vol 26, No 3, p 257-269, September, 1981. 4 Fig, 4 Tab, 27 Ref.

Descriptors: *Natural waters, *Specific conductivity, Water, Conductivity, Soil solution, Mineral water, *Dissolved solids, Suspended solids, Iron, Aluminum, Manganese.

In the absence of non-ionized material and above a pH of around 5.5, specific conductance has been considered a useful measure of total dissolved solids (TDS) for routine water quality analysis. Regression relationships may be used to explain high proportions of variance in TDS loads. In the study presented herein, the levels of dissolved organic matter in stream water and in throughfall were too low and displayed too little variability to be of significance in affecting the specific conductance (SC)/TDS relationship. Water samples for chemical analysis were obtained from two areas. First, river water samples were collected at a small cultivated basin in East Devon from the main stream and three sub-basins: a tile drain, drainage ditch and a woodland stream unaffected by cultivation. Second, water samples were collected from a variety of locations in a forested basin in North Warwickshire. Weekly samples were taken from the main stream and from throughfall beneath the tree canopy during 1978 and 1979. The soil water samples taken did have sufficient variation in dissolved organic matter (DOM) to influence the regression relationship, and DOM must be considered in estimating the dissolved load carried in soil solutions. It may also be of significance in streams draining moorland catchments. Attempts to calculate SC from consideration of the properties of simple solutions were relatively unsuccessful, although improvements in the McNeal model were achieved by including pH in a partial correlation data. Further improvements resulted from consideration of the effects of iron, aluminum, and manganese, whose solubility at low pH is greatly enhanced. (Baker-FRC)
W82-01646

METHODS OF STUDYING INVERTEBRATE DRIFT IN RIVERS,
Akademiya Nauk SSSR, Petrozavodsk. Karelskii Filial.
Yu. A. Shustov, and V. A. Shirokov.
Hydrobiological Journal, Vol 16, No 3, p 66-68, 1980. 1 Fig, 2 Tab, 7 Ref.

Descriptors: *Rivers, *Invertebrates, *Drift, Sampling, Sample preparation, Water sampling, Biological samples, Chrionomidae, Simuliidae, Ephemeroptera, Trichoptera, *Aquatic drift, *USSR.

In an attempt to study invertebrate drift in rivers, a trap was set in a river for a specified period of time, and the material obtained fixed with 4% formalin and processed in the laboratory. The drift sample contains benthic invertebrates, zooplankton organisms, winged and land insects, fish larvae, filamentous algae, scraps of aquatic vegetation, fallen leaves from trees and other debris. Trap exposure time is usually between a few minutes and a few hours to obtain material for a drift sample. Exposure time must be clearly identified in the study, however. Drift samples were taken on one of the bars of the Lizhma, a salmon river in the basin of Lake Onega, in August of 1978 for exposure times of 0.5, 1, 2, 4, and 8 hr. Samples were taken only during daylight, not before 8 a.m. nor after 8 p.m. The river reach sampled was a bar, where depth of 0.5 meters and flow rate of 0.3 meters/second were uniform over the whole width of the river, 15 meters. The results show that sampling times of .5 hours and 1 hour are to be preferred from the whole range of times investigated when taking drift samples under similar conditions. In order to study invertebrate drift in rivers under conditions differing from these, the optimum exposure time should be determined by similar methods. There were appreciable fluctuations in the abundance of the invertebrate drift in this study. The distribution density of benthic invertebrates and the level of drift in the river were not solely determined by the main environmental factors, but were also conditioned by a number of local conditions, the extent of the development of fouling on the stones, or the amount of organic detritus in the bottom material. (Baker-FRC)
W82-02074

WHERE DO WE GO FROM HERE.
R. Briggs.
Water, No 40, p 19-21, September, 1981. 1 Tab, 6 Ref.

Descriptors: *Automation, *Data acquisition, *Data collections, *Monitoring, *Data transmission, Computers, Hydrologic data collection, Water quality management, Water quality control, Sensors, Water treatment, Wastewater treatment.

A report issued by the National Water Council/Department of the Environment Working Party on Control Systems contains guidelines to clarify the water industry's needs for instrumentation, control, and automation (ICA) in water and wastewater treatment technology. To help implement these recommendations, representatives of the environment, industry and engineering factions were incorporated as consultants in the design stages of ICA improvements. Accurate data is required at each level of the management hierarchy in order for water industry management to be effective. Monitoring devices may be used to check the

quality of effluents and protect downstream receiving waters. A number of factors are listed which have contributed to the United Kingdom's dissatisfaction with the overall precision obtained from ICA equipment in the water industry in recent years. In transferring information about water quality to the final user, the weakest unit in the chain is usually the sensor. New advances to improve sensors used in water quality monitoring include the use of computer control and multifunctional sensor devices. (Geiger-FRC)
W82-02086

7B. Data Acquisition

ELECTRONIC MEASUREMENT AND RECORDING OF EVAPORATION LOSS,
J. A. Drabbe.
Water SA, Vol 7, No 3, p 150-154, July, 1981. 6 Fig.

Descriptors: *Evaporation, *Water storage, *Measuring instruments, Storage tanks, Drinking water, Surface tension, Rainfall.

A new electronic system for the measurement of evaporation loss in water storage tanks is described, which includes the recording of the data on a weekly or monthly chart. As the water level falls due to evaporation, a sensitive probe in the still-well switches on the supply of water to a flowmeter. This measures and delivers calibrated quantities directly to the still-well, where the rising water touches the probe and switches off the control circuit. Surface tension is used to provide a quick break of contact when the water surface suddenly falls away. The probe is constructed primarily of platinum, and the flow meter consists of two plastic bottles filled alternately with a sliding valve operated by 12 V solenoids. To counter the effects of rain, a small probe opens a small solenoid-operated drain cock to allow incoming rain to flow to waste. To date, results with the new method have been very encouraging. This method provides continuous readings rather than the required daily readings. (Small-FRC)
W82-01602

SOIL MOISTURE UPDATING AND MICROWAVE REMOTE SENSING FOR HYDROLOGICAL SIMULATION,
Science and Education Administration, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 2G.
W82-01611

REMOTE SENSING IN DEVELOPMENT,
Agency for International Development, Washington, DC.
C. K. Paul, and A. C. Mascarenhas.
Science, Vol 214, No 4517, p 139-145, October 9, 1981. 3 Fig, 9 Ref.

Descriptors: *Remote sensing, *Developing countries, *Satellite technology, *Water resources development, Exploration, Land use.

Among the uses of remote sensing in developing countries is subsurface water location. Satellite images of Bangladesh have located flooded and dry regions and indicated the vigor of vegetation (rice) between the wet and dry seasons. Understanding the changing flood patterns along rivers allows proper designation of land use. Landsat imagery in the Rukwa region, Tanzania, showed that Lake Rukwa was one body of water rather than two separate bodies as depicted on available maps, and that 5% of lakeshore land supposedly suitable for agriculture was actually under water. One problem with interpretation of satellite imagery to locate specific water resources is the technical expertise and computer equipment required, but often not available, in this part of the world. (Cassar-FRC)
W82-01719

AIRCRAFT REMOTE SENSING OF SOIL MOISTURE AND HYDROLOGIC PARAMETERS, TAYLOR CREEK, FLA., AND LITLE RIVER, GA., 1979 DATA REPORT,
Science and Education Administration, Beltsville, MD. Hydrology Lab.
T. J. Jackson, T. J. Schmugge, L. H. Allen, Jr., P. O'Neill, and R. Slack.
Agricultural Research Results ARR-NE-13, September 1981. 38 p, 8 Fig, 11 Tab, 16 Ref, 1 Append.

Descriptors: *Remote sensing, *Aerial photography, *Soil water, Humid areas, Hydrologica data, Monitoring, Infrared imagery, Sensors, Georgia, Florida.

As part of a project to evaluate remote sensing in hydrologic studies, with primary emphasis on soil moisture measurements, in a wide range of physiographic and climatic areas, data were collected in late 1978 and during 1979 in two humid areas: Taylor Creek, Florida, and Little River, Georgia. Experiments were designed to collect remote sensing data concurrent with ground observations of hydrologically significant parameters and phenomena, primarily soil moisture within several surface layers. The observations were made on intensively monitored watersheds. The sampling locations in Florida were all in or west of the Taylor Creek Watershed. One flightline covered mostly citrus grove sites and the other traversed mostly pasture and swampy areas. All sampling locations in Georgia were within the Little River Experimental Watershed. The land cover has about 33% in crops, 40% in woodlands, and 8% in urban categories. The NASA 929 (C-130B) aircraft was the sensor platform used in these experiments. The sensor configuration included color infrared photography, a modular multispectral scanner, a thermal infrared radiometer, C and L band radiometers, a passive microwave scanner, and four active microwave sensors: K, C, L, and P band scatterometers. (Moore-SRC)
W82-01771

EFFECT OF THE ALGAL LENGTH/APERTURE LENGTH RATIO ON COULTER ANALYSES OF LAKE SESTON,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
H. A. Vanderploeg.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 8, p 912-916, August, 1981. 2 Fig, 1 Tab, 28 Ref.

Descriptors: *Algae, *Particle size, *Seston, Lakes, Aquatic life, Phytoplankton, *Lake Michigan, Particle shape, Coutler Counter, Organic matter.

The accuracy of sizing long, thin algae in Lake Michigan water was improved by a more suitable combination of aperture tubes in the Coutler Counter method. Both seston and nylon fibers 200 and 500 micrometers long were sized in aperture tubes of different sizes. There was poor count overlap in some size ranges. This was caused by particles whose length was greater than the aperture length. The suggested technique uses the observations that the large aperture tubes more correctly size the longer particles and that count overlap is usually best in the smallest size categories. The largest tube selected must have an aperture length greater than the length of the longest algae. The size difference between apertures is affected by the shape of the seston. Although excellent count overlap was obtained with 50 and 400 micrometer aperture tubes for mixtures of microspheres similar to the lake seston, it was necessary to add a 140 or 200 micrometer tube for seston mixtures containing long, thin algae. (Cassar-FRC)
W82-01823

POWER SPECTRAL ANALYSIS OF A FORCE-MAIN FAILURE CAUSED BY WATERHAMMER,
McMaster Univ., Hamilton (Ontario). Dept. of Civil Engineering and Engineering Mechanics.
W. James, R. R. Hennessy, and J. W. Disher.
Canadian Journal of Civil Engineering, Vol 7, No 1, p 36-44, 1980. 5 Fig, 6 Ref.

Descriptors: *Water hammer, *Pipe failure, *Water pressure, Pipelines, *Main sewers, Leakage, Remote sensing, Spectral analysis, Monitoring, Water loss.

Leakage problems in a 14 inch asbestos cement sewage forcemain, 3963 ft long, in Ancaster, Ontario, prompted installation of pressure recording equipment on September 9, 1976. Between this date, and September 14, when a pipe failure occurred, 18 pressure recordings were made. This produced a complete record of water hammer pressure waves during deterioration and failure. Power spectral analysis pinpointed the initial small break, which was not detectable on the surface until several days later. After the initial crack appeared, the waterhammer wave changed dramatically. A noticeable frequency shift in the rigid column wave occurred shortly before the ultimate failure, which was caused by an apparent merging of the primary waterhammer wave with an existing and gradually increasing lower frequency wave. Air pockets increasing in size with deterioration produced short-duration, high pressures. Superposition of the two waves produced enough energy to rupture the already damaged pipes. This method may be useful in monitoring the condition of long pipelines. (Cassar-FRC)
W82-01826

DISCHARGE MEASUREMENTS BY A NEWFORMED RELATIVE SALT-DILUTION METHOD IN SMALL TURBULENT STREAMS,
Norges Landbrukshoegskole, Vollebekk.
L. Bjerve, and O. Groterud.
Nordic Hydrology, Vol 11, No 3/4, p 121-132, 1980. 4 Fig, 2 Tab, 10 Ref.

Descriptors: *Discharge measurement, *Stream discharge, *Conductivity, Salt dilution method, Turbulent flow, Saline solution injection, Tracking techniques.

A new salt dilution method for determining water discharge in small turbulent streams relies on injection of concentrated salt solution at constant feed and measuring the dilution level downstream by in situ conductivity readings. Three injection apparatuses are described: a 7 liter chicken feeding bucket for 100 liters per sec discharge, a float-chamber apparatus for larger volumes and discharge up to 300 liters per sec, and a vacuum chamber apparatus for large water discharges. This constant injection method is compared with several other methods (sudden injection, V-notch weir, collection, and Harlacher) and found comparable. For the turbulent streams the new method was easier and more reliable. (Cassar-FRC)
W82-01891

THE APPLICATION OF RADIOACTIVE TRACERS FOR DETERMINATION OF BED-LOAD TRANSPORT IN ALLUVIAL RIVERS,
Copenhagen Univ. (Denmark). Dept. of Geography.
For primary bibliographic entry see Field 2J.
W82-01893

A SIMPLE DEVICE FOR QUANTITATIVE PSEUDOPERIPHYTON SAMPLING,
Lyon-1 Univ., Villeurbanne (France). Dept. de Biologie Animaux et Zoologie.
C. Amoros.
Hydrobiologia, Vol 68, No 3, p 243-246, February 16, 1980. 2 Fig, 1 Tab, 6 Ref.

Descriptors: *Water sampling, *Invertebrates, *Sampling, Cladocerans, Copepods, Bottom sediments, *Ponds, Aquatic plants, Littoral zone.

A simple device for sampling small invertebrates living among aquatic macrophytes in a pond is described. The device consists of a methyl methacrylate tube 1.2 meters high and 50 mm inside diameter, open at both ends and fitted with a sharp iron part at the bottom. It is operated by quickly pushing the bottom of the tube into the pond sediments deep enough to obtain a core to serve as a bottom stopper when the device is raised from the water. After inserting a rubber stopper in the

top, the captured animals and water are released through emptying holes in the side of the tube onto a filter form counting and identification. Sampling of cladocerans and copepods at two sites in the littoral zone of a fishpond produced good correlation within each station, but not between the two stations, using three replicate samples. (Cassar-FRC)
W82-01894

THE USE OF REMOTE SENSING FOR AN INTEGRATED INVENTORY OF A SEMI-ARID AREA,
Arizona Univ., Tucson. Office of Arid Lands Studies.
D. A. Mouat, J. B. Bale, K. E. Foster, and B. D. Treadwell.
Journal of Arid Environments, Vol 4, No 2, p 169-179, June, 1981. 4 Fig, 20 Ref.

Descriptors: *Semiarid lands, *Remote sensing, *Mapping, Arid lands, *Satellite technology, Pima County, Arizona, Vegetation, Geology, Water resources development, Water resources management, Soil types, Land use, Photography, Resources development, Resources management.

The Pima County, Arizona, Resources Inventory provides maps of land use and selected natural resources for a 23,000 sq km semiarid area. Satellite photography and other imagery supplied information on land use, natural vegetation distribution, land forms, and soil types. Field work supplied data on soil types from previously mapped areas, surficial geology, and slope angle. The maps produced by this project are usable for many purposes, including water resources management and development. Begun in 1976, the total costs for the inventory project were $72,000 or $3.00 per sq km. The method is applicable to any large arid or semiarid region. (Cassar-FRC)
W82-01910

MEASUREMENT OF IRRIGATED ACREAGE IN WESTERN KANSAS FROM LANDSAT IMAGES,
Kansas State Geological Survey, Lawrence.
K. M. Keene, and C. D. Conley.
Environmental Geology, Vol 3, No 2, p 107-116, 1980. 5 Fig, 3 Tab, 22 Ref.

Descriptors: *Remote sensing, *Satellite technology, *Irrigation, *Kansas, Agriculture, Infrared imagery, Landsat.

Video image analysis permitted rapid measurement of irrigated summer crops in western Kansas. Spectral response on LANDSAT MSS band 5 (visible red, 0.6-0.7 micrometers) images produces a low response from irrigated summer crops and high response from harvested and fallow fields and most soil types. This permits measurement of irrigated acreage at the rate of 1 hour per county, about 876 sq mi. Standard 1:1,000,000 LANDSAT positive transparency images are used for interpretation. This is a significant time savings compared with the 6 weeks required to analyze LANDSAT data describing a 3140 sq mi area using the false color composite image method. The video image analysis is prone to error when there is significant vegetation growth along streams or other water bodies and when ponds and reservoirs are present. In western Kansas neither of these conditions interferes with analysis. If necessary, the area of significantly large water bodies may be substracted from the irrigated acreage. (Cassar-FRC)
W82-01939

DEVICE FOR COLLECTING REPLICATE ARTIFICIAL SUBSTRATE SAMPLES OF BENTHIC INVERTEBRATES IN LARGE RIVERS,
Institute of Paper Chemistry, Appleton, WI.
D. R. Wefring, and J. C. Teed.
Progressive Fish Culturist, Vol 42, No 1, p 26-28, January, 1980. 2 Fig, 1 Tab, 4 Ref.

Descriptors: *Sampling, *Mechanical equipment, *Rivers, Costs, Design criteria, *Benthic fauna, *Invertebrates.

A device was designed for use in large rivers for suspending triplicate modified multi-plate samplers. Ease of construction and transportation and flexibility of use were important considerations, along with low cost and durability. The device consists of two zinc-plated mending plates bolted together and suspended from an expanded polyethylene boat fender with plastic-coated aircraft cable. Materials for the unit, excluding samplers, cost about $7.00. A field study indicated that the sampling unit provides an unbiased and inexpensive means of positioning triplicate modified multiplate samplers in large rivers. The unit also accommodates Periphytometer II samplers for monitoring periphyton communities. (Small-FRC)
W82-01947

A TEST UTILIZING SEDIMENT TRAPS, SURVEY RODS, AND RADIOGRAPHS TO MONITOR SEDIMENT ACCUMULATION FROM A DREDGING DISPOSAL OPERATION,
NALCO Environmental Sciences, Northbrook, IL.
G. R. Alther, and R. K. Wyeth.
Environmental Geology, Vol 3, No 2, p 97-105, 1980. 8 Fig, 5 Ref.

Descriptors: *Dredging, *Sediment discharge, *Measuring instruments, *Spoil disposal, Sediment distribution, Sediment traps, Survey rods, Radiographs, *Lake Erie, Fate of pollutants.

A combination of sediment traps, survey rods, and radiographs reduced errors in measuring the dispersal of dredged material (fine sand and coarse silt) in Lake Erie near Ashtabula, Ohio. The site was sampled before dumping began and four times after dredge material disposal during 1976. Dredge records indicate that about 24.1 million kg of sediment was discharged. The usual uncertainties with records of this type can be 45-65%. Errors in acoustic methods are 40-70%. The survey rod method accounted for 18,000 cu meters or 16.7 million kg (70%) of the material discharged, and the sediment traps, 14,000 cu meters or 12.5 million kg. Radiographs of sediment cores detected differences between the original and newly-deposited sediments. At the center of the disposal site 18 cm of sediment had accumulated the first day of disposal, May 24. The flat, cone-shaped pile increased to 28 cm after 3 days and to 36 cm after 1 week. (Cassar-FRC)
W82-01950

PHOTOMETRIC INVESTIGATIONS OF PRECIPITABLE WATER AND OPTICAL DEPTH WAVELENGTH EXPONENTS IN AN URBAN AREA,
Wyoming Univ., Laramie. Dept. of Atmospheric Science.
For primary bibliographic entry see Field 2B.
W82-01966

OBSERVATIONS OF TWO COLORADO THUNDERSTORMS BY MEANS OF A ZENITH-POINTING DOPPLER RADAR,
Arizona Univ., Tucson. Inst. of Atmospheric Physics.
For primary bibliographic entry see Field 2B.
W82-01967

APPLICATIONS OF AERIAL PHOTOGRAPHY,
T. Gass.
Water Well Journal, Vol 35, No 8, p 38-39, August, 1981. 1 Fig.

Descriptors: *Groundwater, *Remote sensing, Aerial photography, Water supplies, Water resources development, Groundwater budget.

Applications of aerial photography and technology for the possible improvement of evaluating groundwater resources are considered. Recent advances in remote sensing technology have enhanced the ability to evaluate local and regional hydrogeological conditions. Aerial photography provides two basic types of clues for evaluating groundwater resources. Direct indicators refer to the detection of physical characteristics of the ground directly associated with groundwater. These would include the identification of springs, seeps and discharges of groundwater into surface water bodies. Indirect indicators are clues which enable assumptions or inferences to be made about groundwater resources. Some of these indirect indicators provide information for defining groundwater availability and changes in groundwater conditions. Various techniques of remote sensing are available. Black and white and color photography can give evidence of surface water-groundwater interfaces, soil moisture and some types of vegetation, along with delineation of structural geology, rock type, soil type, vegetation patterns and drainage characteristics. Thermal infrared imagery can detect soil moisture, soil types, zones of groundwater discharge and changes in rock type. One very successful application has been in detecting groundwater discharging to bodies of open water. Side looking airborne radar (SLAR) can detect soil changes and lineaments, distinguish between coarse- and fine-grained surface materials, and delineate zones of recharge. The monopulse radar system is relatively new and offers the ability to penetrate soil depth of 10 meters or to the top of the table if it is less than 35 feet beneath the surface. (Baker-FRC)
W82-01988

MATHEMATICAL MODELING OF STREAM WATER QUALITY BY A NEW MOMENT METHOD: FIELD INVESTIGATION OF A TIDAL RIVER,
National Cheng Kung Univ., Tainan (Taiwan). Dept. of Environmental Engineering.
C-G. Wen, J-F. Kao, and L. K. Wang.
Journal of Environmental Management, Vol 12, No 2, p 127-140, March, 1981. 4 Fig, 5 Tab, 7 Ref.

Descriptors: *Mathematical models, *Water quality, *Tidal rivers, Streams, Pollution load, Biological oxygen demand, Dissolved oxygen, Oxygen demand, Water pollution control, Tam-Sui River, *Taiwan, Path of pollutants.

A new moment method has been developed which can be used to systematically identify water quality parameters for both tidal and non-tidal streams. Results of a field study conducted on the Tam-Sui River in Taiwan, Republic of China, are used to demonstrate the use of this method to identify the following water quality parameters: (1) the reaeration coefficient; (2) the coefficient of organic settling and other parameters; (3) the rate of organic addition to the overlying water from the bottom deposits as well as local run-off; (4) the oxygen production rate of photosynthesis; and (5) the longitudinal dispersion coefficient. The following information must be known in order to use this method: the stream velocity, the downstream distance, the stream water temperature, the biochemical oxygen demand of stream water at each sampling station, the dissolved oxygen of stream water at each sampling station, and the biochemical oxygen demand reaction rate. A chi-square test was conducted to evaluate the correctness of the biochemical oxygen demand model and the dissolved oxygen deficit model developed for the Tam-Sui River. This analysis showed that the proposed moment method can effectively estimate the characteristic parameters of steady state stream models. Observed biochemical oxygen demand and dissolved oxygen values from sampling stations on the Tam-Sui River were in excellent agreement with those estimated by the mathematical models. Once the biochemical oxygen demand model and the dissolved oxygen models have been developed for a stream, the biochemical oxygen demand and dissolved oxygen deficit at any downstream distance X can be readily calculated, and the degree of stream pollution can be assessed. (Carroll-FRC)
W82-01995

SCREENED AUGER AIDS INVESTIGATION,
Johnson Co., Haslett, MI.
D. M. Baron.
Johnson Driller's Journal, Vol 53, No 1, p 4-5, 1981.

Descriptors: *Drilling equipment, *Augers, Well screens, Wells, Test wells, *Groundwater pollution, *Chemical wastes, Muskegon, Michigan.

A new screened auger facilitated drilling on an investigation of groundwater contamination at an abandoned chemical plant dump near Muskegon, Michigan. The later modification of the apparatus consisted of a 2-ft long well screen with an 18 inch stainless steel flush tubing on each end, to which was welded the continuous auger flighting and the top and bottom ends of the hollow stem auger. It eliminates the problem of sand-lock inside hollow stem augers. The 3 and 1/4 inch inside diameter auger can also accept a submersible pump for efficient water extraction and downhole geophysical tools. (Cassar-FRC)
W82-02096

7C. Evaluation, Processing and Publication

HYDROLOGIC DATA FOR EXPERIMENTAL AGRICULTURAL WATERSHEDS IN THE UNITED STATES, 1972,
Science and Education Administration, Beltsville, MD. Water Data Lab.
For primary bibliographic entry see Field 2A.
W82-01772

SELECTED DRILL-STEM-TEST DATA FROM THE NORTHERN GREAT PLAINS AREA OF MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
G. W. Levings.
Available from the OFSS,USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Price: $4.75 in paper copy, $4.00 in microfiche. Geological Survey Open-File Report 81-326, (WRI), April, 1981. 20 p, 1 Fig, 1 Plate, 1 Tab, 3 Ref.

Descriptors: *Data collections, *Groundwater, *Aquifers, *Test wells, Potentiometric level, Oil wells, Transmissivity, Maps, Sites, *Montana, Northern Great Plains, Drill-stem tests.

Selected drill-stem-test data were collected for use in the hydrologic analysis of aquifers in the northern Great Plains area of Montana. To supplement existing data defining the potentiometric surface of various aquifers, shut-in pressures recorded during drill-stem tests of oil and gas test wells were used to calculate the altitude of the potentiometric surface. The transmissivity of the aquifers also was calculated if sufficient data existed. Records for 627 drill-stem tests from 523 wells are tabulated in this report. Data include well location, well name, formation tested, well epth, tested interval, date tested, test number, flow period, transmissivity, shut-in pressure, and altitude of water surface. Locations of the wells are shown on a map at a scale of 1:1,000,000. (USGS)
W82-01774

SURFICIAL GEOLOGY OF DUGWAY QUADRANGLE, OSWEGO COUNTY, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
T. S. Miller.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Price: $2.50 in paper copy, $0.50 in microfiche. Geological Survey Open-File Report 81-335 (WRI), 1981. 1 Sheet.

Descriptors: *Geology, *Glacial aquifers, *Groundwater potential, *Natural resources, Geohydrology, Wells, Water yield, Maps, *New York, Oswego County, Dugway quadrangle.

The location and extent of 11 kinds of surficial deposits in Dugway quadrangle, Oswego County, N.Y., are mapped on a 7.5-minute U.S. Geological Survey topographic map. The map was compiled to indicate the tithology and potential for groundwater development at any specific loaction. (USGS)
W82-01775

SELECTED HYDROGEOLOGIC DATA FROM THE NORTHERN GREAT PLAINS AREA OF MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
G. W. Levings.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Price: $8.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-534, August, 1981. 241 p, 1 Fig, 1 Plate, 1 Tab, 3 Ref.

Descriptors: *Groundwater, *Data collections, *Aquifer characteristics, *Well data, Wells, Springs, Sites, Water use, Water level, Groundwater movement, Specific capacity, Specific conductivity, Water temperature, Aquifers, Transmissivity, Storage coefficient, *Montana, Northern Great Plains, *Hydrologic maps.

Selected hydrologic data have been used in a 4-year study of aquifers of Cenozoic and Mesozoic age in the northern Great Plains to define the hydrologic system and to generate hydrologic maps. Records of 6,754 wells and 188 springs are tabulated in the report. The well data include site location, county, date completed, depth of well, casing diameter, type of lift, use of water, principal aquifer, altitude of land surface, water level, discharge, specific capacity, specific conductance, and water temperature. The spring data include site location, county, use of water, principal aquifer, altitude of land surface, type of spring, discharge, date discharge measured, specific conductance, and water temperature. Locations of the wells and springs are shown on a map at a scale of 1:1,000,000. (USGS)
W82-01777

LOW-FLOW FREQUENCY AND FLOW DURATION OF TENNESSEE STREAMS,
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 2E.
W82-01779

WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN MONTANA, OCTOBER 1980 THROUGH SEPTEMBER 1981,
Geological Survey, Helena, MT. Water Resources Div.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Price $6.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-817, July, 1981. 46 p, 3 Fig, 2 Tab.

Descriptors: *Data collections, *Sites, *Hydrologic data, Water quality, Surface water, Groundwater, Available water, *Montana.

The report describes the investigative efforts of the U.S. Geological Survey toward the water resources of Montana. Hydrologic information and knowledge of the water resources are gained and disseminated principally by programs of (1) collecting hydrologic data on a continuing basis, (2) conducting water-resources appraisals of surface and ground water, (3) conducting supportive research in hydrology and related fields, (4) disseminating water data and results of investigations to the public, (5) coordinating acquisition of water data by Federal agencies, and (6) providing technical assistance in hydrologic fields to other government agencies. (USGS)
W82-01787

RECORDS OF WATER LEVELS IN UNCONSOLIDATED DEPOSITS IN EASTERN SOUTH DAKOTA,
Geological Survey, Huron, SD. Water Resources Div.
W. L. Bradford.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Price: $31.75 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-924, June, 1981. 253 p, 4 Fig, 2 Tab.

Descriptors: *Water level, *Observation wells, *Awuifers, Sites, Water measurement, Monitoring, Well data, Hydrographs, *South Dakota, Minnehala County.

Water levels in unconsolidated deposits measured by the U.S. Geological Survey and State agencies throughout eastern South Dakota during the period 1948-1980 are presented in tabular and graphic form. (USGS)
W82-01788

QUALITY OF WATER AND TIME OF TRAVEL IN PART OF TILLATOBA CREEK BASIN, MISSISSIPPI, OCTOBER 1974 TO SEPTEMBER 1980,
Geological Survey, Jackson, MS. Water Resources Div.
G. A. Bednar.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver CO. 80225, Price: $12.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-825, 1981. 87 p, 23 Fig, 10 Tab, 10 Ref.

Descriptors: *Water quality, Surface water, *Streamflow, *Dye releases, Watershed management, Data collections, Suspended sediments, Discharge measurement, Nutrients, Biochemical oxygen demand, Bacteria, Gaging stations, Sites, Water analysis, *Path of pollutants, *Time of travel, *Mississippi, Tallahatchie County, Yalobusha County, Grenada County, *Tillatoba Creek basin.

A 6-year quality-of-water and time-of-travel study was conducted during the construction phase of a flood-water protection and flood prevention project in a 118 square mile area of Tillatoba Creek basin in northwest Mississippi. Weekly suspended sediment, daily discharge, time of travel, nutrient, biochemical oxygen demand, bacteria and field data were collected. The study was conducted by the U.S. Geological Survey in cooperation with the U.S. Soil Conservation Service. The results of the study are presented in graphs and tables without interpretation. (USGS)
W82-01791

SEDIMENT DATA FOR STREAMS NEAR MOUNT ST. HELENS, WASHINGTON--VOLUME 1, 1980 WATER-YEAR DATA,
Geological Survey, Tacoma, WA. Water Resources Div.
R. L. Dinehart, J. R. Ritter, and J. M. Knott.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Price: $11.25 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-822, 1981. 82 p, 3 Fig, 3 Tab, 3 Ref.

Descriptors: *Fluvial sediments, Data collections, *Streams, *Sediment load, Monitoring, Sediment transport, Particle size, Sediment distribution, Sediment discharge, Sampling, Water temperature, Suspended sediments, *Volcanoes, *Washington, *Mount St. Helens, Toutle River basin, Cowlitz River basin.

This report presents fluvial sediment data collected primarily in response to the eruption of Mount St. Helens. To monitor the sediment transported by streams in the Mount St. Helens area and the particle-size distributions of the sediment, the Water Resources Division of the U.S. Geological Survey initially established 18 fluvial sediment stations. In this report, concentrations and discharges of suspended sediment are given for 16 fluvial-sediment stations (5 are in the Toutle River basin) and for 11 miscellaneous sampling sites. Also included are particle-size distributions of suspended sediment and bed material, water discharge, and water temperature for many of the sediment samples. Daily sediment discharges for the period May 18 to September 30 were calculated for Toutle River at Highway 99 near Castle Rock and Cowlitz River at Castel Rock. Over 150 million tons of sediment are estimated to have passed the Toutle River at Highway 99 station on May 18-19, 1980. High concentrations of suspended sediment persist-

ed at several stations throughout the spring and summer of 1980. (USGS)
W82-01792

8. ENGINEERING WORKS

8A. Structures

RECONSTRUCTION OF A SMALL DAM FOR A RECREATIONAL LAKE.
For primary bibliographic entry see Field 4D.
W82-01604

MOROCCO'S LARGEST MULTIPURPOSE SCHEME,
Ministere des Travaux Publics et des Communications, Rabat (Morocco). Direction de l'Hydraulique.
N. Dinia, and R. B. Bischof.
International Water Power and Dam Construction, Vol 33, No 7, p 19-25, July, 1981. 10 Fig, 4 Tab, 3 Ref.

Descriptors: *Dam construction, *Water supply development, Hydroelectric power, Irrigation, Rivers, *Morocco, Water resources development, Potable water.

Eighty percent of all state investments for agriculture in Morocco are concerned with irrigation projects. It is hoped that this policy will not only ensure adequate food supply for this country, which imports a considerable part of its basic food requirements, but also help to provide jobs and solve the severe problem of the rural exodus. In an average year 80% of the precipitation falls between November and April. The ratio between annual discharge in a typical dry year and the discharge in a typical wet year is as large as 1:6. Dry years often occur consecutively. One major project is the Al Massira multipurpose scheme, which is also the keystone of the Oum-er-R'bia development plan. The Al Massira dam is located halfway between the cities of Casablanca and Marrakesh on the lower reach of the Oum-er-R'bia river. The purpose of the plan is to supply drinking water for towns along the lower reach of the river, especially for the coastal region between Casablanca and Safi; to supply water to the phosphate industry; to extend the irrigated area in the Doukkala region from 40,000 to 100,000 ha; to supply peak energy at a yearly rate of 240 GWh; and to provide flood control. Specifics of dam construction discussed include selection of dam type, standard buttresses, grouting and drainage, foundation excavation, mass concrete, and monitoring arrangements. For the saddle dam construction used specific information is available concerning foundation, fill materials, spillways, hydrological data, bottom outlets, power intakes, and river diversion. (Baker-FRC)
W82-01724

EXPLOITING THE WATERS OF LAKE CHAD.
International Water Power and Dam Construction, Vol 33, No 8, p 15-16, August, 1981. 2 Fig, 1 Tab.

Descriptors: *Irrigation programs, *Canal construction, Seepage, Water supply, Water resources development, Resources development, Chad Basin, *Lake Chad, Lakes, *Africa, Nigeria.

An irrigation project drawing on the waters of one of the largest of Africa's lakes, Lake Chad, is described. The lake covers some 100,000 ha of flat clay plain in Bornu State, 120 km northeast of the state capital, Maiduguri. The lake is land-locked, with no outlet, and is fed mainly by the river Chari. The basic principle of the scheme is that water is drawn from Lake Chad through a 29 km intake channel to the main pumping station at Kirinowa. The main canal then runs for some 22 km to a diversion structure which provides a main canal to each of the three irrigated areas. The initial 9 km of the intake channel were first excavated by scrapers to half the final depth, when groundwater was found, and thereafter dredged. The remaining 20 km was dredged by floating cuttersuction dredgers. The main canal from Kirinowa station to the main diversion structure is 22 km long, and was a cut-and-fill construction with embankments; the bed was clay-lined to a minimum thickness of 1 meter. The project will have four main pumping stations. Hydrological studies show that lake levels during 1870-1970 have generally been higher than at present. Thus the droughts of the early 1970s are regarded as temporary aberrations, rather than as indicative of new low norms. Careful planning has ensured that the water balance in the lake can be maintained and the lake's variation in level can be kept to a reasonable minimum. (Baker-FRC)
W82-01726

CAPE TOWN WATERWORKS SERVICE RESERVOIRS: PLATTEKLOFF (1974) AND TYGERBERG (1964).
Civil Engineer in South Africa, Vol 22, No 1, p 19-21, January, 1980. 3 Fig.

Descriptors: *Reservoirs, *Water treatment, *Cape Town, South Africa, Water demand, Water resources development, Water supply.

The major purposes of normal gravity supply service reservoirs are to permit operation of filtration and pumping plant at substantially constant rates over given periods, usually of about a week, and to allow main pipeline capacity of less than the absolute peak demand rate; to maintain a more or less constant supply pressure as near as topography permits to the center of gravity of the area supplies by the reservoir, thus permitting optimum design of the distribution system and safeguarding this as well as private installations against excessive pressure; and to provide a supply in the event of short-term failure of or damage to conservation works, filtration works and pumping plants caused by normal and abnormal events. Two water supply projects are described which terminate in covered filtered water service reservoirs, the Wemmershoek and Voelvlei projects. It is difficult to forecast the optimum water levels for the various main reservoirs feeding a gravity supply. Storage depth is also difficult to determine objectively. Reservoirs with vertical walls of mass or reinforced concrete are usually cheapest, especially when surrounded by backfilling or embankment. The task of landscaping a service reservoir which is necessarily located above the level of most adjacent developments and is a landmark only to air travellers is easily done with planting of embankment slopes and grassing adjacent grounds. Brief mention is made of the construction costs. (Baker-FRC)
W82-01747

EVALUATING SCOUR AT CULVERT OUTLETS,
Colorado State Univ., Fort Collins. Engineering Research Center.
For primary bibliographic entry see Field 4D.
W82-01934

GROUT CURTAIN IN THE FOUNDATION OF THE ARCH DAM OF THE INGURI HYDROELECTRIC STATION,
E. V. Krylova, M. B. Remenyak, and G. G. Tuzhikhin.
Hydrotechnical Construction, No 10, p 991-996, October, 1980. 3 Fig, 2 Tab, 7 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 10, p 4-7, October, 1980.

Descriptors: *Grouting, *Dam foundations, *Arch dams, Foundation rocks, Permeability, Karst, Absorption, Rock mechanics, *Inguri Dam, USSR, Hydroelectric plants, Carbonate rocks, Seepage control.

The installation of the 120 m deep grout curtain in the foundation of the Inguri hydroelectric plant dam, USSR, is described. Although simulations indicated that seepage losses would not exceed the permissible limits, a grout curtain was constructed for protecting the abutting bank masses from water encroachment and for reducing general seepage discharge. Zones with relatively high permeability were found in the right bank fault and the left bank ancient terraces. The curtain is double-row with 1.7 m between rows and was constructed in descending zones of 5 m. Control holes were tested in crucial regions. Absorption of grout varied between 20 and 4000 kg per m. The greatest grout absorption occurred on the left bank, where karstification was present. Before grouting, 3% of the rocks had a specific water absorption of less than 0.02 liters per min, and after grouting, 80% had less than 0.03 liters per min. Maximum values of specific water absorption decreased from 3 to 0.71 liters per min. As of January 1980 the curtain is operating effectively. Further treatment is planned for some large joints. (Cassar-FRC)
W82-01973

RECORDING UNDERGROUND,
Yorkshire Water Authority (England).
C. Humphries.
Water, No 34, p 33-34, September, 1980. 2 Fig.

Descriptors: *Sewers, *Water mains, *Maps, Sewer systems, Water conveyance, Pipelines, Metropolitan water management, Water management, Standards, Wastewater management, *Great Britain.

Adequate records of sewers and water mains are essential for the design, construction, reconstruction, maintenance, and operation of these water conveyance systems. The water industry in Great Britain has about 500,000 kilometers of sewers and water mains buried out of sight which are worth perhaps 50,000 million pounds sterling. Location records are needed to provide clear information on the position, size, level, materials, function, and age of the apparatus. Condition records are needed to provide information on the condition and operational history of the apparatus, including the results of inspections and surveys and a record of all maintenance and repair work. There is a need for more comprehensive statutory minimum requirements for records and for more standardization of record systems. Standard formats should be adopted for record maps and a standard referencing system should be implemented. Duplicate sets of records should be maintained in a secure location. The possibility of future computerization of records should be considered when revising record systems. The Standing Technical Committee on Sewers and Water Mains has also made several recommendations with respect to access to maps and records, public access to information, the inclusion of non-statutory information in public utilities records, and special arrangements for fundings and transfer of records. (Carroll-FRC)
W82-02036

SULBY RESERVOIR - PROVIDING WATER FOR THE ISLE OF MAN,
Hill (G.H.)., Manchester (England).
P. G. Eccles.
Water Services, Vol 85, No 1023, p 233-235, May, 1981. 1 Fig.

Descriptors: *Rockfill dams, *Reservoir construction, *Reservoir stages, Reservoirs, Dam design, Long-term planning, Water resources development, *Isle of Man, Great Britain.

The construction of the Sulby reservoir includes construction of a dam designed to meet the Isle of Man's water needs for 25 years, followed by construction of a larger dam to meet more distant needs. The drawdown works, pumping station, and rising main are to be completed by spring 1981. The reservoir should be totally operational by the summer of 1982. The dam site is located along the Sulby river and is underlain by Manx slate. The outer shells of the dam are of rockfill obtained from the quarry within the reservoir basin. The original first stage dam is provided with a 750 mm thick central asphaltic concrete core designed to be extended later. After full development, the catchment area will be 1620 ha, with a reservoir capacity of 4540 liters. The water supply pipe has valved intakes at three levels, and water will be supplied by gravity to the filter plant at Sulby Village. Water is also supplied to a hydroelectric generating station below Block Eary. The reservoir is needed to meet the increasing summer demand of visitors to the island. (Small-FRC)
W82-02068

8C. Hydraulic Machinery

INTAKES AND OUTLETS FOR LOW-HEAD HYDROPOWER,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
C. A. Pugh.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY9, p 1029-1045, September, 1981. 16 Fig, 27 Ref.

Descriptors: *Hydroelectric plants, *Intakes, *Outlets, *Design criteria, Hydraulic structures, Hydraulic machinery, Turbines, Hydraulic turbines, Reviews, Construction costs, Powerplants, Vortices, Piers, Trash racks, Fish passages, Flow discharge.

A state of the art survey on design practices for hydropower development in low-head (less than 20 meters) sites is based on the literature and on information from manufacturers and consultants in the field. With rising fossil fuel costs making the low-head sites more attractive economically, it is desirable to determine possible design changes to lower construction costs without producing significant head losses. Flow passages for low-head hydropower development cannot be standardized because of structural and geological differences and fish passages. However, where geological and structural considerations are similar, the same design may be used for a series of installations, reducing engineering and design costs. The possibility of shortening draft tubes (responsible for 30% of civil costs) using boundary layer control is explored. No research in this area has been done on hydraulic turbines. Intakes may probably be reduced in size or simplified in shape without losing efficiency because flow volumes are low. An example is the use of flat surfaces to approximate curved surfaces. Many hydraulic structures were designed with the demands of high flows and pressures experienced in high-head systems. Since low-head systems do not exert these severe demands, it is possible that equipment can be simplified. (Cassar-FRC)
W82-01979

8D. Soil Mechanics

PROBABILISTIC STABILITY ANALYSIS OF EARTH SLOPES,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
E. H. Vanmarcke.
Engineering Geology, Vol 16, No 1/2, p 29-50, July, 1980. 10 Fig, 21 Ref.

Descriptors: *Stability analysis, *Slope stability, *Probabilistic process, Soil stabilization, Mathematical studies, Slopes.

The basic three-dimensional stability problem of earth slopes is considered within a probabilistic framework for slopes under drained, undrained, or partially drained conditions. The methodology presented permits analysis for fairly general shapes of the failure surface by representing effects attributable to the end sections of the failure surface in a simplified manner. It is necessary to account for the three-dimensional nature of the problem in extending conventional stability analysis into the realm of probability. Estimates can be obtained for the probability that failure will occur anywhere along an embankment, which has important implications in the design of cuts and slopes. This method can be a cornerstone for the construction of a more complete methodology of slope reliability assessment which can incorporate time effects and uncertainties about loading and environmental conditions. (Small-FRC)
W82-01952

CURRENT METHODS OF DYNAMIC ANALYSIS FOR SEISMIC STABILITY OF EARTH DAMS,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
W. F. Marcuson, III, P. F. Hadala, and A. G. Franklin.
Engineering Geology, Vol 16, No 1/2, p 19-28, July, 1980. 2 Fig, 21 Ref.

Descriptors: *Dam stability, *Stability analysis, *Earth dams, Seismology, Earthquakes, Liquefaction, Engineering.

Two methods used by the U.S. Army Engineers Waterways Experiment Station to analyze the seismic stability of earth dams are outlined. Evaluation of the liquefaction potential of a dam includes a field investigation, routine laboratory tests, development of a soil profile, seepage analysis, static analysis, development of design earthquake, dynamic analysis, determination of available strength of material, comparison of shear strength and shear stress, and factor of safety. Permanent displacement analysis combines the sliding block analysis with the embankment response analysis. This analysis leads to an estimate of the amount of permanent displacement of the rigid mass. This method also includes laboratory tests, stability analysis, computation of displacement potential, and determination of tolerable displacement potential. These analyses provide insight so that the proper engineering judgment can be made. (Small-FRC)
W82-01953

THE ACCURACY OF EQUILIBRIUM METHODS OF SLOPE STABILITY ANALYSIS,
California Univ., Berkeley. Dept. of Civil Engineering.
J. M. Duncan, and S. G. Wright.
Engineering Geology, Vol 16, No 1/2, p 5-17, July, 1980. 2 Fig, 6 Tab, 12 Ref.

Descriptors: *Stability analysis, *Slope stability, *Equilibrium, Mathematical studies, Safety, Slopes, Soil stabilization.

Equilibrium methods of slope stability analysis are discussed including equations, unknowns, and assumptions, and the accuracy of the methods is evaluated. Inaccuracies can arise from the assumptions that are made and neglected conditions of equilibrium. The ordinary method of slices, force equilibrium procedures, and Bishop's modified method do not satisfy all of the conditions of equilibrium. Under some circumstances, these methods may be inaccurate. For example, the ordinary method of slices may give values of F (factor of safety) which are 50% smaller than the corrected value if used for effective stress analyses of slopes with high pore pressures. Methods which satisfy all conditions of equilibrium, including Janbu's, Spencer's, and Morgenstern and Price's methods have accuracies of + or - 5%. When these methods are used, the engineer is justified in considering the factors of safety he calculates to be correct in terms of the mechanics of the problem. (Small-FRC)
W82-01954

8E. Rock Mechanics and Geology

TECTONIC STATE: ITS SIGNIFICANCE AND CHARACTERIZATION IN THE ASSESSMENT OF SEISMIC EFFECTS ASSOCIATED WITH RESERVOIR IMPOUNDING,
Geological Survey, Menlo Park, CA.
R. O. Castle, M. M. Clark, A. Grantz, and J. C. Savage.
Engineering Geology, Vol 15, No 1/2, p 53-99, January, 1980. 9 Fig, 5 Tab, 133 Ref.

Descriptors: *Reservoir filling, *Seismicity, *Tectonics, Rock mechanics, Geologic faults, Seismology, Strain, Stress, Geologic fractures, Earthquakes, Deformation, Geologic history, *Reservoir design.

An assessment of seismicity associated with filling of large reservoirs should begin with an evaluation of the natural tectonic state. This will reveal whether the impoundment itself is the basic cause of seismicity, it is coincidental, or it is the result of a triggering effect, which is most likely. Deformational style is more critical in forecasting the occurrence of impoundment-induced seismicity than are existing fractures or accumulated elastic strain. Reservoir-associated seismicity is usually seen in areas combining steeply dipping faults, relatively high strain rates, and other extensional or horizontal-shear strains. Reservoir loading may modify the natural tectonic state, as do the following: underground explosions, fluid injection, fluid extraction, underground mining, and volcanic emissions. The possibility of seismic activity is enhanced by reservoir filling as a result of increased fluid pressures and surface loading, which increases the likelihood of crustal failure in areas of normal and transcurrent faulting and inhibits failure in areas of thrust faulting. A table summarizes data on 57 dams throughout the world, their vital statistics, geology, and tectonic activity. Of 33 reservoir sites where seismic activity has been documented, 10 are in seismic areas. (Cassar-FRC)
W82-01951

8G. Materials

HYDRAULIC TESTING OF PLASTIC FILTER FABRICS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
Y. H. Chen, D. B. Simons, and P. M. Demery.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR3, p 307-324, September, 1981. 8 Fig, 2 Tab, 8 Ref.

Descriptors: *Plastics, *Fabrics, *Filters, *Hydraulic properties, *Erosion control, Filter media, Soil types, Bacteria, Permeability coefficient, Soil stabilization, Soil conservation, Soil water, Bank stabilization.

Plastic filter fabrics of the nonwoven type (mean opening size, 0.10-0.95 mm) were laboratory-tested in four types of fine soil (sand, loam, and two sandy loams) to document their hydraulic performances. These materials provide an inexpensive, durable, easy-to-install alternative to a graded filter system. They have been used in bank protection, subdrainage protection, beach protection, and erosion control at bridges. The hydraulic analysis of each fabric consisted of 6 phases: a water filtration discharge study, a water pressure analysis, an analysis of sediment discharge through the plastic filters, a soil size distribution analysis, an analysis of permeability changes, and a bacterial and fabric filter analysis. The presently used Corps of Engineers criteria were found too conservative. The following procedure is recommended for selecting a filter fabric: (1) determine the soil permeability coefficient and size distribution of soil layers to be protected, (2) apply given equation to determine whether or not the soil is a filter (natural graded soils usually are), and (3) select a fabric with a permeability coefficient equal to or larger than that of the soil, using one given equation if the soil layer is not a filter, and two given equations if the soil layer is a filter. Local clogging of the filter can be expected in the latter case under conditions of high discharge. (Cassar-FRC)
W82-01613

9. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

A PERSPECTIVE ON ESTUARINE AND COASTAL RESEARCH FUNDING,
Dartmouth Coll., Hanover, NH.
C. B. Officer, L. E. Cronin, R. B. Biggs, and J. H. Ryther.
Environmental Science and Technology, Vol 15, No 11, p 1282-1285, November, 1981. 3 Tab.

Descriptors: *Research facilities, *Estuaries, *Financing, *Publications, Research properties, Coastal waters, Administrative agencies, Environmental effects, Funding, Universities.

The academic community has produced 77% of the past 5 years' refereed research literature on estuaries, and federal, state, municipal, and industrial sources, the remainder. The most significant cause of this disproportionality is that scientists within the government laboratories are generally required to solve problems needing immediate attention, whereas academia performs more basic research. Academic institutions received 31-37% of total federal estuarine-related funds, depending on the source of the statistics. The National Science Foundation is given credit for more support (21%) than any single agency and has the lowest cost per publication. Most of the federal research facilities for marine environmental research have been established in the past 10 years, but academic research facilities have not been similarly expanded. The authors suggest that the academic community and federal agencies should cooperate in identifying and implementing research on a regional and national scale. (Cassar-FRC)
W82-01803

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

U.S. GEOLOGICAL SURVEY REPORTS ON THE WATER RESOURCES OF FLORIDA, 1886-1980, SECOND EDITION,
Geological Survey, Tallahassee, FL. Water Resources Div.
N. D. Hoy, J. D. Simmons, and M. Claiborne.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, $28.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-816, 1981. 212 p.

Descriptors: *Bibliographies, *Groundwater, *Surface water, Publications, Indexing, *Florida.

The U.S. Geological Survey has released a listing of its reports on water resources in Florida for the period 1886-1980. Most of the reports contained in the listing were prepared by the U.S. Geological Survey in cooperation with numerous public agencies in Florida. The compilation has a full bibliographic list of reports, arranged alphabetically by senior author. In addition, the reports are indexed by geographic areas and by subject. Only two lines are used for each entry in the indexed portions, the complete reference being given only in the bibliographic list. (USGS)
W82-01778

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SUBJECT INDEX

3- (TRIFLUOROMETHYL)-4-NITROPHENOL
Persistence of 3-(Trifluoromethyl)-4-Nitrophenol in Aquatic Environments,
W82-01798 5B

ACCUMULATION
Abiotic Versus Biotic Uptake of Radiophosphorus in Lake Water,
W82-01824 2H

ACID RAIN
Acid Precipitation,
W82-01607 5C

The Natural Acidity of Some Unpolluted Waters in Southeastern Alaska and Potential Impacts of Acid Rain,
W82-01867 5B

Acid Rain Agreement,
W82-01933 5B

Acid Rain and Environmental Policy,
W82-01987 5B

Plant Biotests in the Bioindication of the Rainfall Pollution in an Oil Refinery Region,
W82-02033 5C

ACIDIC WATER
Effect of Aluminum Speciation on Fish in Dilute Acidified Waters,
W82-01663 5C

The Natural Acidity of Some Unpolluted Waters in Southeastern Alaska and Potential Impacts of Acid Rain,
W82-01867 5B

ACTIVATED CARBON
Removal of Organics from Water by Granular Activated Carbon and Microorganisms,
W82-01628 5D

Tying Up TCE,
W82-01866 5G

ACTIVATED SLUDGE PROCESS
Activated Sludge Nickel Toxicity Studies,
W82-01895 5D

ACUTE TOXICITY
Standard Procedure for Testing the Acute Lethality of Liquid Effluents.
W82-01905 5A

ADIRONDACK REGION
Effect of Aluminum Speciation on Fish in Dilute Acidified Waters,
W82-01663 5C

ADSORPTION
Copper(II)- and Cadmium(II)-Binding Abilities of Some New Hampshire Freshwaters Determined by Dialysis Titration,
W82-01632 5F

Effect of Reagent Mixing Rate on Adsorption Process for Am-Fe2O3.H2O,
W82-01799 5F

AERATED LAGOONS
Parasite Egg and Cyst Reduction in Oxidation Ditches and Aerated Lagoons,
W82-01733 5D

AERATION
Destratification and Reaeration as Tools for In-Lake Management.
W82-01648 5G

AERIAL PHOTOGRAPHY
Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Taylor Creek, Fla., and Litle River, Ga., 1979 Data Report,
W82-01771 7B

AEROSOLS
Photometric Investigations of Precipitable Water and Optical Depth Wavelength Exponents in an Urban Area,
W82-01966 2B

AFRICA
Exploiting the Waters of Lake Chad.
W82-01726 8A

A Water Quality Assessment of Development in the Senegal River Basin,
W82-01740 6G

AGRICULTURAL CONSERVATION PROGRAM
Agricultural Conservation Program: An Evaluation,
W82-02019 3F

AGRICULTURAL ENGINEERING
Double and Monocropped Wheat and Grain Sorghum Under Different Tillage and Row Spacings,
W82-01862 2I

The Influence of Tillage on Soil Water Behavior,
W82-02022 2G

AGRICULTURAL RUNOFF
Nutrient Runoff from Agricultural and Non-Agricultural Watersheds,
W82-01662 5B

Eutrophication of the Salt Valley Reservoirs 1968-73. III. The Macroinvertebrate Community: Its Development, Composition, and Change in Response to Eutrophication,
W82-01797 5C

AGRICULTURAL WATERSHEDS
Limnology of Lake Rerewhakaaitu,
W82-01705 2H

Hydrologic Data for Experimental Agricultural Watersheds in the United States, 1972,
W82-01772 2A

AGRICULTURE
Water Requirements and Man-Induced Climate Change,
W82-01633 2D

Case Studies of Agricultural Water Conservation,
W82-01667 3F

AIR ENTRAINMENT
Excess Air in Groundwater,
W82-02099 2F

AIR POLLUTION
The Mercury Cycle,
W82-01869 5B

The Significance of Wet and Dry Synoptic Regions on Long-Range Transport of Pollution and Its Deposition,
W82-01877 5B

AIR POLLUTION EFFECTS
Acid Precipitation,
W82-01607 5C

Deposition of Sulphur Gases from Multiple Scattered Sources in Alberta,
W82-01868 5B

AIR POLLUTION SOURCES
Nitrous Oxide Emission from Simulated Overland Flow Wastewater Treatment Systems,
W82-01624 5D

ALABAMA
Effluent Fees, An Alternative System for Achieving Water Quality: A Case Study,
W82-01665 6F

ALASKA
Analysis of the Origin of Water Which Forms Large Aufeis Fields on the Arctic Slope of Alaska Using Ground and Landsat Data,
W82-01690 2C

ALBERTA
Glacier Surveys in Alberta - 1979,
W82-01855 2C

Deposition of Sulphur Gases from Multiple Scattered Sources in Alberta,
W82-01868 5B

ALGAE
Relationships Between Nannoplankton and Lake Trophic Status,
W82-01640 5C

Effect of the Algal Length/Aperture Length Ratio on Coulter Analyses of Lake Seston,
W82-01823 7B

Abiotic Versus Biotic Uptake of Radiophosphorus in Lake Water,
W82-01824 2H

Effect of Sodium Dodecylsulfate on Unicellular Green Algae of the Genus Chlorella,
W82-01920 5C

The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State,
W82-01924 2H

ALGAL GROWTH
Effects of Artificial Shading on Periphyton and Invertebrates in a New Zealand Stream,
W82-01701 5C

ALLEGHENY RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing: Allegheny River Basin; Pennsylvania-New York.
W82-01751 6D

ALLUVIAL RIVERS
The Application of Radioactive Tracers for Determination of Bed-Load Transport in Alluvial Rivers,
W82-01893 2J

ALTAMAHA RIVER BASIN
Water Resources Appraisal for Hydroelectric Licensing: Altamaha River Basin, Georgia,
W82-01764 6D

ALTERNATIVE PLANNING
A Comprehensive Methodology for Project Appraisal and Environmental Protection in Multinational River Basin Development,
W82-01914 6B

ALTITUDE
Evaluation of a Precipitation Map Using a Smoothed Elevation-Precipitation Relationship and Optimal Estimates (Kriging),
W82-01892 2B

ALUM
Aluminum Sulfate Treatment: Short-Term Effect on Complex Phosphorus Compounds in a Eutrophic Lake,
W82-01833 5F

ALUMINUM
Effect of Aluminum Speciation on Fish in Dilute Acidified Waters,
W82-01663 5C

AMERICIUM
Americium in Intertidal Sediments from the Coastal Environs of Windscale,
W82-02098 5B

AMMONIA
Increased Toxicity of Ammonia to Rainbow Trout (Salmo Gairdneri) Resulting from Reduced Concentrations of Dissolved Oxygen,
W82-01629 5C

ANADROMOUS FISH
Hydropower vs. Salmon: The Struggle of the Pacific Northwest's Anadromous Fish Resources for a Peaceful Coexistence with the Federal Columbia River Power System,
W82-01804 6E

ANAEROBIC DIGESTION
Production of Aromatic Acids During Anaerobic Digestion of Citrus Peel,
W82-02049 5D

ANIMAL WASTES
A Selective Medium for the Enumeration of Streptococcus Bovis by Membrane Filtration,
W82-01620 5A

Pollution from Farms,
W82-02039 5D

ANION EXCHANGE
The Removal of Organic Matter from Surface Water Supplies by Anion Exchange Resins,
W82-01697 5F

ANTARCTIC
A Model of the Antarctic Sink for Stratospheric Water Vapor,
W82-01686 2A

APPLES
Influence of Trickle and Sprinkle Irrigation on Golden Delicious Apple Quality,
W82-02001 3F

AQUACULTURE
Effect of Fertilizers on the Primary and Bacterial Production of Rearing Ponds in the Volga Delta,
W82-02077 2H

AQUATIC ANIMALS
A New Method for Assessing the Lethal Impact of Short-Term, High-Level Discharges of Pollutants on Aquatic Animals,
W82-01993 5C

AQUATIC DRIFT
Methods of Studying Invertebrate Drift in Rivers,
W82-02074 7A

AQUATIC ENVIRONMENT
Kinetics for the Aquatic Environment,
W82-01631 2K

Microbiology of the Aquatic Environment,
W82-01786 5C

Kinetics for the Aquatic Environment,
W82-01806 2K

On the Presence of Fecal Steroids in Sediments from Two Mexican Harbors,
W82-02012 5A

AQUATIC FUNGI
Aquatic Microbiology with Reference to Tannin Degradation,
W82-02028 5B

On Some Chytrids Found in Estuarine Habitats,
W82-02038 2L

AQUATIC LIFE
Microbiology of the Aquatic Environment,
W82-01786 5C

Biota and Biological Parameters as Environmental Indicators,
W82-01794 5C

Effects of the Aquatic Herbicide 2,4-D DMA on the Ecology of Experimental Ponds,
W82-01949 5C

Effect of Fertilizers on the Primary and Bacterial Production of Rearing Ponds in the Volga Delta,
W82-02077 2H

AQUATIC ORGANISMS
An Analysis of the Aquatic Macrophyte, Myriophyllum Exalbescens, as an Indicator of Metal Contamination of Aquatic Ecosystems near a Base Metal Smelter,
W82-02016 5A

AQUATIC PLANTS
Ecological and Physiological Features of the Root System of Inshore Hydrophytes,
W82-01715 5B

Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 5B

Investigation of Selective Uptake of Polychlorinated Biphenyls by Spartina Alterniflora Loisel,
W82-01813 5B

The Flowering of Wastewater Treatment,
W82-02015 5D

AQUATIC WEED CONTROL
Ecological Characteristics of the Rhizosphere Microflora of Myriophyllum Heterophyllum,
W82-01796 4A

AQUATIC WEEDS
Biological and Physical Investigations of Bodies of Water Beneath Dense Water Hyacinth Populations Before and After Chemical Treatment,
W82-01678 5B

AQUIFER CHARACTERISTICS
Selected Hydrogeologic Data from the Northern Great Plains Area of Montana,
W82-01777 7C

Hydrogeology of the Gatlinburg Area, Tennessee,
W82-01782 2F

AQUIFER SYSTEMS
Extension of the Integrodifferential Approach to Inhomogeneous Multiaquifer Systems,
W82-02017 2F

AQUIFERS
Numerical Analysis of Transient Salt/Fresh-Water Interface in Coastal Aquifers,
W82-01693 2F

Selected Drill-Stem-Test Data from the Northern Great Plains Area of Montana,
W82-01774 7C

An Aquifer Simulation Program for Micro-Based Processors,
W82-01879 2F

Mathematical Model for Regional Land Subsidence Due to Pumping 1. Integrated Aquifer Subsidence Equations Based on Vertical Displacement Only,
W82-01926 2F

Mathematical Model for Regional Land Subsidence Due to Pumping 2 Integrated Aquifer Subsidence Equations for Vertical and Horizontal Displacements,
W82-01927 2F

The Statistical Mechanical Theory of Groundwater Flow,
W82-01982 2F

An Integral Transform Method for the Linearized Boussinesq Groundwater Flow Equation,
W82-01984 2F

Hydraulic Connection Between Lake Michigan and a Shallow Ground-Water Aquifer,
W82-02010 2F

ARCATA
Rearing Pacific Salmon in Saltwater Ponds Fertilized with Domestic Wastewater, Data Report, June 1979 - May 1980,
W82-01906 3C

ARCH DAMS
Grout Curtain in the Foundation of the Arch Dam of the Inguri Hydroelectric Station,
W82-01973 8A

ARCTIC
Anomalies in Temperature and Rainfall During Warm Arctic Seasons as a Guide to the Formulation of Climate Scenarios,
W82-01975 2B

ARGENTINA
Flood Control on the Parana and Paraguay Rivers,
W82-01707 2E

Reviving the Rio Reconquista,
W82-02014 5G

ARGON
Excess Air in Groundwater,
W82-02099 2F

ARKANSAS RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing: Upper Arkansas River Basin; Colorado, Kansas, and New Mexico.
W82-01761 6D

AROMATIC COMPOUNDS
Reverse Phase Concentration of Trace Polycyclic Aromatic Hydrocarbons in Water,
W82-01689 5A

ARSENIC
Characterization of an Enzymatic Determination of Arsenic(V) Based on Response Surface Methodology,
W82-01656 5A

Interlaboratory Quality Control Study No. 26, Arsenic and Selenium in Water,
W82-01854 5A

ASBESTOS
Determination of Mineral Fiber Concentrations in Fish Tissues,
W82-01822 5C

Variations and Mechanisms of Asbestos Fibre Distribution in Stream Water,
W82-01853 5A

ATHABASCA GLACIER
Glacier Surveys in Alberta - 1979,
W82-01855 2C

ATMOSPHERIC LOADING
Loading Estimates to Lake Erie, 1967-1976,
W82-01852 5A

ATMOSPHERIC WATER
Photometric Investigations of Precipitable Water and Optical Depth Wavelength Exponents in an Urban Area,
W82-01966 2B

ATOMIC ABSORPTION SPECTROSCOPY
Determination of Germanium, Vanadium, and Titanium by Carbon Furnace Atomic Absorption Spectrometry,
W82-01836 5A

AUFEIS FIELDS
Analysis of the Origin of Water Which Forms Large Aufeis Fields on the Arctic Slope of Alaska Using Ground and Landsat Data,
W82-01690 2C

AUGERS
Screened Auger Aids Investigation,
W82-02096 7B

AUSTRALIA
Log Pearson III Distribution - Is It Applicable to Flood Frequency Analysis of Australian Streams,
W82-01731 2E

Geochemistry and Hydrodynamics in the Hutt and Leeman Evaporitic Lagoons, Western Australia: A Comparative Study,
W82-01746 2L

Transport of Salts in Catchments and Soils,
W82-01880 2G

The Influence of Tillage on Soil Water Behavior,
W82-02022 2G

Water: A Low-Priced But High-Cost Resource,
W82-02061 6C

Isolation of the Mycobacterium Avium-M. Intracellulare-M. Scrofulaceum Complex from Tank Water in Queensland, Australia,
W82-02069 5A

AUSTRIA
Water Quality Management of Lake Neusiedler, Austria,
W82-02090 5C

AUTOMATION
Developments in Instrumentation and Automation in Sewage Treatment,
W82-02043 5D

Where Do We Go from Here.
W82-02086 7A

AVAILABLE WATER
The Influence of Tillage on Soil Water Behavior,
W82-02022 2G

AWUIFERS
Records of Water Levels in Unconsolidated Deposits in Eastern South Dakota,
W82-01788 7C

BACTERIA
Sediment Bacterial Indicators in an Urban Shellfishing Substuary of the Lower Chesapeake Bay,
W82-01661 5A

Petroleum Degradation by Naturally Occurring Populations of Marine Bacteria from Middle Atlantic Outer Continental Shelf Waters,
W82-01683 5G

Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 5B

Distribution of Vibrio Parahaemolyticus in Finfish Harvested from Porto Novo (S. India) Environs: A Seasonal Study,
W82-01737 5A

Potential for Biodegradation of Phthalic Acid Esters in Marine Regions,
W82-01829 5B

The Role of Phototrophic Bacteria in the Sulfur Cycle of a Meromictic Lake,
W82-01831 2H

Numerical Taxonomy Analysis of Bacteria Isolated from the Completed 'Most Probable Numbers' Test for Coliform Bacilli,
W82-01911 5A

Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 5B

Substrate Flux into Biofilms of Any Thickness,
W82-01964 5D

The Population Ecology of Iron Bacteria (Genus Ochrobium) in a Stratified Eutrophic Lake,
W82-01997 2H

Abundance Dynamics of Microorganisms in the Decomposition of Macrophytes,
W82-01999 2H

Isolation of the Mycobacterium Avium-M. Intracellulare-M. Scrofulaceum Complex from Tank Water in Queensland, Australia,
W82-02069 5A

Bacterioplankton and Phytoplankton in the Kiev Sector of Kanev Reservoir During the Period of Its Formation,
W82-02081 2H

BALTIC SEA
International Cooperation to Protect the Baltic,
W82-02087 6E

BAMBOO
Using the Bamboo (Bambusa Vulgaris) as Field Drainage Material,
W82-01743 4A

BANANAS
Shortening the Irrigation Interval as a Means of Saving Water in a Banana Plantation,
W82-02093 3F

BASELINE STUDIES
Geographic Variations in Water Quality and Recreational Use Along the Upper Wallowa River and Selected Tributaries,
W82-01681 5A

The Natural Acidity of Some Unpolluted Waters in Southeastern Alaska and Potential Impacts of Acid Rain,
W82-01867 5B

BASIN IRRIGATION
The Effects of Man on Basin Runoff, and on the Water Balance and Water Stage of the Caspian Sea,
W82-01709 4C

Development of Solutions for Level-Basin Design,
W82-01976 3F

BASINS
Variations and Mechanisms of Asbestos Fibre Distribution in Stream Water,
W82-01853 5A

BED LOAD
Note on Two Limit Distributions of Bedload Movement,
W82-01643 2J

Sediment Analyses for Selected Sites in the South Platte River in Colorado and Nebraska, and the North Platte and Platte Rivers in Nebraska--Suspended Sediment, Bedload, and Bed Material,
W82-01776 2J

Diffusion of Sediment on the Lee of Dune-Like Bedforms: Theoretical and Numerical Analysis,
W82-01842 2J

The Application of Radioactive Tracers for Determination of Bed-Load Transport in Alluvial Rivers,
W82-01893 2J

BELFAST LOUGH
Effects of Pollution Upon the Benthos of Belfast Lough,
W82-02059 5C

BELIZE
A Limnological Investigation of a Tropical Fresh-Water Ecosystem: The Belize River, Belize, Central America,
W82-01682 5G

BENTHIC FAUNA
Device for Collecting Replicate Artificial Substrate Samples of Benthic Invertebrates in Large Rivers,
W82-01947 7B

Dredged Material Evaluations: Correlations Between Chemical and Biological Evaluation Procedures,
W82-01985 5C

The Effects of Mine Drainage and Organic Enrichment on Benthos in the River Nent System, Northern Pennines,
W82-02053 5C

BENTHOS
Biota and Biological Parameters as Environmental Indicators,
W82-01794 5C

Effects of Pollution Upon the Benthos of Belfast Lough,
W82-02059 5C

Phytobenthos of the River Tees and Its Tributaries,
W82-02065 2K

BIBLIOGRAPHIES
U.S. Geological Survey Reports on the Water Resources of Florida, 1886-1980, Second Edition,
W82-01778 10C

BIGHTS
Tide-Induced Residual Flow in Shallow Bays,
W82-02003 2L

BIOACCUMULATION
Toxicant Accumulation in Hydrobiont Tissues Following Effluent Discharge,
W82-01919 5C

BIOASSAY
Comparison of Liquid-Liquid Extraction and Resin Adsorption for Concentrating Mutagens in Ames Salmonella/Microsome Assays on Water,
W82-01812 5A

Determination of Free Metal Ion Concentrations Using Bioassays,
W82-01821 5A

Standard Procedure for Testing the Acute Lethality of Liquid Effluents.
W82-01905 5A

BIOCHEMISTRY
Tracing Food Webs with Stable Hydrogen Isotopes,
W82-02021 6G

BIODEGRADATION
Petroleum Degradation by Naturally Occurring Populations of Marine Bacteria from Middle Atlantic Outer Continental Shelf Waters,
W82-01683 5G

Dissolved Hydrocarbons and Related Microflora in a Fjordal Seaport: Sources, Sinks, Concentrations, and Kinetics,
W82-01816 5B

Potential for Biodegradation of Phthalic Acid Esters in Marine Regions,
W82-01829 5B

Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 5B

The Dynamics of Anaerobic Phenol Biodegradation in Lower Greenland,
W82-02071 5B

BIOINDICATORS
A Selective Medium for the Enumeration of Streptococcus Bovis by Membrane Filtration,
W82-01620 5A

Mercury Methylation by Fish Intestinal Contents,
W82-01830 5C

Variations in Trace Metal Content of the Mussel Choromytilus Meridionalis (Kr.) with Season and Sex,
W82-01969 5A

An Analysis of the Aquatic Macrophyte, Myriophyllum Exalbescens, as an Indicator of Metal Contamination of Aquatic Ecosystems near a Base Metal Smelter,
W82-02016 5A

Experience with a Simple Method for the Biological Evaluation of Surface Water Quality,
W82-02029 5A

BIOLOGICAL SAMPLES
Tracing Food Webs with Stable Hydrogen Isotopes,
W82-02021 6G

BIOLOGICAL WASTEWATER TREATMENT
Combining Sewer Water Purification Processes to Treat Effluents Produced by Transient Populations,
W82-01992 5D

BIOMASS
Biological Pollution and Pollution Control in Canals Diverting Flow from One River Basin to Another,
W82-01922 5C

BLACK RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing; Black River Basin, New York.
W82-01758 6D

BLACK WARRIOR RIVER
Effluent Fees, An Alternative System for Achieving Water Quality: A Case Study,
W82-01665 6F

BLEACHING WASTES
Oxygen Bleaching Shows Potential for Reducing Costs, Effluent Problems,
W82-01899 5D

BORDER IRRIGATION
Optimal Design of Border Irrigation Systems,
W82-01977 3F

BOTTOM CURRENTS
Contourites in Lake Superior,
W82-01935 2H

BOTTOM SEDIMENTS
On The Use of Carotenoid Stratigraphy in Lake Sediments for Detecting Past Developments of Phytoplankton,
W82-01706 2H

Distribution, Morphology, and Origin of Sedimentary Furrows in Cohesive Sediments, Southampton Water,
W82-01720 2L

BRACKISH WATER
Effect of Different Water Salinity Levels and Organic Matter Application on the Composition of Water Soluble and Exchangeable Bases in a Brackishwater Fish Pond Soil,
W82-02027 2H

BRAZIL
Irrigation for Brazil's Poligono Das Secas,
W82-01744 3F

BROMIDES
Bromide in Canterbury Ground Water,
W82-02056 5B

BROWN SOILS
Direct Evidence of Water-Soluble Organic Matter Leaching in Brown Earths and Slightly Podzolized Soils,
W82-02034 2G

BYPRODUCTS
Composition of Fruit and Vegetable Processing Wastes,
W82-01601 5D

CADMIUM
Copper(II)- and Cadmium(II)-Binding Abilities of Some New Hampshire Freshwaters Determined by Dialysis Titration,
W82-01632 5F

CALIFORNIA
Abundance, Life History, and Growth of Introduced Populations of the Opossum Shrimp (Mysis Relicta) in Subalpine California Lakes,
W82-01638 2H

Addendum to: Sources of Powerplant Cooling Water in the Desert Area of Southern California--Reconnaissance Study,
W82-01773 6B

The California State Water Project--Current Activities and Future Management Plans.
W82-01851 6E

CANADA
A National Survey of Tri(Haloalkyl)-, Trialkyl-, and Triarylphosphates in Canadian Drinking Water,
W82-01989 5B

CANAL CONSTRUCTION
Exploiting the Waters of Lake Chad.
W82-01726 8A

CANALS
Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 5B

Biological Pollution and Pollution Control in Canals Diverting Flow from One River Basin to Another,
W82-01922 5C

CAPE PENINSULA
Towards an Understanding of the Effects of Orography on the Distribution of Precipitation Over the Cape Peninsula,
W82-02085 2B

CAPE TOWN
Cape Town Waterworks Service Reservoirs: Platteklоff (1974) and Tygerberg (1964).
W82-01747 8A

CARBOHYDRATES
Composition of Fruit and Vegetable Processing Wastes,
W82-01601 5D

CARBON CYCLE
A Sensitivity Analysis of an Ecosystem Model of Estuarine Carbon Flow,
W82-01875 2L

CARBON DIOXIDE
Water Requirements and Man-Induced Climate Change,
W82-01633 2D

Summer Ice and Carbon Dioxide,
W82-01843 2C

A Control Mechanism of the Phytoplankton Respiration in a Eutrophic Reservoir,
W82-02030 2H

CARCINOGENS
Health Aspects of Organic Substances in South African Waters - Opinions and Realities,
W82-01712 5A

CAROTENOIDS
On The Use of Carotenoid Stratigraphy in Lake Sediments for Detecting Past Developments of Phytoplankton,
W82-01706 2H

CARP
Dynamics of Carp Growth and Biosynthetic Processes in the Liver of the Carp Reared in Containers in Heated Waste Water from Themal Power Stations,
W82-01998 5C

CARRYING CAPACITY
The Lake Tahoe Basin: A Systems Analysis of Its Characteristics and Human Carrying Capacity,
W82-01807 6A

CASE STUDIES
The National Commission on Water Quality: A Case Study in Congressional Policy Analysis,
W82-01669 6B

CASPIAN SEA
The Effects of Man on Basin Runoff, and on the Water Balance and Water Stage of the Caspian Sea,
W82-01709 4C

CATHODES
A Mechanistic Model of a Packed-Bed Electrode Cell to Remove Metal Ions from Dilute Effluent Solutions,
W82-02050 5D

CATTLE
Effects of a Cattle Feedlot on Ground-Water Quality in the South Platte River Valley Near Greeley, Colorado,
W82-01790 5B

CENTRIFUGATION
Centrifugal Dewatering,
W82-01912 5E

CESIUM RADIOISOTOPES
Spatial and Temporal Variations in Cesium-137 and Carbon in Sediments of Saguenay Fjord (Variations Spatiales et Temporelles du Cesium-137 et du Carbone dans des Sediments du Fjord du Saguenay),
W82-01644 2J

CHAMBAL PROJECT
The Chambal Project: Problems and Solutions,
W82-01739 4A

CHANNEL MORPHOLOGY
Hydraulic Geometry and Minimum Rate of Energy Dissipation,
W82-01918 2J

CHELATING AGENTS
Voltammetric Studies on the Stability of the ZN(II) Chelates with NTA and EDTA and the Kinetics of their Formation in Lake Ontario Water,
W82-01839 2H

CHEMICAL ANALYSIS
Reverse Phase Concentration of Trace Polycyclic Aromatic Hydrocarbons in Water,
W82-01689 5A

CHEMICAL COMPOSITION
Plant Biotests in the Bioindication of the Rainfall Pollution in an Oil Refinery Region,
W82-02033 5C

CHEMICAL PRECIPITATION
Precipitate Flotation Studies with Monolauryl Phosphate and Monolauryldithiocarbamate,
W82-01863 5D

CHEMICAL PROPERTIES
Groundwater Chemistry of Some Selected Areas in Southeaster Norway,
W82-02020 2K

CHEMICAL REACTIONS
Nitrate Reduction to Ammonium and Organic Nitrogen in an Estuarine Sediment,
W82-01625 5B

Kinetics for the Aquatic Environment,
W82-01631 2K

Kinetics for the Aquatic Environment,
W82-01806 2K

The Geochemical Control of Seawater (Sillen Revisited),
W82-01936 2K

CHEMICAL TREATMENT
Combining Sewer Water Purification Processes to Treat Effluents Produced by Transient Populations,
W82-01992 5D

CHEMICAL WASTES
Organic Compounds Found Near Dump Sites in Niagara Falls, New York,
W82-01802 5B

Water Pollution: A Risk to the Future in the Case of the Rhine (Eaux Polluees' Avenir en Danger Dans le Cas du Rhin),
W82-02067 5G

Screened Auger Aids Investigation,
W82-02096 7B

CHEMICAL WASTEWATER
Oxidation of Phenolic Antioxidants in a River System,
W82-01801 5B

Predicting Priority Pollutants from Petrochemical Processes,
W82-01809 5B

A Multilevel Model and Algorithm for Some Multiobjective Problems,
W82-01884 6A

CHEMOCLINE
Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 2H

CHEMUNG COUNTY
Simulating Effects of Combined Sewer Overflows,
W82-01864 6A

CHESAPEAKE BAY
Public Opinion and Interest Group Positions on Chesapeake Bay Issues: Implications for Resource Management,
W82-01642 6B

Sediment Bacterial Indicators in an Urban Shellfishing Substuary of the Lower Chesapeake Bay,
W82-01661 5A

CHICAGO
Parasite Ova in Anaerobically Digested Sludge,
W82-02018 5B

CHINA
Erosion and Sediment Control in China's Yellow River Basin,
W82-01729 4D

Impressions of Soil and Water Conservation in China,
W82-01730 4D

CHLORALKALI PLANTS
Removal of Elemental Mercury from Wastewaters Using Polysulfides,
W82-01800 5D

CHLORATES
Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
W82-01835 5A

CHLORINATION
The Effects of Chlorinated Sea Water on the Blue Crab, Callinectes Sapidus,
W82-01679 5C

CHLOROPHYLL
Rapid, Quantitative Separation of Chlorophylls and Their Degradation Products by High-Performance Liquid Chromatography,
W82-01619 5A

Effects of Thermocline Displacement Upon Subsurface Chlorophyll Maxima in Lake Michigan,
W82-01957 2H

Seasonal and Diurnal Changes of Chlorophyll in a Tropical Fresh Water Impoundment,
W82-02052 2H

CHLOROPHYLL A
Some Effects of Sewage Discharge Upon Phytoplankton in Hong Kong,
W82-02095 5C

CHROMIUM
Chromium Levels in Fish from a Lake Chronically Contaminated with Chromates from Cooling Towers,
W82-01941 5B

Ion Flotation-Spectrophotometric Determination of Traces of Chromium (VI),
W82-02007 5A

CITRUS FRUITS
Production of Aromatic Acids During Anaerobic Digestion of Citrus Peel,
W82-02049 5D

CIVIL ENGINEERING
Irrigation for Brazil's Poligono Das Secas,
W82-01744 3F

CLADOPHORA
Denitrification Associated With Periphyton Communities,
W82-01814 5B

CLARIFICATION
Technology and Performance of the Hi-Capacity Thickener,
W82-01929 5D

CLASSIFICATION
Water Quality Indices: An Additional Management Tool,
W82-01994 5G

CLEAR-CUTTING
Long Term Responses of Streamflow Following Clearcutting and Regrowth,
W82-01610 4C

CLIMATOLOGY
Water Requirements and Man-Induced Climate Change,
W82-01633 2D

CLOUD PHYSICS
Water-Ice and Water-Updraft Relationships Near -10 Degrees C Within Populations of Florida Cumuli,
W82-01968 2B

COAGULATION
Using Zeta Potential to Optimize Coagulating Aid Doses Used to Treat Food Processing Wastes,
W82-01627 5D

Effect of Reagent Mixing Rate on Adsorption Process for Am-Fe2O3.H2O,
W82-01799 5F

COAL MINING
Effects of Sedimentation on the Gravels of an Industrial River System,
W82-01881 5C

COASTAL AQUIFERS
Numerical Analysis of Transient Salt/Fresh-Water Interface in Coastal Aquifers,
W82-01693 2F

Steady Periodic Flow Through a Rectangular Dam,
W82-01983 2F

COASTAL WATERS
Gulf of Mexico: A Socioeconomic View of Competing Resources,
W82-01901 6B

COASTAL ZONE MANAGEMENT
Relating Population Growth to Shellfish Bed Closures: A Case Study from North Carolina,
W82-01641 5C

COLIFORMS
Numerical Taxonomy Analysis of Bacteria Isolated from the Completed 'Most Probable Numbers' Test for Coliform Bacilli,
W82-01911 5A

COLOR REMOVAL
Kinetics and Diffusion Processes in Colour Removal from Effluent Using Wood as an Adsorbent,
W82-02047 5D

COLORADO
Sediment Analyses for Selected Sites in the South Platte River in Colorado and Nebraska, and the North Platte and Platte Rivers in Nebraska--Suspended Sediment, Bedload, and Bed Material,
W82-01776 2J

Effects of a Cattle Feedlot on Ground-Water Quality in the South Platte River Valley Near Greeley, Colorado,
W82-01790 5B

Environmental and Physiological Control of Water Flux Through Pinus Contorta,
W82-01827 2D

COLORADO RIVER BASIN
Water Management in the Colorado River Basin: An Application of Nonlinear Transportation Algorithms,
W82-01677 6A

Water Resources Appraisals for Hydroelectric Licensing; Colorado River Basin, Texas.
W82-01752 6D

COLUMBIA RIVER
Hydropower vs. Salmon: The Struggle of the Pacific Northwest's Anadromous Fish Resources for a Peaceful Coexistence with the Federal Columbia River Power System,
W82-01804 6E

COMBINED TREATMENT
Combining Sewer Water Purification Processes to Treat Effluents Produced by Transient Populations,
W82-01992 5D

COMPREHENSIVE PLANNING
The California State Water Project--Current Activities and Future Management Plans.
W82-01851 6E

COMPRESSIBILITY
Mathematical Model for Regional Land Subsidence Due to Pumping 1. Integrated Aquifer Subsidence Equations Based on Vertical Displacement Only,
W82-01926 2F

Mathematical Model for Regional Land Subsidence Due to Pumping 2 Integrated Aquifer Subsidence Equations for Vertical and Horizontal Displacements,
W82-01927 2F

COMPUTER PROGRAMS
A Structural Systems Analysis Approach to Determine Optimum Operating Policies for Irrigation and Hydropower Generation for Water Resources, Systems,
W82-01680 6A

An Aquifer Simulation Program for Micro-Based Processors,
W82-01879 2F

CONDUCTIVITY
Simple Retention Time Analysis in Trickling Filters Using Conductivity,
W82-01876 5D

Discharge Measurements by a New-Formed Relative Salt-Dilution Method in Small Turbulent Streams,
W82-01891 7B

CONGRESSIONAL POLICY
The National Commission on Water Quality: A Case Study in Congressional Policy Analysis,
W82-01669 6B

CONJUNCTIVE USE
Operating Policies for a Surface/Ground Water System,
W82-01741 4B

Food and Energy Production: Conjunctive Water Planning,
W82-01856 3C

CONSERVATION
Agricultural Conservation Program: An Evaluation,
W82-02019 3F

CONSUMPTIVE USE
Ways of Successive Refinement of Methods of Calculating the Duty of Water,
W82-02094 2D

CONTAMINATION
On the Presence of Fecal Steroids in Sediments from Two Mexican Harbors,
W82-02012 5A

An Analysis of the Aquatic Macrophyte, Myriophyllum Exalbescens, as an Indicator of Metal Contamination of Aquatic Ecosystems near a Base Metal Smelter,
W82-02016 5A

CONTOURS
Contourites in Lake Superior,
W82-01935 2H

CONVECTIVE PRECIPITATION
Water-Ice and Water-Updraft Relationships Near -10 Degrees C Within Populations of Florida Cumuli,
W82-01968 2B

COOLING
Cooling Potential of Missouri River in Missouri,
W82-01654 5B

COOLING WATER
Water Resources Appraisal for Hydroelectric Licensing; Menominee River Basin; Michigan, Wisconsin,
W82-01753 6D

Water Resources Appraisals for Hydroelectric Licensing; Lower Red River Basin; Arkansas, Louisiana, Oklahoma and Texas,
W82-01754 6D

Water Resources Appraisal for Hydroelectric Licensing: Penobscot River Basin, Maine,
W82-01763 6D

Water Resources Appraisal for Hydroelectric Licensing: Altamaha River Basin, Georgia,
W82-01764 6D

Water Resources Appraisals for Hydroelectric Licensing, Saginaw and Au Sable River Basins Area, Michigan.
W82-01767 6D

Chromium Levels in Fish from a Lake Chronically Contaminated with Chromates from Cooling Towers,
W82-01941 5B

Ecological and Physiological Characteristics of Dikerogammarus Haemobaphes in the Areas in Which Heated Water Is Discharged from the Tripol'ye Power Station,
W82-01970 5C

COOPER
Determination of Free Metal Ion Concentrations Using Bioassays,
W82-01821 5A

COPEPODS
Determination of Free Metal Ion Concentrations Using Bioassays,
W82-01821 5A

COPPER
Copper(II)- and Cadmium(II)-Binding Abilities of Some New Hampshire Freshwaters Determined by Dialysis Titration,
W82-01632 5F

Effect of the Copper Content of Distillery Spent Wash on Its Utilization for Single-Cell Protein Production by Geotrichum Candidum, Hansenula Anomala and Candida Kruzei,
W82-01750 5C

Extraction of Copper with Liquid Surfactant Membranes,
W82-01896 5D

A New Method for Assessing the Lethal Impact of Short-Term, High-Level Discharges of Pollutants on Aquatic Animals,
W82-01993 5C

CORN
Simulation of Soil Water Within the Root Zone of a Corn Crop,
W82-01834 2G

COST-BENEFIT ANALYSIS
River Thermal Standards Costs in the Upper Midwest,
W82-01655 6B

A Comprehensive Methodology for Project Appraisal and Environmental Protection in Multinational River Basin Development,
W82-01914 6B

COST SHARING
Agricultural Conservation Program: An Evaluation,
W82-02019 3F

CRABS
The Effects of Chlorinated Sea Water on the Blue Crab, Callinectes Sapidus,
W82-01679 5C

CROP PRODUCTION
Note on the Role of Irrigation Frequencies on the Regrowth of Berseem,
W82-01745 2I

Effect of Profile Soil Moisture and Phosphorus Levels on the Growth and Yield of Anonutrient Uptake by Chickpea,
W82-02042 2I

Effect of Soil-Moisture Tensions and Preceding Winter Crops on the Yield and Water-Use Efficiency of Succeeding Crop of Tossa Jute,
W82-02045 2I

CROP YIELD
River Basin Sequential Water Use and Salinity Effects on Crop Yield Economics,
W82-01671 3F

Effect of Periods of Moisture Availability on Groundnut Crop in the Saurashtra Region of Gujarat,
W82-01708 2G

Effect of Irrigation Practices and Methods of Sowing-Cum-Irrigation on the Performance of Safflower,
W82-01878 3F

Control of Peach Tree Growth and Productivity by Regulated Water Supply, Tree Density, and Summer Pruning,
W82-01883 2I

Intraseasonal Water Allocation in Deficit Irrigation,
W82-01916 3F

Optimal Design of Border Irrigation Systems,
W82-01977 3F

CROPLAND
Crop Residue Removal and Tillage; Effects on Soil Erosion and Nutrient Loss in the Corn Belt,
W82-01770 2J

R-Factors for Soil Loss Impact Prediction,
W82-01963 2J

CRYSTAL GROWTH
Non-Equilibrium Water/Rock Interactions,
W82-01684 1A

CRYSTALLIZATION
Water-Ice and Water-Updraft Relationships Near -10 Degrees C Within Populations of Florida Cumuli,
W82-01968 2B

CULTIVATION
Crop Residue Removal and Tillage; Effects on Soil Erosion and Nutrient Loss in the Corn Belt,
W82-01770 2J

CULTURE MEDIA
A Selective Medium for the Enumeration of Streptococcus Bovis by Membrane Filtration,
W82-01620 5A

CULTURES
Seasonal Variations in the Actual Fecundity of Daphnia Magna in a Laboratory Culture,
W82-02083 5C

CULVERTS
Legal Challenge of the Ungaged Watershed,
W82-01664 2E

Evaluating Scour at Culvert Outlets,
W82-01934 4D

LIBRARY U. OF I. URBANA-CHAMPAIGN

CUMBERLAND RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing; Cumberland River Basin; Kentucky-Tennessee.
W82-01756 6D

CURRENT METERS
Coherence Between Wind and Current Events in a Nearshore, Shallow Water, Wave Dominated Environment,
W82-01674 2L

CYCLING NUTRIENTS
Phosphorus Cycling in a Dense Potamogeton Pectinatus L. Bed,
W82-02070 2H

CYPRESS DOMES
The Effects of Secondary Sewage Effluent on the Water Quality, Nutrient Cycles and Mass Balances, and Accumulation of Soil Organic Matter in Cypress Domes,
W82-01687 5G

DAM CONSTRUCTION
Morocco's Largest Multipurpose Scheme,
W82-01724 8A

DAM FOUNDATIONS
Grout Curtain in the Foundation of the Arch Dam of the Inguri Hydroelectric Station,
W82-01973 8A

DAM STABILITY
Current Methods of Dynamic Analysis for Seismic Stability of Earth Dams,
W82-01953 8D

DAMS
Recent Changes in Level of Lake Victoria,
W82-01711 4A

Stage-Discharge Relations at Dams on the Illinois and Des Plaines Rivers in Illinois,
W82-01793 4A

Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 5G

DAPHNIA
Acute Toxicity of an In Situ Shale Oil Process Wastewater and It's Major Components to Daphnia Magna,
W82-01811 5C

Seasonal Variations in the Actual Fecundity of Daphnia Magna in a Laboratory Culture,
W82-02083 5C

DATA ACQUISITION
Where Do We Go from Here.
W82-02086 7A

DATA COLLECTIONS
Selected Drill-Stem-Test Data from the Northern Great Plains Area of Montana,
W82-01774 7C

Sediment Analyses for Selected Sites in the South Platte River in Colorado and Nebraska, and the North Platte and Platte Rivers in Nebraska--Suspended Sediment, Bedload, and Bed Material,
W82-01776 2J

Selected Hydrogeologic Data from the Northern Great Plains Area of Montana,
W82-01777 7C

Low-Flow Characteristics of Streams in the Deschutes River Basin, Washington,
W82-01781 2E

Water-Resources Investigations of the U.S. Geological Survey in Montana, October 1980 through September 1981,
W82-01787 7C

Where Do We Go from Here.
W82-02086 7A

DATA TRANSMISSION
Where Do We Go from Here.
W82-02086 7A

DECISION MAKING
A Multilevel Model and Algorithm for Some Multiobjective Problems,
W82-01884 6A

A Comprehensive Methodology for Project Appraisal and Environmental Protection in Multinational River Basin Development,
W82-01914 6B

Acid Rain and Environmental Policy,
W82-01987 5B

DECOMPOSITION
Abundance Dynamics of Microorganisms in the Decomposition of Macrophytes,
W82-01999 2H

DEGRADATION
Persistence of 3-(Trifluoromethyl)-4-Nitrophenol in Aquatic Environments,
W82-01798 5B

DEGREE-DAY FACTOR
On the Values and Variability of Degree-Day Melting Factor in Finland,
W82-01735 2C

DENITRIFICATION
Denitrification Associated With Periphyton Communities,
W82-01814 5B

DENSITY
Effect of Bulk Density on Calibration of Neutron Moisture Probe for Organic Soils,
W82-01861 2G

DESALINATION
Cycling Zone Adsorption Applied to Purification of Brackish Water with Thermally Regenerable Ion-Exchange Resins,
W82-01696 3A

DESIGN CRITERIA
Intakes and Outlets for Low-Head Hydropower,
W82-01979 8C

Technical and Economic Implications of Installing an Industrial Waste-Water Pretreatment Plant,
W82-02044 5D

DESIGN FLOW
Statistical Determination of Design Low Flows,
W82-01858 2E

DESTRATIFICATION
Destratification and Reaeration as Tools for In-Lake Management,
W82-01648 5G

Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 5G

DEUTERIUM
Measurement of Heavy Water Concentration with a Density Meter,
W82-02009 5A

DEVELOPING COUNTRIES
Remote Sensing in Development,
W82-01719 7B

Simplified Method for Rainfall Intensities,
W82-01978 2B

Wanted: Water for Development,
W82-02088 6D

Disinfection of Drinking Water in Developing Countries,
W82-02091 5F

DIATOMS
Periphytic Community Response to Chronic Nutrient Enrichment by a Reservoir Discharge,
W82-01658 5C

DIFFUSION COEFFICIENT
Seasonal and Spring-Neap Tidal Dependence of Axial Dispersion Coefficients in the Severn - A Wide, Vertically Mixed Estuary,
W82-01749 2L

Properties of the Sorptivity for Exponential Diffusivity and Application to the Measurement of the Soil Water Diffusivity,
W82-01897 2G

DISCHARGE MEASUREMENT
Discharge Measurements by a New-Formed Relative Salt-Dilution Method in Small Turbulent Streams,
W82-01891 7B

DISEASES
Infectious Waterborne Diseases,
W82-01784 5A

DISINFECTION
Disinfection of Drinking Water in Developing Countries,
W82-02091 5F

DISPERSIVITY
Scale-Dependent Dispersion in a Stratified Granular Aquifer,
W82-01986 2F

DISSOLVED OXYGEN
Increased Toxicity of Ammonia to Rainbow Trout (Salmo Gairdneri) Resulting from Reduced Concentrations of Dissolved Oxygen,
W82-01629 5C

Dissolved Oxygen Dependent Phosphorus Release from Profundal Sediments of Lake Constance (Obersee),
W82-02055 2H

DISSOLVED SOLIDS
The Use of Specific Conductance in Studies of Natural Waters and Soil Solutions,
W82-01646 7A

Watershed Constituent Loading Analysis Utilizing Empirical Hydro-Chemical Modeling Techniques,
W82-01676 5B

DISTILLATION
Multi-Saline Sample Distillation Apparatus for Hydrogen Isotope Analyses: Design and Accuracy,
W82-01789 3A

DISTRIBUTION
Development of Solutions for Level-Basin Design,
W82-01976 3F

DIVERSION
Hydrology of Okarito Lagoon and the Inferred Effects of Selective Logging in Okarito Forest,
W82-01703 4C

Biological Consequences of Stream Routing Through a Final-Cut Strip Mine Pit: Benthic Macroinvertebrates,
W82-01948 4A

DIVERSION STRUCTURES
Erosion and Sediment Control in China's Yellow River Basin,
W82-01729 4D

DORCHESTER COUNTY
Investigations into the Dynamics of Water Movement on a Low Relief Landscape on the Eastern Shore of Maryland,
W82-01673 2F

DRAINAGE
Simple In Situ Determination of Hydraulic Conductivity by Power Function Descriptions of Drainage,
W82-01666 2G

The Chambal Project: Problems and Solutions,
W82-01739 4A

Using the Bamboo (Bambusa Vulgaris) as Field Drainage Material,
W82-01743 4A

DRAINAGE CANALS
Parish Is Not Liable for Subsidence.
W82-01603 6E

DRAWDOWN
Drawdowns at the Free Water Table During Pumping Tests in Artesian and Semiartesian Aquifers,
W82-01890 2F

DREDGING
Parish Is Not Liable for Subsidence.
W82-01603 6E

Impacts of Navigational Dredging on Fish and Wildlife: A Literature Review,
W82-01768 6G

Estuarine Dredge and Fill Activities: A Review of Impacts,
W82-01805 2L

A Test Utilizing Sediment Traps, Survey Rods, and Radiographs to Monitor Sediment Accumulation from a Dredging Disposal Operation,
W82-01950 7B

Dredged Material Evaluations: Correlations Between Chemical and Biological Evaluation Procedures,
W82-01985 5C

DRIFT
Methods of Studying Invertebrate Drift in Rivers,
W82-02074 7A

DRILLING EQUIPMENT
Screened Auger Aids Investigation,
W82-02096 7B

DRINKING WATER
Planning with Great Uncertainty: A Review and Case Study of the Safe Drinking Water Controversy,
W82-01606 5A

An Alternative for Meeting the Nitrate Standard for Public Water Supplies,
W82-01623 5C

Regulating the Quality of Drinking Water: An Economic Analysis of the Safe Drinking Water Act of 1974,
W82-01691 5G

Health Aspects of Organic Substances in South African Waters - Opinions and Realities,
W82-01712 5A

Drinking Water and Its Treatment: An Interview with Professor Sontheimer,
W82-01728 5F

DRIP IRRIGATION
Drip Irrigation Uniformity Considering Emitter Plugging,
W82-01860 3F

DUNES
Diffusion of Sediment on the Lee of Dune-Like Bedforms: Theoretical and Numerical Analysis,
W82-01842 2J

DUPUIT-FORCHHEIMER THEORY
Steady Periodic Flow Through a Rectangular Dam,
W82-01983 2F

DYE RELEASES
Quality of Water and Time of Travel in Part of Tillatoba Creek Basin, Mississippi, October 1974 to September 1980,
W82-01791 7C

DYES
Kinetics and Diffusion Processes in Colour Removal from Effluent Using Wood as an Adsorbent,
W82-02047 5D

EARTH DAMS
Current Methods of Dynamic Analysis for Seismic Stability of Earth Dams,
W82-01953 8D

ECOLOGICAL EFFECTS
Ecological Studies of Phytoplankton in the Waikato River and Its Catchment,
W82-01704 5C

Estuarine Dredge and Fill Activities: A Review of Impacts,
W82-01805 2L

Effects of Sedimentation on the Gravels of an Industrial River System,
W82-01881 5C

The Value of Ecological Monitoring in the Management of Petroleum Industry Effluent Discharges: Experience in Esso Petroleum Company U.K. Refineries,
W82-01913 5G

Temperature Tolerance and the Final Preferendum - Rapid Methods for the Assessment of Optimum Growth Temperatures,
W82-01996 5C

ECONOMIC ANALYSIS
Regulating the Quality of Drinking Water: An Economic Analysis of the Safe Drinking Water Act of 1974,
W82-01691 5G

ECONOMIC ASPECTS
Case Studies of Agricultural Water Conservation,
W82-01667 3F

Standards and Charges in the Control of Trade Effluent Discharges to Public Sewers in England and Wales,
W82-01717 6C

Stationary Source Pollution Policy and Choices for Reform,
W82-01847 6E

Long-Run Effects of Environmental Regulation,
W82-01848 6A

The California State Water Project--Current Activities and Future Management Plans.
W82-01851 6E

Gulf of Mexico: A Socioeconomic View of Competing Resources,
W82-01901 6B

Economic Instruments for Controlling Effluent Discharges to the River Tees Estuary,
W82-02060 2L

ECONOMIC FEASIBILITY
Regulating the Quality of Drinking Water: An Economic Analysis of the Safe Drinking Water Act of 1974,
W82-01691 5G

ECONOMICS
The Management of Water Resources: A Synthesis of Goal Programming and Input-Output Analysis with Application to the Iowa Economy,
W82-01685 6A

An Economic and Institutional Assessment of the Water Problem Facing the Tucson Basin,
W82-01698 6B

ECOSYSTEMS
A Limnological Investigation of a Tropical Fresh-Water Ecosystem: The Belize River, Belize, Central America,
W82-01682 5G

A Sensitivity Analysis of an Ecosystem Model of Estuarine Carbon Flow,
W82-01875 2L

Gulf of Mexico Wetlands: Value, State of Knowledge and Research Needs,
W82-01902 2L

The Modeling of Aquatic Ecological Systems,
W82-01972 5B

An Analysis of the Aquatic Macrophyte, Myriophyllum Exalbescens, as an Indicator of Metal Contamination of Aquatic Ecosystems near a Base Metal Smelter,
W82-02016 5A

Tracing Food Webs with Stable Hydrogen Isotopes,
W82-02021 6G

EFFLUENT CHARGES
Effluent Fees, An Alternative System for Achieving Water Quality: A Case Study,
W82-01665 6F

Standards and Charges in the Control of Trade Effluent Discharges to Public Sewers in England and Wales,
W82-01717 6C

EFFLUENT STANDARDS
Water Sanitation Legislation Regarded as the Basis of Water Quality Monitoring,
W82-01990 6E

EFFLUENTS
Standards and Charges in the Control of Trade Effluent Discharges to Public Sewers in England and Wales,
W82-01717 6C

Loading Estimates to Lake Erie, 1967-1976,
W82-01852 5A

Standard Procedure for Testing the Acute Lethality of Liquid Effluents.
W82-01905 5A

Toxicant Accumulation in Hydrobiont Tissues Following Effluent Discharge,
W82-01919 5C

Microbial Pollution of Coasts and Estuaries: The Public Health Implications,
W82-02051 5C

Economic Instruments for Controlling Effluent Discharges to the River Tees Estuary,
W82-02060 2L

EGGS
Parasite Ova in Anaerobically Digested Sludge,
W82-02018 5B

EGYPT
Environmental Studies: Their Implications and the Special Case of Egypt,
W82-02062 6G

ELECTRIC POWER PRODUCTION
Severn Barrage Scheme Gets Favourable Response.
W82-02089 6B

ELECTRIC POWERPLANTS
Cooling Potential of Missouri River in Missouri,
W82-01654 5B

River Thermal Standards Costs in the Upper Midwest,
W82-01655 6B

ELECTROCHEMISTRY
Applications of Stripping Analysis to Metal Determinations in Natural Waters,
W82-01670 1A

EMISSION SPECTROSCOPY
Simultaneous Determination of Trace Metals in Sewage and Sewage Effluents by Inductively Coupled Argon Plasma Atomic Emission Spectrometry,
W82-01828 5A

ENERGY DISSIPATION
Hydraulic Geometry and Minimum Rate of Energy Dissipation,
W82-01918 2J

ENERGY EQUATION
The Statistical Mechanical Theory of Groundwater Flow,
W82-01982 2F

ENGLAND
Standards and Charges in the Control of Trade Effluent Discharges to Public Sewers in England and Wales,
W82-01717 6C

Charging for Water Supply in England and Wales in the 1980s,
W82-01722 6C

Slowhill Copse Sewage Treatment Works.
W82-01727 5D

Operating Policies for a Surface/Ground Water System,
W82-01741 4B

The Population Ecology of Iron Bacteria (Genus Ochrobium) in a Stratified Eutrophic Lake,
W82-01997 2H

The Effects of Mine Drainage and Organic Enrichment on Benthos in the River Nent System, Northern Pennines,
W82-02053 5C

ENTEROVIRUSES
Survival of Enteroviruses Adsorbed on Glass Microfibers During Postal Transport (Survie de Virus Enteriques Adsorbes sur Microfibre de Verre au Cours d'un Transport Postal),
W82-01637 5A

ENVIRONMENTAL EFFECTS
A Water Quality Assessment of Development in the Senegal River Basin,
W82-01740 6G

Impacts of Navigational Dredging on Fish and Wildlife: A Literature Review,
W82-01768 6G

Biota and Biological Parameters as Environmental Indicators,
W82-01794 5C

Gulf of Mexico: A Socioeconomic View of Competing Resources,
W82-01901 6B

Industrial Waste Dumping at Deepwater Sites in the Gulf of Mexico,
W82-01903 5E

Environmental Design and Operation of Nanticoke Thermal Generating Station,
W82-01907 5D

Some Environmental and Social Impacts of the James Bay Hydroelectric Project, Canada,
W82-01908 6G

Ecological and Physiological Characteristics of Dikerogammarus Haemobaphes in the Areas in Which Heated Water Is Discharged from the Tripol'ye Power Station,
W82-01970 5C

Environmental Studies: Their Implications and the Special Case of Egypt,
W82-02062 6G

ENVIRONMENTAL EFFECTS. *POLLUTANT IDENTIFICATION
Organic Substances in Water,
W82-01783 5A

ENVIRONMENTAL PROTECTION
Regulation for Environmental Protection: The Nanticoke Industrial Complex, Ontario, Canada,
W82-02024 6E

International Cooperation to Protect the Baltic,
W82-02087 6E

ENZYMES
Detection of Organophosphate Insecticide by an Immobilized-Enzyme System,
W82-02025 5A

EPIDEMIOLOGY
Planning with Great Uncertainty: A Review and Case Study of the Safe Drinking Water Controversy,
W82-01606 5A

EQUILIBRIUM
Kinetics for the Aquatic Environment,
W82-01806 2K

The Accuracy of Equilibrium Methods of Slope Stability Analysis,
W82-01954 8D

EROSION
Estimating Erosion and Sediment Yield on Field-Sized Areas,
W82-01849 2J

Resource Inventory--Sheet, Rill and Wind Erosion,
W82-01850 2J

Evaluating Scour at Culvert Outlets,
W82-01934 4D

EROSION CONTROL
Reconstruction of a Small Dam for a Recreational Lake.
W82-01604 4D

Hydraulic Testing of Plastic Filter Fabrics,
W82-01613 8G

Erosion and Sediment Control in China's Yellow River Basin,
W82-01729 4D

ERROR ANALYSIS
Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 2H

ERRORS
Note on Random Raindrops and Sampling Error,
W82-02032 2B

ESTUARIES
Salt Dispersion in the Hudson Estuary,
W82-01615 2L

Sediment Bacterial Indicators in an Urban Shellfishing Substuary of the Lower Chesapeake Bay,
W82-01661 5A

Hydrology of Okarito Lagoon and the Inferred Effects of Selective Logging in Okarito Forest,
W82-01703 4C

Field Observations of the Isotopic Composition of Particulate Organic Carbon in the Southern North Sea and Adjacent Estuaries,
W82-01714 2J

Distribution, Morphology, and Origin of Sedimentary Furrows in Cohesive Sediments, Southampton Water,
W82-01720 2L

Seasonal and Spring-Neap Tidal Dependence of Axial Dispersion Coefficients in the Severn - A Wide, Vertically Mixed Estuary,
W82-01749 2L

A Perspective on Estuarine and Coastal Research Funding,
W82-01803 9A

Estuarine Dredge and Fill Activities: A Review of Impacts,
W82-01805 2L

A Sensitivity Analysis of an Ecosystem Model of Estuarine Carbon Flow,
W82-01875 2L

Gulf of Mexico Wetlands: Value, State of Knowledge and Research Needs,
W82-01902 2L

Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 5G

On Some Chytrids Found in Estuarine Habitats,
W82-02038 2L

Microbial Pollution of Coasts and Estuaries: The Public Health Implications,
W82-02051 5C

PCB and HCB in the Sediments and Waters of the Tiber Estuary,
W82-02057 2L

ESTUARINE ENVIRONMENT
Nitrate Reduction to Ammonium and Organic Nitrogen in an Estuarine Sediment,
W82-01625 5B

Investigation of Selective Uptake of Polychlorinated Biphenyls by Spartina Alterniflora Loisel,
W82-01813 5B

EUTROPHIC LAKES
Aluminum Sulfate Treatment: Short-Term Effect on Complex Phosphorus Compounds in a Eutrophic Lake,
W82-01833 5F

A Control Mechanism of the Phytoplankton Respiration in a Eutrophic Reservoir,
W82-02030 2H

Seasonal and Diurnal Changes of Chlorophyll in a Tropical Fresh Water Impoundment,
W82-02052 2H

Experience with Lake and Reservoir Restoration Techniques in the German Democratic Republic,
W82-02054 2H

EUTROPHICATION
Eutrophication of the Salt Valley Reservoirs, 1968-73. I. The Effects of Eutrophication on Standing Crop and Composition of Phytoplankton,
W82-01653 5C

Periphytic Community Response to Chronic Nutrient Enrichment by a Reservoir Discharge,
W82-01658 5C

On The Use of Carotenoid Stratigraphy in Lake Sediments for Detecting Past Developments of Phytoplankton,
W82-01706 2H

Eutrophication of the Salt Valley Reservoirs 1968-73. III. The Macroinvertebrate Community: Its Development, Composition, and Change in Response to Eutrophication,
W82-01797 5C

Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 2H

Biological Pollution and Pollution Control in Canals Diverting Flow from One River Basin to Another,
W82-01922 5C

The Population Ecology of Iron Bacteria (Genus Ochrobium) in a Stratified Eutrophic Lake,
W82-01997 2H

Water Quality Management of Lake Neusiedler, Austria,
W82-02090 5C

EVALUATION
Addendum to: Sources of Powerplant Cooling Water in the Desert Area of Southern California--Reconnaissance Study,
W82-01773 6B

EVAPORATION
Electronic Measurement and Recording of Evaporation Loss,
W82-01602 7B

Evaporation from a Snow Cover--Review and Discussion of Measurements,
W82-01888 2D

Ways of Successive Refinement of Methods of Calculating the Duty of Water,
W82-02094 2D

EVAPOTRANSPIRATION
Corn and Alfalfa Production as Influenced by Limited Irrigation,
W82-01945 3F

EXCESS RAINFALL
Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 2A

EXPERIMENTAL FARMS
Double and Monocropped Wheat and Grain Sorghum Under Different Tillage and Row Spacings,
W82-01862 2I

FABRICS
Hydraulic Testing of Plastic Filter Fabrics,
W82-01613 8G

FALLOUT
The Significance of Wet and Dry Synoptic Regions on Long-Range Transport of Pollution and Its Deposition,
W82-01877 5B

FARM WASTES
Effects of a Cattle Feedlot on Ground-Water Quality in the South Platte River Valley Near Greeley, Colorado,
W82-01790 5B

Pollution from Farms,
W82-02039 5D

FARMING
Logistics of Farm Water Supply.
W82-02037 6A

FATE OF POLLUTANTS
Fate of Kepone and Mirex in a Model Aquatic Environment: Sediment, Fish, and Diet,
W82-01820 5B

Deposition of Sulphur Gases from Multiple Scattered Sources in Alberta,
W82-01868 5B

Toxicant Accumulation in Hydrobiont Tissues Following Effluent Discharge,
W82-01919 5C

Geologic Aspects of Waste Disposal Site Evaluations,
W82-02011 5E

Environmental Fate of Methyl Eugenol,
W82-02013 5B

FEDERAL REPUBLIC OF GERMANY
Structural Aspects of the Water Supply in the Federal Republic of Germany,
W82-02066 6E

FEEDLOT RUNOFF
Controlling Runoff for Livestock Feedlots; A State of the Art,
W82-01769 5G

FEEDLOT WASTES
Controlling Runoff for Livestock Feedlots; A State of the Art,
W82-01769 5G

FEEDLOTS
Effects of a Cattle Feedlot on Ground-Water Quality in the South Platte River Valley Near Greeley, Colorado,
W82-01790 5B

FERMENTATION
Effect of the Copper Content of Distillery Spent Wash on Its Utilization for Single-Cell Protein Production by Geotrichum Candidum, Hansenula Anomala and Candida Kruzei,
W82-01750 5C

FERTILIZERS
Effect of Fertilizers on the Primary and Bacterial Production of Rearing Ponds in the Volga Delta,
W82-02077 2H

FILMS
The Spreading of Thin Liquid Films on a Water-Air Interface,
W82-01955 1B

The Containment of an Oil Slick by a Boom Placed Across a Uniform Stream,
W82-01956 1B

FILTERS
Hydraulic Testing of Plastic Filter Fabrics,
W82-01613 8G

FILTRATION
Gauze Filtration and Enrichment Procedures for Recovery of Vibrio Cholerae From Contaminated Waters,
W82-01815 5A

FINANCING
A Perspective on Estuarine and Coastal Research Funding,
W82-01803 9A

FINLAND
On the Values and Variability of Degree-Day Melting Factor in Finland,
W82-01735 2C

FISH
Effect of Aluminum Speciation on Fish in Dilute Acidified Waters,
W82-01663 5C

Distribution of Vibrio Parahaemolyticus in Finfish Harvested from Porto Novo (S. India) Environs: A Seasonal Study,
W82-01737 5A

Impacts of Navigational Dredging on Fish and Wildlife: A Literature Review,
W82-01768 6G

Effect of an Aerial Application of Carbaryl on Brook Trout (Salvelinus Fontinalis),
W82-01818 5C

Determination of Mineral Fiber Concentrations in Fish Tissues,
W82-01822 5C

Mercury Methylation by Fish Intestinal Contents,
W82-01830 5C

Acute Toxicities of the Herbicides Komeen and Hydrothol-191 to Golden Shiner (Notemigonus Crysoleucas),
W82-01882 5C

Toxicant Accumulation in Hydrobiont Tissues Following Effluent Discharge,
W82-01919 5C

Occult Hemoglobin as an Indicator of Impingement Stress in Fishes,
W82-01931 5C

Chromium Levels in Fish from a Lake Chronically Contaminated with Chromates from Cooling Towers,
W82-01941 5B

Temperature Tolerance and the Final Preferendum - Rapid Methods for the Assessment of Optimum Growth Temperatures,
W82-01996 5C

Dynamics of Carp Growth and Biosynthetic Processes in the Liver of the Carp Reared in Containers in Heated Waste Water from Themal Power Stations,
W82-01998 5C

FISH BARRIERS
Occult Hemoglobin as an Indicator of Impingement Stress in Fishes,
W82-01931 5C

FISH FARMING
Effect of Fertilizers on the Primary and Bacterial Production of Rearing Ponds in the Volga Delta,
W82-02077 2H

FISH FOOD
Abundance, Life History, and Growth of Introduced Populations of the Opossum Shrimp (Mysis Relicta) in Subalpine California Lakes,
W82-01638 2H

FISH MANAGEMENT
Persistence of 3-(Trifluoromethyl)-4-Nitrophenol in Aquatic Environments,
W82-01798 5B

FISH PHYSIOLOGY
Rearing Pacific Salmon in Saltwater Ponds Fertilized with Domestic Wastewater, Data Report, June 1979 - May 1980,
W82-01906 3C

FISH PONDS
Effect of Different Water Salinity Levels and Organic Matter Application on the Composition of Water Soluble and Exchangeable Bases in a Brackishwater Fish Pond Soil,
W82-02027 2H

FISH POPULATIONS
Effects of Sedimentation on the Gravels of an Industrial River System,
W82-01881 5C

Rearing Pacific Salmon in Saltwater Ponds Fertilized with Domestic Wastewater, Data Report, June 1979 - May 1980,
W82-01906 3C

Generalized Computer Simulation Model for the Impact Assessment of Industrial Water Use on Fish Populations,
W82-01915 5C

FISHERIES
Hydropower vs. Salmon: The Struggle of the Pacific Northwest's Anadromous Fish Resources for a Peaceful Coexistence with the Federal Columbia River Power System,
W82-01804 6E

Gulf of Mexico Wetlands: Value, State of Knowledge and Research Needs,
W82-01902 2L

FISHKILL
Acid Precipitation,
W82-01607 5C

FJORDS
Temporal and Spatial Variations of Mercury, Lead, Zinc, and Copper in Sediments of the Saguenay Fjord,
W82-01639 5B

Spatial and Temporal Variations in Cesium-137 and Carbon in Sediments of Saguenay Fjord (Variations Spatiales et Temporelles du Cesium-137 et du Carbone dans des Sediments du Fjord du Saguenay),
W82-01644 2J

FLASH FLOODS
Learning from the Skipton Flood,
W82-02063 2E

FLOCCULATION
Technology and Performance of the Hi-Capacity Thickener,
W82-01929 5D

FLOOD CONTROL
Flood Control on the Parana and Paraguay Rivers,
W82-01707 2E

The Chambal Project: Problems and Solutions,
W82-01739 4A

Streamlined Regulations Could Help Make New Stormwater Management Concepts Part of the Tradition,
W82-02000 4A

The Day That the Rain Came Down,
W82-02064 2E

FLOOD DAMAGE
Floodplain Management: A Flood and Land Planning System,
W82-01872 6F

The Day That the Rain Came Down,
W82-02064 2E

FLOOD FORECASTING
Log Pearson III Distribution - Effect of Dependence, Distribution Parameters and Sample Size on Peak Annual Flood Estimates,
W82-01649 2E

Learning from the Skipton Flood,
W82-02063 2E

FLOOD FREQUENCY
Log Pearson III Distribution - An Empirically-Derived Plotting Position,
W82-01650 2E

Log Pearson III Distribution - Is It Applicable to Flood Frequency Analysis of Australian Streams,
W82-01731 2E

FLOOD PEAK
Log Pearson III Distribution - Effect of Dependence, Distribution Parameters and Sample Size on Peak Annual Flood Estimates,
W82-01649 2E

Legal Challenge of the Ungaged Watershed,
W82-01664 2E

FLOOD PLAIN MANAGEMENT
Floodplain Management: A Flood and Land Planning System,
W82-01872 6F

FLOOD PROTECTION
Floodplain Management: A Flood and Land Planning System,
W82-01872 6F

FLORIDA
The Effects of Secondary Sewage Effluent on the Water Quality, Nutrient Cycles and Mass Balances, and Accumulation of Soil Organic Matter in Cypress Domes,
W82-01687 5G

U.S. Geological Survey Reports on the Water Resources of Florida, 1886-1980, Second Edition,
W82-01778 10C

Hydrogeology of Well-Field Areas Near Tampa, Florida, Phase 1--Development and Documentation of a Two-Dimensional Finite-Difference Model for Simulation of Steady-State Ground-Water Flow,
W82-01780 6A

Water-Ice and Water-Updraft Relationships Near -10 Degrees C Within Populations of Florida Cumuli,
W82-01968 2B

FLOTATION
Precipitate Flotation Studies with Monolauryl Phosphate and Monolauryldithiocarbamate,
W82-01863 5D

FLOW
Effect of Field Variability in Soil Hydraulic Properties on Solutions of Unsaturated Water and Salt Flows,
W82-01898 2G

FLOW DURATION
Low-Flow Frequency and Flow Duration of Tennessee Streams,
W82-01779 2E

FLOW NETS
A Graphical Approach to Prediction of Groundwater Pollutant Movement,
W82-01634 5B

FLOW PATTERNS
Tide-Induced Residual Flow in Shallow Bays,
W82-02003 2L

FLOW RATES
Low-Flow Frequency and Flow Duration of Tennessee Streams,
W82-01779 2E

FLUCTUATIONS
Substrate Flux into Biofilms of Any Thickness,
W82-01964 5D

FLUVIAL SEDIMENTS
Field Observations of the Isotopic Composition of Particulate Organic Carbon in the Southern North Sea and Adjacent Estuaries,
W82-01714 2J

Erosion and Sediment Control in China's Yellow River Basin,
W82-01729 4D

Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01792 7C

FOAM SEPARATION
Water Purification Studies with Activated Carbon and Foam Flotation,
W82-01692 5D

FOOD CHAINS
Fate of Kepone and Mirex in a Model Aquatic Environment: Sediment, Fish, and Diet,
W82-01820 5B

Tracing Food Webs with Stable Hydrogen Isotopes,
W82-02021 6G

FOOD-PROCESSING WASTES
Composition of Fruit and Vegetable Processing Wastes,
W82-01601 5D

Using Zeta Potential to Optimize Coagulating Aid Doses Used to Treat Food Processing Wastes,
W82-01627 5D

FORECASTING
The Modeling of Aquatic Ecological Systems,
W82-01972 5B

Learning from the Skipton Flood,
W82-02063 2E

FOREST MANAGEMENT
Long Term Responses of Streamflow Following Clearcutting and Regrowth,
W82-01610 4C

FRANCE
Sustaining the Growth of Provence.
W82-01738 6D

FREQUENCY ANALYSIS
Low-Flow Frequency and Flow Duration of Tennessee Streams,
W82-01779 2E

FRUIT CROPS
Control of Peach Tree Growth and Productivity by Regulated Water Supply, Tree Density, and Summer Pruning,
W82-01883 2I

Turnover of Tritiated Water in Calamondin Plants,
W82-02048 5A

FUNGI
Thermophillic and Thermotolerant Fungi Isolated from the Thermal Effluent of Nuclear Power Generating Reactors: Disposal of Human Opportunistic and Veterinary Pathogenic Fungi,
W82-01928 5B

On Some Chytrids Found in Estuarine Habitats,
W82-02038 2L

FURROW IRRIGATION
Furrow Advance Rates Under Surge Flow Systems,
W82-01612 3F

Low Energy Precision Application (LEPA) Irrigation System,
W82-01859 3F

Effect of Irrigation Practices and Methods of Sowing-Cum-Irrigation on the Performance of Safflower,
W82-01878 3F

GAS CHROMATOGRAPHY
Matacil Residue Determination in Foliage, Fish, Soil and Water,
W82-01621 5A

GEOCHEMISTRY
Geochemistry and Hydrodynamics in the Hutt and Leeman Evaporitic Lagoons, Western Australia: A Comparative Study,
W82-01746 2L

Groundwater Discharge Through Springs with Well-Defined Outlets--A Case Study from Jeloya-Moss, S. Norway,
W82-01748 2F

The Geochemical Control of Seawater (Sillen Revisited),
W82-01936 2K

Groundwater Chemistry of Some Selected Areas in Southeaster Norway,
W82-02020 2K

GEOHYDROLOGIC UNITS
Geologic Aspects of Waste Disposal Site Evaluations,
W82-02011 5E

GEOHYDROLOGY
Role of the Geotechnical Consultant in Siting Suitable Areas for Hazardous Waste Disposal,
W82-01636 5E

Components of Saturated Zone Thickness in a Nigerian Basement Complex Regolith,
W82-01710 2F

The Relationship Between Macro-Topography and the Groundwater Quality in the Great Fish River Basin, Eastern Cape Province,
W82-01718 2F

Groundwater Discharge Through Springs with Well-Defined Outlets--A Case Study from Jeloya-Moss, S. Norway,
W82-01748 2F

Hydrogeology of Well-Field Areas Near Tampa, Florida, Phase 1--Development and Documentation of a Two-Dimensional Finite-Difference Model for Simulation of Steady-State Ground-Water Flow,
W82-01780 6A

Hydrogeology of the Gatlinburg Area, Tennessee,
W82-01782 2F

GEOLOGY
Surficial Geology of Dugway Quadrangle, Oswego County, New York,
W82-01775 7C

GERMAN DEMOCRATIC REPUBLIC
Experience with Lake and Reservoir Restoration Techniques in the German Democratic Republic,
W82-02054 2H

GERMANIUM
Determination of Germanium, Vanadium, and Titanium by Carbon Furnace Atomic Absorption Spectrometry,
W82-01836 5A

GERMANY
Drinking Water and Its Treatment: An Interview with Professor Sontheimer,
W82-01728 5F

On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 5A

GLACIAL AQUIFERS
Surficial Geology of Dugway Quadrangle, Oswego County, New York,
W82-01775 7C

GLACIERS
Glacier Surveys in Alberta - 1979,
W82-01855 2C

Development and Applications of a Runoff Model for Snowcovered and Glacierized Basins,
W82-01885 2C

GLACIOHYDROLOGY
Glacier Surveys in Alberta - 1979,
W82-01855 2C

GLOBAL CLIMATE CHANGE
Water Requirements and Man-Induced Climate Change,
W82-01633 2D

GOOSE CREEK
Biological Consequences of Stream Routing Through a Final-Cut Strip Mine Pit: Benthic Macroinvertebrates,
W82-01948 4A

GRAIN CROPS
Corn and Alfalfa Production as Influenced by Limited Irrigation,
W82-01945 3F

GRAND RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing; Grand River Basin, Michigan,
W82-01759 6D

GRAPHICAL ANALYSIS
Perspective on Management and Disposal of Hazardous Wastes,
W82-01635 5E

GREAT BRITAIN
Waste Disposal--Choosing and Licensing Site,
W82-02035 5G

Recording Underground,
W82-02036 8A

Technical and Economic Implications of Installing an Industrial Waste-Water Pretreatment Plant,
W82-02044 5D

Microbial Pollution of Coasts and Estuaries: The Public Health Implications,
W82-02051 5C

Economic Instruments for Controlling Effluent Discharges to the River Tees Estuary,
W82-02060 2L

Learning from the Skipton Flood,
W82-02063 2E

The Day That the Rain Came Down,
W82-02064 2E

Phytobenthos of the River Tees and Its Tributaries,
W82-02065 2K

GREAT LAKES
Persistence of 3-(Trifluoromethyl)-4-Nitrophenol in Aquatic Environments,
W82-01798 5B

Nitrous Oxide in Freshwaters of the Great Lakes Basin,
W82-01841 2H

Quantification of the Lake Trophic Typologies of Naumann (Surface Quality) and Thienemann (Oxygen) with Special Reference to the Great Lakes,
W82-02004 2H

GREAT LAKES TRIBUTARIES
Water Resources Appraisals for Hydroelectric Licensing; Western Great Lakes Tributaries; Michigan, Wisconsin, Indiana and Illinois.
W82-01762 6D

GREEN LAKE
Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 2H

GROUNDWATER
Analysis of the Origin of Water Which Forms Large Aufeis Fields on the Arctic Slope of Alaska Using Ground and Landsat Data,
W82-01690 2C

Toxic Substances in Water: Patterns of Contamination and Policy Implications,
W82-01695 5A

An Economic and Institutional Assessment of the Water Problem Facing the Tucson Basin,
W82-01698 6B

Components of Saturated Zone Thickness in a Nigerian Basement Complex Regolith,
W82-01710 2F

Selected Drill-Stem-Test Data from the Northern Great Plains Area of Montana,
W82-01774 7C

Selected Hydrogeologic Data from the Northern Great Plains Area of Montana,
W82-01777 7C

U.S. Geological Survey Reports on the Water Resources of Florida, 1886-1980, Second Edition,
W82-01778 10C

Groundwater Levels in Nebraska 1980,
W82-01785 2F

Water Quality Study -- Southwest Minnesota Public Water Supplies,
W82-01795 2K

Applications of Aerial Photography,
W82-01988 7B

Groundwater Chemistry of Some Selected Areas in Southeaster Norway,
W82-02020 2K

GROUNDWATER AVAILABILITY
Addendum to: Sources of Powerplant Cooling Water in the Desert Area of Southern California--Reconnaissance Study,
W82-01773 6B

Hydrogeology of the Gatlinburg Area, Tennessee,
W82-01782 2F

GROUNDWATER BASINS
Addendum to: Sources of Powerplant Cooling Water in the Desert Area of Southern California--Reconnaissance Study,
W82-01773 6B

GROUNDWATER HYDROLOGY
The Relationship Between Macro-Topography and the Groundwater Quality in the Great Fish River Basin, Eastern Cape Province,
W82-01718 2F

LIBRARY U. OF ILL. URBANA-CHAMPAIGN

Geologic Aspects of Waste Disposal Site Evaluations,
W82-02011 5E

GROUNDWATER LEVEL
Steady Periodic Flow Through a Rectangular Dam,
W82-01983 2F

GROUNDWATER MANAGEMENT
Operating Policies for a Surface/Ground Water System,
W82-01741 4B

GROUNDWATER MOVEMENT
A Graphical Approach to Prediction of Groundwater Pollutant Movement,
W82-01634 5B

Groundwater Discharge to the Pacific Ocean,
W82-01647 2F

Hydrogeology of Well-Field Areas Near Tampa, Florida, Phase 1--Development and Documentation of a Two-Dimensional Finite-Difference Model for Simulation of Steady-State Ground-Water Flow,
W82-01780 6A

The Statistical Mechanical Theory of Groundwater Flow,
W82-01982 2F

Steady Periodic Flow Through a Rectangular Dam,
W82-01983 2F

An Integral Transform Method for the Linearized Boussinesq Groundwater Flow Equation,
W82-01984 2F

Scale-Dependent Dispersion in a Stratified Granular Aquifer,
W82-01986 2F

GROUNDWATER POLLUTION
Influence on Groundwater from the Bermed Infiltration Pond,
W82-01622 5D

Perspective on Management and Disposal of Hazardous Wastes,
W82-01635 5E

Effects of a Cattle Feedlot on Ground-Water Quality in the South Platte River Valley Near Greeley, Colorado,
W82-01790 5B

Tying Up TCE,
W82-01866 5G

Waste Disposal--Choosing and Licensing Site,
W82-02035 5G

Terrain, Groundwater and Secondary Salinity in Victoria, Australia,
W82-02046 2F

Bromide in Canterbury Ground Water,
W82-02056 5B

Screened Auger Aids Investigation,
W82-02096 7B

GROUNDWATER POTENTIAL
Surficial Geology of Dugway Quadrangle, Oswego County, New York,
W82-01775 7C

GROUNDWATER RUNOFF
Investigations into the Dynamics of Water Movement on a Low Relief Landscape on the Eastern Shore of Maryland,
W82-01673 2F

GROUNDWATER STORAGE
Drawdowns at the Free Water Table During Pumping Tests in Artesian and Semiartesian Aquifers,
W82-01890 2F

GROUTING
Grout Curtain in the Foundation of the Arch Dam of the Inguri Hydroelectric Station,
W82-01973 8A

GROWTH
Abundance, Life History, and Growth of Introduced Populations of the Opossum Shrimp (Mysis Relicta) in Subalpine California Lakes,
W82-01638 2H

Effects of the Aquatic Herbicide 2,4-D DMA on the Ecology of Experimental Ponds,
W82-01949 5C

GULF OF MEXICO
Gulf of Mexico Wetlands: Value, State of Knowledge and Research Needs,
W82-01902 2L

Industrial Waste Dumping at Deepwater Sites in the Gulf of Mexico,
W82-01903 5E

GULF OF MEXICO STATES
Gulf of Mexico: A Socioeconomic View of Competing Resources,
W82-01901 6B

HABITATS
Gulf of Mexico Wetlands: Value, State of Knowledge and Research Needs,
W82-01902 2L

HAIL
Various Kinetic Energy Characteristics of Hail-patterns in the Grossversuch IV Experiment,
W82-01732 2B

HALOPHYTES
Finds of Relict Infusoria in Kiev Reservoir,
W82-02079 2H

HARBORS
Resonant Oscillation in Duluth-Superior Harbor,
W82-01837 2H

On the Presence of Fecal Steroids in Sediments from Two Mexican Harbors,
W82-02012 5A

HAY
Soil Water Studies on Small Lucerne Plots,
W82-01713 2I

HAZARDOUS MATERIALS
Perspective on Management and Disposal of Hazardous Wastes,
W82-01635 5E

Role of the Geotechnical Consultant in Siting Suitable Areas for Hazardous Waste Disposal,
W82-01636 5E

The Hazards of Hazardous Waste Management,
W82-01940 6E

HEAT TRANSFER
On the Values and Variability of Degree-Day Melting Factor in Finland,
W82-01735 2C

HEATED WATER
Ecological and Physiological Characteristics of Dikerogammarus Haemobaphes in the Areas in Which Heated Water Is Discharged from the Tripol'ye Power Station,
W82-01970 5C

Temperature Tolerance and the Final Preferendum - Rapid Methods for the Assessment of Optimum Growth Temperatures,
W82-01996 5C

Dynamics of Carp Growth and Biosynthetic Processes in the Liver of the Carp Reared in Containers in Heated Waste Water from Themal Power Stations,
W82-01998 5C

HEAVY METALS
Copper(II)- and Cadmium(II)-Binding Abilities of Some New Hampshire Freshwaters Determined by Dialysis Titration,
W82-01632 5F

Temporal and Spatial Variations of Mercury, Lead, Zinc, and Copper in Sediments of the Saguenay Fjord,
W82-01639 5B

Effect of Reagent Mixing Rate on Adsorption Process for Am-Fe2O3.H2O,
W82-01799 5F

Selective Removal of Heavy Metal Ions from Aqueous Solutions by Diafiltration of Macromolecular Complexes,
W82-01900 5D

Pollution Solutions--The Wire Drawing Industry.
W82-02041 5D

HERBICIDES
Biological and Physical Investigations of Bodies of Water Beneath Dense Water Hyacinth Populations Before and After Chemical Treatment,
W82-01678 5B

Acute Toxicities of the Herbicides Komeen and Hydrothol-191 to Golden Shiner (Notemigonus Crysoleucas),
W82-01882 5C

Effects of the Aquatic Herbicide 2,4-D DMA on the Ecology of Experimental Ponds,
W82-01949 5C

HETEROGENEITY
Extension of the Integrodifferential Approach to Inhomogeneous Multiaquifer Systems,
W82-02017 2F

HEXACHLOROCYCLOPENTADIENE
Determination of Hexachlorocyclopentadiene at the Nanogram Per Liter Level in Drinking Water,
W82-01819 5A

HONG KONG
Degree of Pollution of Several Major Streams Entering Tolo Harbour, Hong Kong,
W82-02058 5B

Stream Pollution in Hong Kong - An Appraisal,
W82-02084 5B

Some Effects of Sewage Discharge Upon Phytoplankton in Hong Kong,
W82-02095 5C

HUDSON RIVER ESTUARY
Salt Dispersion in the Hudson Estuary,
W82-01615 2L

HYDRAULIC CONDUCTIVITY
Simple In Situ Determination of Hydraulic Conductivity by Power Function Descriptions of Drainage,
W82-01666 2G

HYDRAULIC GEOMETRY
Hydraulic Geometry and Minimum Rate of Energy Dissipation,
W82-01918 2J

HYDRAULIC GRADIENT
Simple In Situ Determination of Hydraulic Conductivity by Power Function Descriptions of Drainage,
W82-01666 2G

Hydraulic Connection Between Lake Michigan and a Shallow Ground-Water Aquifer,
W82-02010 2F

HYDRAULIC MODELS
Hydraulic Modeling for Waste Stabilization Ponds,
W82-01965 5D

HYDRAULIC PROPERTIES
Hydraulic Testing of Plastic Filter Fabrics,
W82-01613 8G

HYDROCARBONS
Dissolved Hydrocarbons and Related Microflora in a Fjordal Seaport: Sources, Sinks, Concentrations, and Kinetics,
W82-01816 5B

Hydrocarbon Concentrations in Water and Sediments from UK Marine Waters, Determined by Fluorescence Spectroscopy,
W82-02097 5B

HYDROELECTRIC PLANTS
Water Resources Appraisals for Hydroelectric Licensing: Allegheny River Basin; Pennsylvania-New York.
W82-01751 6D

Water Resources Appraisals for Hydroelectric Licensing; Colorado River Basin, Texas.
W82-01752 6D

Water Resources Appraisal for Hydroelectric Licensing; Menominee River Basin; Michigan, Wisconsin,
W82-01753 6D

Water Resources Appraisals for Hydroelectric Licensing; Cumberland River Basin; Kentucky-Tennessee.
W82-01756 6D

Water Resources Appraisals for Hydroelectric Licensing; Tombigbee-Warrior River Basin; Alabama-Mississippi.
W82-01757 6D

Water Resources Appraisals for Hydroelectric Licensing; Black River Basin, New York.
W82-01758 6D

Water Resources Appraisals for Hydroelectric Licensing; Grand River Basin, Michigan,
W82-01759 6D

Water Resources Appraisal for Hydroelectric Licensing; Potomac River Basin; Pennsylvania, Maryland, West Virginia, Virginia, and District of Columbia,
W82-01760 6D

Water Resources Appraisals for Hydroelectric Licensing: Upper Arkansas River Basin; Colorado, Kansas, and New Mexico.
W82-01761 6D

Water Resources Appraisals for Hydroelectric Licensing; Western Great Lakes Tributaries; Michigan, Wisconsin, Indiana and Illinois.
W82-01762 6D

Water Resources Appraisals for Hydroelectric Licensing; Santee River Basin; South Carolina-North Carolina.
W82-01765 6D

Water Resources Appraisals for Hydroelectric Licensing: Tennessee River Basin; Virginia-Tennessee-North Carolina-Mississippi, Georgia-Kentucky-Alabama.
W82-01766 6D

Some Environmental and Social Impacts of the James Bay Hydroelectric Project, Canada,
W82-01908 6G

A Preliminary Study of the Effect of Pumped-Storage Plant Operation on Zooplankton,
W82-01971 5C

Intakes and Outlets for Low-Head Hydropower,
W82-01979 8C

HYDROELECTRIC POWER
Water Resources Appraisals for Hydroelectric Licensing; Lower Red River Basin; Arkansas, Louisiana, Oklahoma and Texas,
W82-01754 6D

Water Resources Appraisal for Hydroelectric Licensing; Kennebec River Basin, Maine.
W82-01755 6D

Water Resources Appraisal for Hydroelectric Licensing: Penobscot River Basin, Maine,
W82-01763 6D

Water Resources Appraisal for Hydroelectric Licensing: Altamaha River Basin, Georgia,
W82-01764 6D

Water Resources Appraisals for Hydroelectric Licensing, Saginaw and Au Sable River Basins Area, Michigan.
W82-01767 6D

Hydropower vs. Salmon: The Struggle of the Pacific Northwest's Anadromous Fish Resources for a Peaceful Coexistence with the Federal Columbia River Power System,
W82-01804 6E

HYDROGEN ION CONCENTRATION
Acute Toxicity of Increased pH to Freshwater Shrimp Paratya Curvirostris,
W82-01645 5C

HYDROGEN SULFIDE
Reviving the Rio Reconquista,
W82-02014 5G

HYDROLOGIC BUDGET
The Effects of Man on Basin Runoff, and on the Water Balance and Water Stage of the Caspian Sea,
W82-01709 4C

HYDROLOGIC CYCLE
Geochemistry and Hydrodynamics in the Hutt and Leeman Evaporitic Lagoons, Western Australia: A Comparative Study,
W82-01746 2L

HYDROLOGIC DATA
Hydrologic Data for Experimental Agricultural Watersheds in the United States, 1972,
W82-01772 2A

Water-Resources Investigations of the U.S. Geological Survey in Montana, October 1980 through September 1981,
W82-01787 7C

HYDROLOGIC MAPS
Selected Hydrogeologic Data from the Northern Great Plains Area of Montana,
W82-01777 7C

HYDROLOGICAL REGIME
A Mathematical Model of the Hydrologic Regime of the Upper Nile Basin,
W82-01857 2A

HYDROPHYTES
Ecological and Physiological Features of the Root System of Inshore Hydrophytes,
W82-01715 5B

ICE
Summer Ice and Carbon Dioxide,
W82-01843 2C

ILLINOIS
Stage-Discharge Relations at Dams on the Illinois and Des Plaines Rivers in Illinois,
W82-01793 4A

Water Quality and the Demand for Recreation,
W82-01942 6D

IMPAIRED WATER QUALITY
The Relationship Between Macro-Topography and the Groundwater Quality in the Great Fish River Basin, Eastern Cape Province,
W82-01718 2F

INDIA
Effect of Periods of Moisture Availability on Groundnut Crop in the Saurashtra Region of Gujarat,
W82-01708 2G

Parasite Egg and Cyst Reduction in Oxidation Ditches and Aerated Lagoons,
W82-01733 5D

Distribution of Vibrio Parahaemolyticus in Finfish Harvested from Porto Novo (S. India) Environs: A Seasonal Study,
W82-01737 5A

The Chambal Project: Problems and Solutions,
W82-01739 4A

Note on the Role of Irrigation Frequencies on the Regrowth of Berseem,
W82-01745 2I

Water Use, Yield and Quality of Rapeseed as Influenced by Spacing, Irrigation and Time of Harvest When Raised in a Multiple-Cropping System,
W82-02031 3F

Seasonal and Diurnal Changes of Chlorophyll in a Tropical Fresh Water Impoundment,
W82-02052 2H

INDIANA
A Stochastic Cluster Model of Daily Rainfall Sequences,
W82-01651 2B

INDUSTRIAL PLANTS
Regulation for Environmental Protection: The Nanticoke Industrial Complex, Ontario, Canada,
W82-02024 6E

INDUSTRIAL WASTES
Water Reuse: Ultrafiltration of Industrial and Municipal Wastewaters,
W82-01652 5D

Standards and Charges in the Control of Trade Effluent Discharges to Public Sewers in England and Wales,
W82-01717 6C

Toxicity and BOD Effluents Derived from Kraft Pulping of Aged Wood Chips,
W82-01845 5B

Selective Removal of Heavy Metal Ions from Aqueous Solutions by Diafiltration of Macromolecular Complexes,
W82-01900 5D

Industrial Waste Dumping at Deepwater Sites in the Gulf of Mexico,
W82-01903 5E

Environmental Design and Operation of Nanticoke Thermal Generating Station,
W82-01907 5D

Selenium: A Water Pollutant from Flue Gas Desulfurization,
W82-01960 5B

Bromide in Canterbury Ground Water,
W82-02056 5B

LIBRARY U. S. L. URBANA-CHAMPAIGN

Degree of Pollution of Several Major Streams Entering Tolo Harbour, Hong Kong,
W82-02058 5B

Poland: Coming to Grips with Pollution,
W82-02092 5G

INDUSTRIAL WASTEWATER
Environmental Assessment of Industrial Discharges Based on Multiplicative Models,
W82-01808 5B

Acute Toxicity of an In Situ Shale Oil Process Wastewater and It's Major Components to Daphnia Magna,
W82-01811 5C

INDUSTRIAL WATER
Generalized Computer Simulation Model for the Impact Assessment of Industrial Water Use on Fish Populations,
W82-01915 5C

INFECTION
Infectious Waterborne Diseases,
W82-01784 5A

INFILTRATION
Influence on Groundwater from the Bermed Infiltration Pond,
W82-01622 5D

Transport of Nonpolar Organic Compounds from Surface Water to Groundwater. Laboratory Sorption Studies,
W82-01873 5B

INFILTRATION RATE
Furrow Advance Rates Under Surge Flow Systems,
W82-01612 3F

Penetration and Distribution of Tritiated Water in Soils of a Lysimeter,
W82-01886 2G

INGURI DAM
Grout Curtain in the Foundation of the Arch Dam of the Inguri Hydroelectric Station,
W82-01973 8A

INSECTICIDES
On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 5A

Detection of Organophosphate Insecticide by an Immobilized-Enzyme System,
W82-02025 5A

INSTREAM FLOW
Preserving Instream Flows in Oregon's Rivers and Streams,
W82-01871 6E

INTAKES
Intakes and Outlets for Low-Head Hydropower,
W82-01979 8C

INTERNATIONAL AGREEMENTS
The Economics of Cooperation Over Collective Bads,
W82-01909 6A

Acid Rain Agreement,
W82-01933 5B

INTERNATIONAL COMMISSIONS
International Cooperation to Protect the Baltic,
W82-02087 6E

INTERNATIONAL WATERS
A Comprehensive Methodology for Project Appraisal and Environmental Protection in Multinational River Basin Development,
W82-01914 6B

INVERTEBRATES
Effects of Artificial Shading on Periphyton and Invertebrates in a New Zealand Stream,
W82-01701 5C

A Simple Device for Quantitative Pseudoperiphyton Sampling,
W82-01894 7B

Device for Collecting Replicate Artificial Substrate Samples of Benthic Invertebrates in Large Rivers,
W82-01947 7B

Methods of Studying Invertebrate Drift in Rivers,
W82-02074 7A

ION EXCHANGE
Cycling Zone Adsorption Applied to Purification of Brackish Water with Thermally Regenerable Ion-Exchange Resins,
W82-01696 3A

IONS
Precipitate Flotation Studies with Monolauryl Phosphate and Monolauryldithiocarbamate,
W82-01863 5D

IOWA
The Management of Water Resources: A Synthesis of Goal Programming and Input-Output Analysis with Application to the Iowa Economy,
W82-01685 6A

IRRIGATION
A Structural Systems Analysis Approach to Determine Optimum Operating Policies for Irrigation and Hydropower Generation for Water Resources, Systems,
W82-01680 6A

Optimization of Water Resources for Irrigation in East Jordan,
W82-01742 6A

Measurement of Irrigated Acreage in Western Kansas from Landsat Images,
W82-01939 7B

Agricultural Conservation Program: An Evaluation,
W82-02019 3F

IRRIGATION DESIGN
Low Energy Precision Application (LEPA) Irrigation System,
W82-01859 3F

IRRIGATION EFFECTS
Note on the Role of Irrigation Frequencies on the Regrowth of Berseem,
W82-01745 2I

Effect of Irrigation Practices and Methods of Sowing-Cum-Irrigation on the Performance of Safflower,
W82-01878 3F

IRRIGATION EFFICIENCY
Furrow Advance Rates Under Surge Flow Systems,
W82-01612 3F

Responses of Grain Sorghum to Variable Water Supply Under Two Irrigation Frequencies,
W82-01944 3F

Development of Solutions for Level-Basin Design,
W82-01976 3F

Influence of Trickle and Sprinkle Irrigation on Golden Delicious Apple Quality,
W82-02001 3F

Ways of Successive Refinement of Methods of Calculating the Duty of Water,
W82-02094 2D

IRRIGATION PRACTICES
Using the Bamboo (Bambusa Vulgaris) as Field Drainage Material,
W82-01743 4A

Low Energy Precision Application (LEPA) Irrigation System,
W82-01859 3F

Control of Peach Tree Growth and Productivity by Regulated Water Supply, Tree Density, and Summer Pruning,
W82-01883 2I

Corn and Alfalfa Production as Influenced by Limited Irrigation,
W82-01945 3F

Shortening the Irrigation Interval as a Means of Saving Water in a Banana Plantation,
W82-02093 3F

IRRIGATION PROGRAMS
Integrated Agricultural Development in the Philippines,
W82-01725 6B

Exploiting the Waters of Lake Chad.
W82-01726 8A

Sustaining the Growth of Provence.
W82-01738 6D

The Chambal Project: Problems and Solutions,
W82-01739 4A

Irrigation for Brazil's Poligono Das Secas,
W82-01744 3F

IRRIGATION REQUIREMENTS
Intraseasonal Water Allocation in Deficit Irrigation,
W82-01916 3F

Optimal Design of Border Irrigation Systems,
W82-01977 3F

Water Use, Yield and Quality of Rapeseed as Influenced by Spacing, Irrigation and Time of Harvest When Raised in a Multiple-Cropping System,
W82-02031 3F

IRRIGATION WATER
Impressions of Soil and Water Conservation in China,
W82-01730 4D

A Proposal for Reclamation by Dilution of Irrigation Water,
W82-01943 3C

IRTYSH-KARAGANDA CANAL
Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 5B

ISLE OF MAN
Sulby Reservoir - Providing Water for the Isle of Man,
W82-02068 8A

ISOTOPE STUDIES
Field Observations of the Isotopic Composition of Particulate Organic Carbon in the Southern North Sea and Adjacent Estuaries,
W82-01714 2J

ISRAEL
Shortening the Irrigation Interval as a Means of Saving Water in a Banana Plantation,
W82-02093 3F

JAMES BAY
Some Environmental and Social Impacts of the James Bay Hydroelectric Project, Canada,
W82-01908 6G

JAMES RIVER
Protecting Virginia's Waterways,
W82-01608 5G

Sediment-Contaminant Transport Model,
W82-01614 5B

JORDAN
Optimization of Water Resources for Irrigation in East Jordan,
W82-01742 6A

JUDICIAL DECISIONS
Legal Challenge of the Ungaged Watershed,
W82-01664 2E

KANEV RESERVOIR
Bacterioplankton and Phytoplankton in the Kiev Sector of Kanev Reservoir During the Period of Its Formation,
W82-02081 2H

KANSAS
Measurement of Irrigated Acreage in Western Kansas from Landsat Images,
W82-01939 7B

KARST HYDROLOGY
Morphology, Hydrology and Hydrochemistry of Karst in Permafrost Terrain Near Great Bear Lake, Northwest Territories,
W82-01904 2F

KENNEBEC RIVER BASIN
Water Resources Appraisal for Hydroelectric Licensing; Kennebec River Basin, Maine.
W82-01755 6D

KEPONE
Protecting Virginia's Waterways,
W82-01608 5G

Sediment-Contaminant Transport Model,
W82-01614 5B

Fate of Kepone and Mirex in a Model Aquatic Environment: Sediment, Fish, and Diet,
W82-01820 5B

KHARKOV
The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State,
W82-01924 2H

KIEV RESERVOIR
Finds of Relict Infusoria in Kiev Reservoir,
W82-02079 2H

Planktonic Infusoria of Kiev and Kremenchug Reservoirs,
W82-02082 2H

KIEV RESERVOIRS
A Preliminary Study of the Effect of Pumped-Storage Plant Operation on Zooplankton,
W82-01971 5C

KINETIC ENERGY
Various Kinetic Energy Characteristics of Hail-patterns in the Grossversuch IV Experiment,
W82-01732 2B

KINETICS
Kinetics for the Aquatic Environment,
W82-01631 2K

Kinetics for the Aquatic Environment,
W82-01806 2K

KREMENCHUG RESERVOIR
Planktonic Infusoria of Kiev and Kremenchug Reservoirs,
W82-02082 2H

KRIGING
Evaluation of a Precipitation Map Using a Smoothed Elevation-Precipitation Relationship and Optimal Estimates (Kriging),
W82-01892 2B

LABORATORY EQUIPMENT
Apparatus to Produce Tidal Fluctuations in a Simulated Salt Marsh System,
W82-01930 2L

LADOGA LAKE
Investigation of Turbulence and Langmuir Circulation in Lake Ladoga,
W82-02100 2H

LAGOONS
Geochemistry and Hydrodynamics in the Hutt and Leeman Evaporitic Lagoons, Western Australia: A Comparative Study,
W82-01746 2L

Limnology and Performance of Waste Treatment Lagoons,
W82-02026 5D

LAKE BAIKAL
Calculation of Brachionus Rubens Production by the Direct Method and by Edmondson's Method,
W82-01921 2H

Phytoplankton Distribution in the Southern and Middle Parts of Lake Baikal,
W82-02078 2H

LAKE BEDS
Hydraulic Connection Between Lake Michigan and a Shallow Ground-Water Aquifer,
W82-02010 2F

LAKE CHAD
Exploiting the Waters of Lake Chad.
W82-01726 8A

LAKE ERIE
Loading Estimates to Lake Erie, 1967-1976,
W82-01852 5A

Environmental Design and Operation of Nanticoke Thermal Generating Station,
W82-01907 5D

A Test Utilizing Sediment Traps, Survey Rods, and Radiographs to Monitor Sediment Accumulation from a Dredging Disposal Operation,
W82-01950 7B

Comparative Limnology of Inner Long Point Bay, Lake Erie, and Adjacent Waters of the Outer Bay,
W82-02005 5B

Regulation for Environmental Protection: The Nanticoke Industrial Complex, Ontario, Canada,
W82-02024 6E

LAKE HURON
Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 2H

LAKE KNAACK
The Role of Phototrophic Bacteria in the Sulfur Cycle of a Meromictic Lake,
W82-01831 2H

LAKE LUCERNE
Reconstruction of a Small Dam for a Recreational Lake.
W82-01604 4D

LAKE MEMPHREMAGOG
Relationships Between Nannoplankton and Lake Trophic Status,
W82-01640 5C

LAKE MICHIGAN
Effect of the Algal Length/Aperture Length Ratio on Coulter Analyses of Lake Seston,
W82-01823 7B

Effects of Thermocline Displacement Upon Subsurface Chlorophyll Maxima in Lake Michigan,
W82-01957 2H

Southern Lake Michigan Sediments: Changes in Accumulation Rate, Mineralogy, and Organic Content,
W82-01958 2J

Inorganic Chemistry of Particulate Matter from the Nearshore Zone of Lake Michigan,
W82-01959 2H

Dredged Material Evaluations: Correlations Between Chemical and Biological Evaluation Procedures,
W82-01985 5C

Hydraulic Connection Between Lake Michigan and a Shallow Ground-Water Aquifer,
W82-02010 2F

LAKE MORPHOMETRY
Limnology of Lake Rerewhakaaitu,
W82-01705 2H

LAKE NASSER
Environmental Studies: Their Implications and the Special Case of Egypt,
W82-02062 6G

LAKE NEUSIEDLER
Water Quality Management of Lake Neusiedler, Austria,
W82-02090 5C

LAKE OGLETHROPE
The Relative Importance of Protozoans, Rotifers, and Crustaceans in a Freshwater Zooplankton Community,
W82-01840 2H

LAKE ONTARIO
A Method of Objective Analysis for Currents in a Lake with Application to Lake Ontario,
W82-01616 2H

Voltammetric Studies on the Stability of the ZN(II) Chelates with NTA and EDTA and the Kinetics of their Formation in Lake Ontario Water,
W82-01839 2H

LAKE REREWHAKAAITU
Limnology of Lake Rerewhakaaitu,
W82-01705 2H

LAKE RESTORATION
Destratification and Reaeration as Tools for In-Lake Management,
W82-01648 5G

Experience with Lake and Reservoir Restoration Techniques in the German Democratic Republic,
W82-02054 2H

LAKE SEDIMENTS
The Contributions of Temperature and the Input of Organic Matter in Controlling Rates of Sediment Methanogenesis,
W82-01832 2H

Southern Lake Michigan Sediments: Changes in Accumulation Rate, Mineralogy, and Organic Content,
W82-01958 2J

Dissolved Oxygen Dependent Phosphorus Release from Profundal Sediments of Lake Constance (Obersee),
W82-02055 2H

LAKE ST. CLAIR
Zooplankton Species Diversity in Lake St. Clair, Ontario, Canada,
W82-01937 5C

LAKE SUPERIOR
Resonant Oscillation in Duluth-Superior Harbor,
W82-01837 2H

Contourites in Lake Superior,
W82-01935 2H

LAKE TAHOE
The Lake Tahoe Basin: A Systems Analysis of Its Characteristics and Human Carrying Capacity,
W82-01807 6A

LAKE TAUPO
Nitrate Accumulation in Aerobic Hypolimnia: Relative Importance of Benthic and Planktonic Nitrifiers in an Oligotrophic Lake,
W82-02023 2H

LAKE VICTORIA
Recent Changes in Level of Lake Victoria,
W82-01711 4A

LAKES
Reconstruction of a Small Dam for a Recreational Lake.
W82-01604 4D

A Method of Objective Analysis for Currents in a Lake with Application to Lake Ontario,
W82-01616 2H

Abundance, Life History, and Growth of Introduced Populations of the Opossum Shrimp (Mysis Relicta) in Subalpine California Lakes,
W82-01638 2H

Benthic Macroinvertebrates of Lake Taupo,
W82-01702 2H

On The Use of Carotenoid Stratigraphy in Lake Sediments for Detecting Past Developments of Phytoplankton,
W82-01706 2H

Recent Changes in Level of Lake Victoria,
W82-01711 4A

The Relative Importance of Protozoans, Rotifers, and Crustaceans in a Freshwater Zooplankton Community,
W82-01840 2H

The Mercury Cycle,
W82-01869 5B

Calculation of Brachionus Rubens Production by the Direct Method and by Edmondson's Method,
W82-01921 2H

Contourites in Lake Superior,
W82-01935 2H

Zooplankton Species Diversity in Lake St. Clair, Ontario, Canada,
W82-01937 5C

Quantification of the Lake Trophic Typologies of Naumann (Surface Quality) and Thienemann (Oxygen) with Special Reference to the Great Lakes,
W82-02004 2H

Comparative Limnology of Inner Long Point Bay, Lake Erie, and Adjacent Waters of the Outer Bay,
W82-02005 5B

Phosphorus Cycling in a Dense Potamogeton Pectinatus L. Bed,
W82-02070 2H

Phytoplankton Distribution in the Southern and Middle Parts of Lake Baikal,
W82-02078 2H

Investigation of Turbulence and Langmuir Circulation in Lake Ladoga,
W82-02100 2H

LAND DISPOSAL
Nitrous Oxide Emission from Simulated Overland Flow Wastewater Treatment Systems,
W82-01624 5D

Geologic and Hydrologic Implications of Hazardous Wastes Management Rules on Siting in North Carolina,
W82-01630 5E

Flow Calculations for Household Effluent Disposal in Elevated Sand Mounds,
W82-01660 5E

LAND USE
Land-Use Conflict in Wildland Watershed Management: A Multiple Objective Economic Analysis,
W82-01675 6A

LANDFILLS
The Dynamics of Anaerobic Phenol Biodegradation in Lower Greenland,
W82-02071 5B

LANGMUIR CELLS
Phytoplankton Accumulation in Langmuir Cells,
W82-01946 2H

LARVICIDES
Persistence of 3-(Trifluoromethyl)-4-Nitrophenol in Aquatic Environments,
W82-01798 5B

LEACHATES
Composition of Leachage from Surface-Retorted and Unretorted Colorado Oil Shale,
W82-01810 5B

Control of Bark Landfill Leachates with an Anaerobic Treatment System,
W82-02006 5D

LEACHING
Leaching of Fertilizer Ions in a Ultisol from the High Rainfall Tropics: Leaching Through Undisturbed Soil Columns,
W82-01721 2G

Direct Evidence of Water-Soluble Organic Matter Leaching in Brown Earths and Slightly Podzolized Soils,
W82-02034 2G

LEAKY AQUIFERS
Extension of the Integrodifferential Approach to Inhomogeneous Multiaquifer Systems,
W82-02017 2F

LEECHES
The Use of Leeches to Identify Pesticides in Water,
W82-02075 5A

LEGAL ASPECTS
Parish Is Not Liable for Subsidence.
W82-01603 6E

The National Water Policy Review and Western Water Rights Law Reform: An Overview,
W82-01659 6E

Hydropower vs. Salmon: The Struggle of the Pacific Northwest's Anadromous Fish Resources for a Peaceful Coexistence with the Federal Columbia River Power System,
W82-01804 6E

Preserving Instream Flows in Oregon's Rivers and Streams,
W82-01871 6E

Perseverance Produces County Park,
W82-01932 6D

LEGISLATION
Pollution Control: Changing Approaches,
W82-01870 6E

LIGHT PENETRATION
Effects of Artificial Shading on Periphyton and Invertebrates in a New Zealand Stream,
W82-01701 5C

LIME
Effect of the Liming of Intensively Exploited Ponds on Phytoplankton Development,
W82-01923 2H

LIMNOLOGY
Benthic Macroinvertebrates of Lake Taupo,
W82-01702 2H

Limnology of Lake Rerewhakaaitu,
W82-01705 2H

Comparative Limnology of Inner Long Point Bay, Lake Erie, and Adjacent Waters of the Outer Bay,
W82-02005 5B

Limnology and Performance of Waste Treatment Lagoons,
W82-02026 5D

LINDANE
A New Method for Assessing the Lethal Impact of Short-Term, High-Level Discharges of Pollutants on Aquatic Animals,
W82-01993 5C

LITERATURE REVIEW
Health Aspects of Organic Substances in South African Waters - Opinions and Realities,
W82-01712 5A

Impacts of Navigational Dredging on Fish and Wildlife: A Literature Review,
W82-01768 6G

LIVESTOCK
Controlling Runoff for Livestock Feedlots; A State of the Art,
W82-01769 5G

LOG PEARSON DISTRIBUTION
Log Pearson III Distribution - Is It Applicable to Flood Frequency Analysis of Australian Streams,
W82-01731 2E

LOGGING
Hydrology of Okarito Lagoon and the Inferred Effects of Selective Logging in Okarito Forest,
W82-01703 4C

LONG-TERM PLANNING
Long-Run Effects of Environmental Regulation,
W82-01848 6A

LOUISIANA
Parish Is Not Liable for Subsidence.
W82-01603 6E

LOVE CANAL
Organic Compounds Found Near Dump Sites in Niagara Falls, New York,
W82-01802 5B

LOW FLOW
Low-Flow Frequency and Flow Duration of Tennessee Streams,
W82-01779 2E

Low-Flow Characteristics of Streams in the Deschutes River Basin, Washington,
W82-01781 2E

Statistical Determination of Design Low Flows,
W82-01858 2E

MACROINVERTEBRATES
Benthic Macroinvertebrates of Lake Taupo,
W82-01702 2H

Eutrophication of the Salt Valley Reservoirs 1968-73. III. The Macroinvertebrate Community: Its Development, Composition, and Change in Response to Eutrophication,
W82-01797 5C

Biological Consequences of Stream Routing Through a Final-Cut Strip Mine Pit: Benthic Macroinvertebrates,
W82-01948 4A

MACROPHYTES
Abundance Dynamics of Microorganisms in the Decomposition of Macrophytes,
W82-01999 2H

MAIN SEWERS
Power Spectral Analysis of a Forcemain Failure Caused by Waterhammer,
W82-01826 7B

MAPPING
The Use of Remote Sensing for an Integrated Inventory of a Semi-Arid Area,
W82-01910 7B

MAPS
Evaluation of a Precipitation Map Using a Smoothed Elevation-Precipitation Relationship and Optimal Estimates (Kriging),
W82-01892 2B

Recording Underground,
W82-02036 8A

MARGINAL COSTS
Charging Policies for Water Services,
W82-01734 6C

MARINE SEDIMENTS
PCB and HCB in the Sediments and Waters of the Tiber Estuary,
W82-02057 2L

MARSHES
Upland Marsh for Water Quality Control,
W82-01962 5B

MASS TRANSFER
Non-Equilibrium Water/Rock Interactions,
W82-01684 1A

MASS TRANSPORT
Non-Equilibrium Water/Rock Interactions,
W82-01684 1A

MATACIL
Matacil Residue Determination in Foliage, Fish, Soil and Water,
W82-01621 5A

MATHEMATICAL EQUATIONS
Flow Calculations for Household Effluent Disposal in Elevated Sand Mounds,
W82-01660 5E

MATHEMATICAL MODELS
Random Differential Equations in Water Quality Modeling,
W82-01688 6A

A Mathematical Model of the Hydrologic Regime of the Upper Nile Basin,
W82-01857 2A

Mixing Zone Analysis for River Plumes,
W82-01961 5B

The Modeling of Aquatic Ecological Systems,
W82-01972 5B

Modeling Stormwater Storage/Treatment Transients: Theory,
W82-01980 2A

Modeling Stormwater Storage/Treatment Transients: Applications,
W82-01981 2E

Mathematical Modeling of Stream Water Quality by a New Moment Method: Field Investigation of a Tidal River,
W82-01995 7B

Accuracy of Suspended Sediment Measurements in Natural Streamflows,
W82-02002 2J

MATHEMATICAL STUDIES
A Method of Objective Analysis for Currents in a Lake with Application to Lake Ontario,
W82-01616 2H

Kinetics for the Aquatic Environment,
W82-01631 2K

Note on Two Limit Distributions of Bedload Movement,
W82-01643 2J

Log Pearson III Distribution - Effect of Dependence, Distribution Parameters and Sample Size on Peak Annual Flood Estimates,
W82-01649 2E

Log Pearson III Distribution - An Empirically-Derived Plotting Position,
W82-01650 2E

Log Pearson III Distribution - Is It Applicable to Flood Frequency Analysis of Australian Streams,
W82-01731 2E

MEASURING INSTRUMENTS
Electronic Measurement and Recording of Evaporation Loss,
W82-01602 7B

A Test Utilizing Sediment Traps, Survey Rods, and Radiographs to Monitor Sediment Accumulation from a Dredging Disposal Operation,
W82-01950 7B

MECHANICAL EQUIPMENT
Device for Collecting Replicate Artificial Substrate Samples of Benthic Invertebrates in Large Rivers,
W82-01947 7B

MELT WATER
Glacier Surveys in Alberta - 1979,
W82-01855 2C

MEMBRANE FILTERS
Extraction of Copper with Liquid Surfactant Membranes,
W82-01896 5D

Selective Removal of Heavy Metal Ions from Aqueous Solutions by Diafiltration of Macromolecular Complexes,
W82-01900 5D

MENOMINEE RIVER BASIN
Water Resources Appraisal for Hydroelectric Licensing; Menominee River Basin; Michigan, Wisconsin,
W82-01753 6D

MERCURY
Removal of Elemental Mercury from Wastewaters Using Polysulfides,
W82-01800 5D

Mercury Methylation by Fish Intestinal Contents,
W82-01830 5C

The Mercury Cycle,
W82-01869 5B

MEROMICTIC LAKES
The Role of Phototrophic Bacteria in the Sulfur Cycle of a Meromictic Lake,
W82-01831 2H

Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 2H

MESOTROPHIC LAKES
Ecological Characteristics of the Rhizosphere Microflora of Myriophyllum Heterophyllum,
W82-01796 4A

METAL *ANALYTICAL TECHNIQUES
Applications of Stripping Analysis to Metal Determinations in Natural Waters,
W82-01670 1A

METAL-FINISHING WASTES
Managing Water at Helicopter Plant,
W82-01974 5D

A Mechanistic Model of a Packed-Bed Electrode Cell to Remove Metal Ions from Dilute Effluent Solutions,
W82-02050 5D

METALS
Simultaneous Determination of Trace Metals in Sewage and Sewage Effluents by Inductively Coupled Argon Plasma Atomic Emission Spectrometry,
W82-01828 5A

Precipitate Flotation Studies with Monolauryl Phosphate and Monolauryldithiocarbamate,
W82-01863 5D

Ion Flotation-Spectrophotometric Determination of Traces of Chromium (VI),
W82-02007 5A

METEOROLOGICAL DATA
Analysis of the Origin of Water Which Forms Large Aufeis Fields on the Arctic Slope of Alaska Using Ground and Landsat Data,
W82-01690 2C

METHANE
The Contributions of Temperature and the Input of Organic Matter in Controlling Rates of Sediment Methanogenesis,
W82-01832 2H

METHANE BACTERIA
Methanogenesis in Freshwater Sediments: Inherent Variability and Effects of Environmental Contaminants,
W82-01825 5C

METHEMOGLOBINEMIA
An Alternative for Meeting the Nitrate Standard for Public Water Supplies,
W82-01623 5C

METHYL EUGENOL
Environmental Fate of Methyl Eugenol,
W82-02013 5B

METHYLATION
Mercury Methylation by Fish Intestinal Contents,
W82-01830 5C

MEXICO
A Structural Systems Analysis Approach to Determine Optimum Operating Policies for Irrigation and Hydropower Generation for Water Resources, Systems,
W82-01680 6A

On the Presence of Fecal Steroids in Sediments from Two Mexican Harbors,
W82-02012 5A

LIBRARY U. OF ILL. URBANA-CHAMPAIGN

MIAMI
Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
W82-01835 5A

MICROBIAL DEGRADATION
Petroleum Degradation by Naturally Occurring Populations of Marine Bacteria from Middle Atlantic Outer Continental Shelf Waters,
W82-01683 5G

Aquatic Microbiology with Reference to Tannin Degradation,
W82-02028 5B

MICROBIOLOGICAL STUDIES
Microbiology of the Aquatic Environment,
W82-01786 5C

MICROORGANISMS
Abundance Dynamics of Microorganisms in the Decomposition of Macrophytes,
W82-01999 2H

MINE DRAINAGE
The Effects of Mine Drainage and Organic Enrichment on Benthos in the River Nent System, Northern Pennines,
W82-02053 5C

MINE WASTES
Effects of Sedimentation on the Gravels of an Industrial River System,
W82-01881 5C

Technology and Performance of the Hi-Capacity Thickener,
W82-01929 5D

MINERAL INDUSTRY
Determination of Mineral Fiber Concentrations in Fish Tissues,
W82-01822 5C

MINERAL WATER REACTIONS
Non-Equilibrium Water/Rock Interactions,
W82-01684 1A

MINERALS
Variations and Mechanisms of Asbestos Fibre Distribution in Stream Water,
W82-01853 5A

MIREX
Fate of Kepone and Mirex in a Model Aquatic Environment: Sediment, Fish, and Diet,
W82-01820 5B

MISSISSIPPI
Quality of Water and Time of Travel in Part of Tillatoba Creek Basin, Mississippi, October 1974 to September 1980,
W82-01791 7C

MISSISSIPPI RIVER
The Removal of Organic Matter from Surface Water Supplies by Anion Exchange Resins,
W82-01697 5F

MISSOURI RIVER
Cooling Potential of Missouri River in Missouri,
W82-01654 5B

MIXING
Effect of Reagent Mixing Rate on Adsorption Process for Am-Fe2O3.H2O,
W82-01799 5F

MODEL STUDIES
Simulation of the Topographic Influence on SLAR Data for Soil Moisture Detection in a Hilly Area,
W82-01605 2G

Can We Model the Rainfall-Runoff Process Today,
W82-01609 2A

Soil Moisture Updating and Microwave Remote Sensing for Hydrological Simulation,
W82-01611 2G

Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 2A

Kinetics for the Aquatic Environment,
W82-01631 2K

Note on Two Limit Distributions of Bedload Movement,
W82-01643 2J

Parameter Estimation of Rainfall-Runoff Models with Heteroscedastic Streamflow Errors--The Noninformative Data Case,
W82-01657 2A

Simulation of Water and Nitrogen Movement and Nitrogen Transformations in Forest Soils,
W82-01668 2G

River Basin Sequential Water Use and Salinity Effects on Crop Yield Economics,
W82-01671 3F

Predicting Storm Runoff from Small Grassland Watersheds with the USDAHL Hydrologic Model,
W82-01672 2E

Watershed Constituent Loading Analysis Utilizing Empirical Hydro-Chemical Modeling Techniques,
W82-01676 5B

Water Management in the Colorado River Basin: An Application of Nonlinear Transportation Algorithms,
W82-01677 6A

Random Differential Equations in Water Quality Modeling,
W82-01688 6A

The Technology Transfer Process in Water Resources R&D Management,
W82-01694 6A

Pollution Permits and Markets for Water Quality,
W82-01699 6A

Hydrogeology of Well-Field Areas Near Tampa, Florida, Phase 1--Development and Documentation of a Two-Dimensional Finite-Difference Model for Simulation of Steady-State Ground-Water Flow,
W82-01780 6A

Environmental Assessment of Industrial Discharges Based on Multiplicative Models,
W82-01808 5B

A Gel Partition Model for Organic Desorption from a Pond Sediment,
W82-01844 5A

Estimating Erosion and Sediment Yield on Field-Sized Areas,
W82-01849 2J

Simulating Effects of Combined Sewer Overflows,
W82-01864 6A

A Sensitivity Analysis of an Ecosystem Model of Estuarine Carbon Flow,
W82-01875 2L

Development and Applications of a Runoff Model for Snowcovered and Glacierized Basins,
W82-01885 2C

Generalized Computer Simulation Model for the Impact Assessment of Industrial Water Use on Fish Populations,
W82-01915 5C

Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 2H

Mathematical Model for Regional Land Subsidence Due to Pumping 1. Integrated Aquifer Subsidence Equations Based on Vertical Displacement Only,
W82-01926 2F

MONITORING
Environmental Design and Operation of Nanticoke Thermal Generating Station,
W82-01907 5D

The Value of Ecological Monitoring in the Management of Petroleum Industry Effluent Discharges: Experience in Esso Petroleum Company U.K. Refineries,
W82-01913 5G

Where Do We Go from Here,
W82-02086 7A

MONTANA
Selected Drill-Stem-Test Data from the Northern Great Plains Area of Montana,
W82-01774 7C

Selected Hydrogeologic Data from the Northern Great Plains Area of Montana,
W82-01777 7C

Water-Resources Investigations of the U.S. Geological Survey in Montana, October 1980 through September 1981,
W82-01787 7C

MONTE CARLO METHOD
Log Pearson III Distribution - An Empirically-Derived Plotting Position,
W82-01650 2E

MOROCCO
Morocco's Largest Multipurpose Scheme,
W82-01724 8A

MOSCOW RIVER
Seasonal Variations in the Actual Fecundity of Daphnia Magna in a Laboratory Culture,
W82-02083 5C

MOST PROBABLE NUMBER TEST
Numerical Taxonomy Analysis of Bacteria Isolated from the Completed 'Most Probable Numbers' Test for Coliform Bacilli,
W82-01911 5A

MOUNT ST. HELENS
Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01792 7C

MULTIOBJECTIVE PLANNING
The California State Water Project--Current Activities and Future Management Plans.
W82-01851 6E

A Multilevel Model and Algorithm for Some Multiobjective Problems,
W82-01884 6A

MUNICIPAL WASTES
Degree of Pollution of Several Major Streams Entering Tolo Harbour, Hong Kong,
W82-02058 5B

MUNICIPAL WATER
Water Quality Study -- Southwest Minnesota Public Water Supplies,
W82-01795 2K

MURFREESBORO
A Survey of Trihalomethanes in the Drinking Water System of Murjreesboro, Tennessee,
W82-01817 5B

MUSSELS
Variations in Trace Metal Content of the Mussel Choromytilus Meridionalis (Kr.) with Season and Sex,
W82-01969 5A

MUTAGENS
Comparison of Liquid-Liquid Extraction and Resin Adsorption for Concentrating Mutagens in Ames Salmonella/Microsome Assays on Water,
W82-01812 5A

NANNOPLANKTON
Relationships Between Nannoplankton and Lake Trophic Status,
W82-01640 5C

NANTICOKE THERMAL GENERATING STATION
Environmental Design and Operation of Nanticoke Thermal Generating Station,
W82-01907 5D

NATURAL RESOURCES
Surficial Geology of Dugway Quadrangle, Oswego County, New York,
W82-01775 7C

NATURAL STREAMS
Stream Pollution in Hong Kong - An Appraisal,
W82-02084 5B

NATURAL WATERS
The Use of Specific Conductance in Studies of Natural Waters and Soil Solutions,
W82-01646 7A

NEBRASKA
Eutrophication of the Salt Valley Reservoirs, 1968-73. I. The Effects of Eutrophication on Standing Crop and Composition of Phytoplankton,
W82-01653 5C

Sediment Analyses for Selected Sites in the South Platte River in Colorado and Nebraska, and the North Platte and Platte Rivers in Nebraska--Suspended Sediment, Bedload, and Bed Material,
W82-01776 2J

Groundwater Levels in Nebraska 1980,
W82-01785 2F

NENT RIVER
The Effects of Mine Drainage and Organic Enrichment on Benthos in the River Nent System, Northern Pennines,
W82-02053 5C

NETHERLANDS
Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 5G

NEW JERSEY
Reconstruction of a Small Dam for a Recreational Lake.
W82-01604 4D

Toxic Substances in Water: Patterns of Contamination and Policy Implications,
W82-01695 5A

NEW YORK
Surficial Geology of Dugway Quadrangle, Oswego County, New York,
W82-01775 7C

Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 2H

NEW ZEALAND
Acute Toxicity of Increased pH to Freshwater Shrimp Paratya Curvirostris,
W82-01645 5C

Phytoplankton Photosynthesis and Its Relation to Standing Crop and Nutrients in Two Warm-Monomictic South Island Lakes,
W82-01700 2H

Effects of Artificial Shading on Periphyton and Invertebrates in a New Zealand Stream,
W82-01701 5C

Benthic Macroinvertebrates of Lake Taupo,
W82-01702 2H

Hydrology of Okarito Lagoon and the Inferred Effects of Selective Logging in Okarito Forest,
W82-01703 4C

Ecological Studies of Phytoplankton in the Waikato River and Its Catchment,
W82-01704 5C

Limnology of Lake Rerewhakaaitu,
W82-01705 2H

Nitrate Accumulation in Aerobic Hypolimnia: Relative Importance of Benthic and Planktonic Nitrifiers in an Oligotrophic Lake,
W82-02023 2H

Logistics of Farm Water Supply.
W82-02037 6A

Bromide in Canterbury Ground Water,
W82-02056 5B

NICKEL
Activated Sludge Nickel Toxicity Studies,
W82-01895 5D

NIGERIA
River Basin Sequential Water Use and Salinity Effects on Crop Yield Economics,
W82-01671 3F

Components of Saturated Zone Thickness in a Nigerian Basement Complex Regolith,
W82-01710 2F

Using the Bamboo (Bambusa Vulgaris) as Field Drainage Material,
W82-01743 4A

NILE BASIN
A Mathematical Model of the Hydrologic Regime of the Upper Nile Basin,
W82-01857 2A

NILE RIVER
Environmental Studies: Their Implications and the Special Case of Egypt,
W82-02062 6G

NITRATE
Leaching of Fertilizer Ions in a Ultisol from the High Rainfall Tropics: Leaching Through Undisturbed Soil Columns,
W82-01721 2G

NITRATE REMOVAL
Tackling the Nitrate Problem.
W82-01874 5F

NITRATES
An Alternative for Meeting the Nitrate Standard for Public Water Supplies,
W82-01623 5C

Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
W82-01835 5A

Tackling the Nitrate Problem.
W82-01874 5F

Nitrate Accumulation in Aerobic Hypolimnia: Relative Importance of Benthic and Planktonic Nitrifiers in an Oligotrophic Lake,
W82-02023 2H

NITRIFICATION
Nitrate Accumulation in Aerobic Hypolimnia: Relative Importance of Benthic and Planktonic Nitrifiers in an Oligotrophic Lake,
W82-02023 2H

NITROGEN
Nitrate Reduction to Ammonium and Organic Nitrogen in an Estuarine Sediment,
W82-01625 5B

Excess Air in Groundwater,
W82-02099 2F

NITROGEN CYCLE
Simulation of Water and Nitrogen Movement and Nitrogen Transformations in Forest Soils,
W82-01668 2G

NITROGEN FIXING BACTERIA
Ecological Characteristics of the Rhizosphere Microflora of Myriophyllum Heterophyllum,
W82-01796 4A

NITROUS OXIDE
Nitrous Oxide Emission from Simulated Overland Flow Wastewater Treatment Systems,
W82-01624 5D

Nitrous Oxide in Freshwaters of the Great Lakes Basin,
W82-01841 2H

NORTH CAROLINA
Geologic and Hydrologic Implications of Hazardous Wastes Management Rules on Siting in North Carolina,
W82-01630 5E

Relating Population Growth to Shellfish Bed Closures: A Case Study from North Carolina,
W82-01641 5C

Coherence Between Wind and Current Events in a Nearshore, Shallow Water, Wave Dominated Environment,
W82-01674 2L

NORTHERN IRELAND
Effects of Pollution Upon the Benthos of Belfast Lough,
W82-02059 5C

NORTHWEST TERRITORIES
Morphology, Hydrology and Hydrochemistry of Karst in Permafrost Terrain Near Great Bear Lake, Northwest Territories,
W82-01904 2F

NORWAY
Groundwater Discharge Through Springs with Well-Defined Outlets--A Case Study from Jeloya-Moss, S. Norway,
W82-01748 2F

Groundwater Chemistry of Some Selected Areas in Southeaster Norway,
W82-02020 2K

NUCLEAR ENERGY
Americium in Intertidal Sediments from the Coastal Environs of Windscale,
W82-02098 5B

NUMERICAL ANALYSIS
Numerical Analysis of Transient Salt/Fresh-Water Interface in Coastal Aquifers,
W82-01693 2F

NUTRIENT REMOVAL
Nutrient Runoff from Agricultural and Non-Agricultural Watersheds,
W82-01662 5B

Crop Residue Removal and Tillage; Effects on Soil Erosion and Nutrient Loss in the Corn Belt,
W82-01770 2J

NUTRIENTS
Periphytic Community Response to Chronic Nutrient Enrichment by a Reservoir Discharge,
W82-01658 5C

The Effects of Secondary Sewage Effluent on the Water Quality, Nutrient Cycles and Mass Balances, and Accumulation of Soil Organic Matter in Cypress Domes,
W82-01687 5G

Ecological Studies of Phytoplankton in the Waikato River and Its Catchment,
W82-01704 5C

Eutrophication of the Salt Valley Reservoirs 1968-73. III. The Macroinvertebrate Community: Its Development, Composition, and Change in Response to Eutrophication,
W82-01797 5C

OBSERVATION WELLS
Records of Water Levels in Unconsolidated Deposits in Eastern South Dakota,
W82-01788 7C

OCEAN CIRCULATION
Groundwater Discharge to the Pacific Ocean,
W82-01647 2F

OCEAN DUMPING
Industrial Waste Dumping at Deepwater Sites in the Gulf of Mexico,
W82-01903 5E

ODORS
Reviving the Rio Reconquista,
W82-02014 5G

OIL POLLUTION
Petroleum Degradation by Naturally Occurring Populations of Marine Bacteria from Middle Atlantic Outer Continental Shelf Waters,
W82-01683 5G

The Value of Ecological Monitoring in the Management of Petroleum Industry Effluent Discharges: Experience in Esso Petroleum Company U.K. Refineries,
W82-01913 5G

Hydrocarbon Concentrations in Water and Sediments from UK Marine Waters, Determined by Fluorescence Spectroscopy,
W82-02097 5B

OIL SHALE
Composition of Leachage from Surface-Retorted and Unretorted Colorado Oil Shale,
W82-01810 5B

Acute Toxicity of an In Situ Shale Oil Process Wastewater and It's Major Components to Daphnia Magna,
W82-01811 5C

OIL-WATER INTERFACES
The Spreading of Thin Liquid Films on a Water-Air Interface,
W82-01955 1B

The Containment of an Oil Slick by a Boom Placed Across a Uniform Stream,
W82-01956 1B

OKLAHOMA
Predicting Storm Runoff from Small Grassland Watersheds with the USDAHL Hydrologic Model,
W82-01672 2E

OLIGOTROPHIC LAKES
Nitrate Accumulation in Aerobic Hypolimnia: Relative Importance of Benthic and Planktonic Nitrifiers in an Oligotrophic Lake,
W82-02023 2H

OPOSSUM SHRIMP
Abundance, Life History, and Growth of Introduced Populations of the Opossum Shrimp (Mysis Relicta) in Subalpine California Lakes,
W82-01638 2H

OREGON
Geographic Variations in Water Quality and Recreational Use Along the Upper Wallowa River and Selected Tributaries,
W82-01681 5A

Preserving Instream Flows in Oregon's Rivers and Streams,
W82-01871 6E

ORGANIC ACIDS
The Natural Acidity of Some Unpolluted Waters in Southeastern Alaska and Potential Impacts of Acid Rain,
W82-01867 5B

Production of Aromatic Acids During Anaerobic Digestion of Citrus Peel,
W82-02049 5D

ORGANIC CARBON
Field Observations of the Isotopic Composition of Particulate Organic Carbon in the Southern North Sea and Adjacent Estuaries,
W82-01714 2J

A Gel Partition Model for Organic Desorption from a Pond Sediment,
W82-01844 5A

ORGANIC COMPOUNDS
Removal of Organics from Water by Granular Activated Carbon and Microorganisms,
W82-01628 5D

Health Aspects of Organic Substances in South African Waters - Opinions and Realities,
W82-01712 5A

Organic Substances in Water,
W82-01783 5A

Oxidation of Phenolic Antioxidants in a River System,
W82-01801 5B

Predicting Priority Pollutants from Petrochemical Processes,
W82-01809 5B

Potential for Biodegradation of Phthalic Acid Esters in Marine Regions,
W82-01829 5B

Tying Up TCE,
W82-01866 5G

Transport of Nonpolar Organic Compounds from Surface Water to Groundwater. Laboratory Sorption Studies,
W82-01873 5B

ORGANIC MATTER
The Effects of Secondary Sewage Effluent on the Water Quality, Nutrient Cycles and Mass Balances, and Accumulation of Soil Organic Matter in Cypress Domes,
W82-01687 5G

The Removal of Organic Matter from Surface Water Supplies by Anion Exchange Resins,
W82-01697 5F

Voltammetric Studies on the Stability of the ZN(II) Chelates with NTA and EDTA and the Kinetics of their Formation in Lake Ontario Water,
W82-01839 2H

Effect of Different Water Salinity Levels and Organic Matter Application on the Composition of Water Soluble and Exchangeable Bases in a Brackishwater Fish Pond Soil,
W82-02027 2H

Direct Evidence of Water-Soluble Organic Matter Leaching in Brown Earths and Slightly Podzolized Soils,
W82-02034 2G

The Predicted Content of Organic and Biogenic Matter in the Water of Vilyuy Reservoir and the Extent to Which It Has Been Confirmed,
W82-02080 2H

ORGANIC SOILS
Effect of Bulk Density on Calibration of Neutron Moisture Probe for Organic Soils,
W82-01861 2G

ORGANOPHOSPHORUS COMPOUNDS
A National Survey of Tri(Haloalkyl)-, Trialkyl-, and Triarylphosphates in Canadian Drinking Water,
W82-01989 5B

ORGANOPHOSPHORUS PESTICIDES
Detection of Organophosphate Insecticide by an Immobilized-Enzyme System,
W82-02025 5A

OROGRAPHIC PRECIPITATION
Towards an Understanding of the Effects of Orography on the Distribution of Precipitation Over the Cape Peninsula,
W82-02085 2B

OSCILLATORY WAVES
Resonant Oscillation in Duluth-Superior Harbor,
W82-01837 2H

OUTLETS
Intakes and Outlets for Low-Head Hydropower,
W82-01979 8C

OVERLAND FLOW
Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 2A

OXIDATION
Parasite Egg and Cyst Reduction in Oxidation Ditches and Aerated Lagoons,
W82-01733 5D

OXYGEN
Oxygen Bleaching Shows Potential for Reducing Costs, Effluent Problems,
W82-01899 5D

OXYGEN DEPLETION
Quantification of the Lake Trophic Typologies of Naumann (Surface Quality) and Thienemann (Oxygen) with Special Reference to the Great Lakes,
W82-02004 2H

PACKED BEDS
A Mechanistic Model of a Packed-Bed Electrode Cell to Remove Metal Ions from Dilute Effluent Solutions,
W82-02050 5D

PARAGUAY
Flood Control on the Parana and Paraguay Rivers,
W82-01707 2E

PARASITE
Parasite Ova in Anaerobically Digested Sludge,
W82-02018 5B

PARASITES
Parasite Egg and Cyst Reduction in Oxidation Ditches and Aerated Lagoons,
W82-01733 5D

PARKS
Perseverance Produces County Park,
W82-01932 6D

Water Quality and the Demand for Recreation,
W82-01942 6D

PARTICLE SIZE
Effect of the Algal Length/Aperture Length Ratio on Coulter Analyses of Lake Seston,
W82-01823 7B

PARTICULATE MATTER
Inorganic Chemistry of Particulate Matter from the Nearshore Zone of Lake Michigan,
W82-01959 2H

PATH OF POLLUTANTS
Sediment-Contaminant Transport Model,
W82-01614 5B

A Graphical Approach to Prediction of Groundwater Pollutant Movement,
W82-01634 5B

Quality of Water and Time of Travel in Part of Tillatoba Creek Basin, Mississippi, October 1974 to September 1980,
W82-01791 7C

Oxidation of Phenolic Antioxidants in a River System,
W82-01801 5B

Investigation of Selective Uptake of Polychlorinated Biphenyls by Spartina Alterniflora Loisel,
W82-01813 5B

The Mercury Cycle,
W82-01869 5B

Hydrocarbon Concentrations in Water and Sediments from UK Marine Waters, Determined by Fluorescence Spectroscopy,
W82-02097 5B

PAWTUXET RIVER
Oxidation of Phenolic Antioxidants in a River System,
W82-01801 5B

PEACHES
Control of Peach Tree Growth and Productivity by Regulated Water Supply, Tree Density, and Summer Pruning,
W82-01883 2I

PENNSYLVANIA
Legal Challenge of the Ungaged Watershed,
W82-01664 2E

PENOBSCOT RIVER BASIN
Water Resources Appraisal for Hydroelectric Licensing: Penobscot River Basin, Maine,
W82-01763 6D

PERMAFROST
The Predicted Content of Organic and Biogenic Matter in the Water of Vilyuy Reservoir and the Extent to Which It Has Been Confirmed,
W82-02080 2H

PERMEABILITY COEFFICIENT
Effect of Field Variability in Soil Hydraulic Properties on Solutions of Unsaturated Water and Salt Flows,
W82-01898 2G

PESTICIDE KINETICS
Apparatus to Produce Tidal Fluctuations in a Simulated Salt Marsh System,
W82-01930 2L

PESTICIDE RESIDUES
Protecting Virginia's Waterways,
W82-01608 5G

Matacil Residue Determination in Foliage, Fish, Soil and Water,
W82-01621 5A

PESTICIDES
Effect of an Aerial Application of Carbaryl on Brook Trout (Salvelinus Fontinalis),
W82-01818 5C

A New Method for Assessing the Lethal Impact of Short-Term, High-Level Discharges of Pollutants on Aquatic Animals,
W82-01993 5C

Environmental Fate of Methyl Eugenol,
W82-02013 5B

The Use of Leeches to Identify Pesticides in Water,
W82-02075 5A

PETROLEUM PRODUCTS
Predicting Priority Pollutants from Petrochemical Processes,
W82-01809 5B

PHENOLS
Oxidation of Phenolic Antioxidants in a River System,
W82-01801 5B

The Dynamics of Anaerobic Phenol Biodegradation in Lower Greenland,
W82-02071 5B

PHILIPPINES
Integrated Agricultural Development in the Philippines,
W82-01725 6B

PHOSPHORUS
Dissolved Oxygen Dependent Phosphorus Release from Profundal Sediments of Lake Constance (Obersee),
W82-02055 2H

Phosphorus Cycling in a Dense Potamogeton Pectinatus L. Bed,
W82-02070 2H

PHOSPHORUS COMPOUNDS
Aluminum Sulfate Treatment: Short-Term Effect on Complex Phosphorus Compounds in a Eutrophic Lake,
W82-01833 5F

PHOSPHORUS REMOVAL
Abiotic Versus Biotic Uptake of Radiophosphorus in Lake Water,
W82-01824 2H

PHOTOMETRY
Photometric Investigations of Precipitable Water and Optical Depth Wavelength Exponents in an Urban Area,
W82-01966 2B

PHOTOSYNTHESIS
Phytoplankton Photosynthesis and Its Relation to Standing Crop and Nutrients in Two Warm-Monomictic South Island Lakes,
W82-01700 2H

A Control Mechanism of the Phytoplankton Respiration in a Eutrophic Reservoir,
W82-02030 2H

PHYSICAL PROPERTIES
The Spreading of Thin Liquid Films on a Water-Air Interface,
W82-01955 1B

PHYTOPLANKTON
Eutrophication of the Salt Valley Reservoirs, 1968-73. I. The Effects of Eutrophication on Standing Crop and Composition of Phytoplankton,
W82-01653 5C

Phytoplankton Photosynthesis and Its Relation to Standing Crop and Nutrients in Two Warm-Monomictic South Island Lakes,
W82-01700 2H

Ecological Studies of Phytoplankton in the Waikato River and Its Catchment,
W82-01704 5C

Effect of the Liming of Intensively Exploited Ponds on Phytoplankton Development,
W82-01923 2H

Phytoplankton Distributions Observed During a 3 1/2 Days Fixed-Station in the Lower St. Lawrence Estuary,
W82-01938 2L

Phytoplankton Accumulation in Langmuir Cells,
W82-01946 2H

A Control Mechanism of the Phytoplankton Respiration in a Eutrophic Reservoir,
W82-02030 2H

Seasonal and Diurnal Changes of Chlorophyll in a Tropical Fresh Water Impoundment,
W82-02052 2H

Phytobenthos of the River Tees and Its Tributaries,
W82-02065 2K

Phytoplankton Distribution in the Southern and Middle Parts of Lake Baikal,
W82-02078 2H

Bacterioplankton and Phytoplankton in the Kiev Sector of Kanev Reservoir During the Period of Its Formation,
W82-02081 2H

Some Effects of Sewage Discharge Upon Phytoplankton in Hong Kong,
W82-02095 5C

PIPE FAILURE
Power Spectral Analysis of a Forcemain Failure Caused by Waterhammer,
W82-01826 7B

PLANE FLOW
Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 2A

PLANKTON
Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 5B

Estimation of the Production of Planktonic Infusorians in Connection with Fluctuations in Their Abundance,
W82-02072 2H

Finds of Relict Infusoria in Kiev Reservoir,
W82-02079 2H

Planktonic Infusoria of Kiev and Kremenchug Reservoirs,
W82-02082 2H

PLANNING
Reviving the Rio Reconquista,
W82-02014 5G

PLANT NUTRIENT UPTAKE
Upland Marsh for Water Quality Control,
W82-01962 5B

PLANT POPULATIONS
Turnover of Tritiated Water in Calamondin Plants,
W82-02048 5A

PLASTICS
Hydraulic Testing of Plastic Filter Fabrics,
W82-01613 8G

PLAYAS
Geochemistry and Hydrodynamics in the Hutt and Leeman Evaporitic Lagoons, Western Australia: A Comparative Study,
W82-01746 2L

PLUG FLOW
Step Fed Plug Flow Reactor for Biological Wastewater Treatment Versus Continuous Flow Stirred Tank Reactor (CFSTR),
W82-01618 5D

POLAND
Poland: Coming to Grips with Pollution,
W82-02092 5G

POLICY MAKING
Public Opinion and Interest Group Positions on Chesapeake Bay Issues: Implications for Resource Management,
W82-01642 6B

POLITICAL ASPECTS
Structural Aspects of the Water Supply in the Federal Republic of Germany,
W82-02066 6E

POLITICAL CONSTRAINTS
Acid Rain Agreement,
W82-01933 5B

POLLUTANT IDENTIFICATION
A Selective Medium for the Enumeration of Streptococcus Bovis by Membrane Filtration,
W82-01620 5A

Matacil Residue Determination in Foliage, Fish, Soil and Water,
W82-01621 5A

Infectious Waterborne Diseases,
W82-01784 5A

Determination of Hexachlorocyclopentadiene at the Nanogram Per Liter Level in Drinking Water,
W82-01819 5A

Ion Flotation-Spectrophotometric Determination of Traces of Chromium (VI),
W82-02007 5A

Experience with a Simple Method for the Biological Evaluation of Surface Water Quality,
W82-02029 5A

The Use of Leeches to Identify Pesticides in Water,
W82-02075 5A

POLLUTANTS
The Significance of Wet and Dry Synoptic Regions on Long-Range Transport of Pollution and Its Deposition,
W82-01877 5B

PCB and HCB in the Sediments and Waters of the Tiber Estuary,
W82-02057 2L

POLLUTION ABATEMENT
Pollution Permits and Markets for Water Quality,
W82-01699 6A

POLLUTION LOAD
Microbial Pollution of Coasts and Estuaries: The Public Health Implications,
W82-02051 5C

POLLUTION TAXES
The Economics of Cooperation Over Collective Bads,
W82-01909 6A

POLYCHLORINATED BIPHENYLS
Investigation of Selective Uptake of Polychlorinated Biphenyls by Spartina Alterniflora Loisel,
W82-01813 5B

PONDS
Influence on Groundwater from the Bermed Infiltration Pond,
W82-01622 5D

Biological and Physical Investigations of Bodies of Water Beneath Dense Water Hyacinth Populations Before and After Chemical Treatment,
W82-01678 5B

A Gel Partition Model for Organic Desorption from a Pond Sediment,
W82-01844 5A

A Simple Device for Quantitative Pseudoperiphyton Sampling,
W82-01894 7B

Effect of the Liming of Intensively Exploited Ponds on Phytoplankton Development,
W82-01923 2H

The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State,
W82-01924 2H

Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 5B

Limnology and Performance of Waste Treatment Lagoons,
W82-02026 5D

Estimation of the Production of Planktonic Infusorians in Connection with Fluctuations in Their Abundance,
W82-02072 2H

Effect of Fertilizers on the Primary and Bacterial Production of Rearing Ponds in the Volga Delta,
W82-02077 2H

POPULATION DENSITY
Ecological Studies of Phytoplankton in the Waikato River and Its Catchment,
W82-01704 5C

The Relative Importance of Protozoans, Rotifers, and Crustaceans in a Freshwater Zooplankton Community,
W82-01840 2H

POPULATION DYNAMICS
Relating Population Growth to Shellfish Bed Closures: A Case Study from North Carolina,
W82-01641 5C

Combining Sewer Water Purification Processes to Treat Effluents Produced by Transient Populations,
W82-01992 5D

Estimation of the Production of Planktonic Infusorians in Connection with Fluctuations in Their Abundance,
W82-02072 2H

PORT VALDEZ
Dissolved Hydrocarbons and Related Microflora in a Fjordal Seaport: Sources, Sinks, Concentrations, and Kinetics,
W82-01816 5B

POTABLE WATER
A Survey of Trihalomethanes in the Drinking Water System of Murjreesboro, Tennessee,
W82-01817 5B

Determination of Hexachlorocyclopentadiene at the Nanogram Per Liter Level in Drinking Water,
W82-01819 5A

A National Survey of Tri(Haloalkyl)-, Trialkyl-, and Triarylphosphates in Canadian Drinking Water,
W82-01989 5B

Disinfection of Drinking Water in Developing Countries,
W82-02091 5F

POTENTIOMETRIC HEAD
An Integral Transform Method for the Linearized Boussinesq Groundwater Flow Equation,
W82-01984 2F

POTOMAC RIVER BASIN
Water Resources Appraisal for Hydroelectric Licensing; Potomac River Basin; Pennsylvania, Maryland, West Virginia, Virginia, and District of Columbia,
W82-01760 6D

POWERPLANTS
Addendum to: Sources of Powerplant Cooling Water in the Desert Area of Southern California--Reconnaissance Study,
W82-01773 6B

Generalized Computer Simulation Model for the Impact Assessment of Industrial Water Use on Fish Populations,
W82-01915 5C

Occult Hemoglobin as an Indicator of Impingement Stress in Fishes,
W82-01931 5C

PRECIPITAION
Hydrologic Data for Experimental Agricultural Watersheds in the United States, 1972,
W82-01772 2A

PRECIPITATION
The Significance of Wet and Dry Synoptic Regions on Long-Range Transport of Pollution and Its Deposition,
W82-01877 5B

Evaluation of a Precipitation Map Using a Smoothed Elevation-Precipitation Relationship and Optimal Estimates (Kriging),
W82-01892 2B

Morphology, Hydrology and Hydrochemistry of Karst in Permafrost Terrain Near Great Bear Lake, Northwest Territories,
W82-01904 2F

Photometric Investigations of Precipitable Water and Optical Depth Wavelength Exponents in an Urban Area,
W82-01966 2B

Anomalies in Temperature and Rainfall During Warm Arctic Seasons as a Guide to the Formulation of Climate Scenarios,
W82-01975 2B

Simplified Method for Rainfall Intensities,
W82-01978 2B

PRECIPITATION INTENSITY
Towards an Understanding of the Effects of Orography on the Distribution of Precipitation Over the Cape Peninsula,
W82-02085 2B

PREDICTION
R-Factors for Soil Loss Impact Prediction,
W82-01963 2J

PRICING
Water: A Low-Priced But High-Cost Resource,
W82-02061 6C

PRIORITIES
The Sewerage Policy of Thames Water,
W82-02040 6E

PRIORITY POLLUTANTS
Predicting Priority Pollutants from Petrochemical Processes,
W82-01809 5B

PROBABILISTIC PROCESS
Probabilistic Stability Analysis of Earth Slopes,
W82-01952 8D

PRODUCTIVITY
Abundance, Life History, and Growth of Introduced Populations of the Opossum Shrimp (Mysis Relicta) in Subalpine California Lakes,
W82-01638 2H

Calculation of Brachionus Rubens Production by the Direct Method and by Edmondson's Method,
W82-01921 2H

Estimation of the Production of Planktonic Infusorians in Connection with Fluctuations in Their Abundance,
W82-02072 2H

PROJECT PLANNING
Simulating Effects of Combined Sewer Overflows,
W82-01864 6A

PROTOZOA
The Relative Importance of Protozoans, Rotifers, and Crustaceans in a Freshwater Zooplankton Community,
W82-01840 2H

Planktonic Infusoria of Kiev and Kremenchug Reservoirs,
W82-02082 2H

PUBLIC HEALTH
Planning with Great Uncertainty: A Review and Case Study of the Safe Drinking Water Controversy,
W82-01606 5A

Water Quality Study -- Southwest Minnesota Public Water Supplies,
W82-01795 2K

Thermophillic and Thermotolerant Fungi Isolated from the Thermal Effluent of Nuclear Power Generating Reactors: Disposal of Human Opportunistic and Veterinary Pathogenic Fungi,
W82-01928 5B

Microbial Pollution of Coasts and Estuaries: The Public Health Implications,
W82-02051 5C

Wanted: Water for Development,
W82-02088 6D

PUBLIC POLICY
Public Opinion and Interest Group Positions on Chesapeake Bay Issues: Implications for Resource Management,
W82-01642 6B

PUBLICATIONS
A Perspective on Estuarine and Coastal Research Funding,
W82-01803 9A

PULP AND PAPER INDUSTRY
Century-Old Board Mill Operates with Zero Effluent Discharge,
W82-01626 5D

Toxicity and BOD Effluents Derived from Kraft Pulping of Aged Wood Chips,
W82-01845 5B

Oxygen Bleaching Shows Potential for Reducing Costs, Effluent Problems,
W82-01899 5D

Control of Bark Landfill Leachates with an Anaerobic Treatment System,
W82-02006 5D

PUMPING TESTS
Drawdowns at the Free Water Table During Pumping Tests in Artesian and Semiartesian Aquifers,
W82-01890 2F

RADAR
Simulation of the Topographic Influence on SLAR Data for Soil Moisture Detection in a Hilly Area,
W82-01605 2G

Observations of Two Colorado Thunderstorms by Means of a Zenith-Pointing Doppler Radar,
W82-01967 2B

RADIOACTIVE TRACERS
The Application of Radioactive Tracers for Determination of Bed-Load Transport in Alluvial Rivers,
W82-01893 2J

RADIOACTIVITY
Turnover of Tritiated Water in Calamondin Plants,
W82-02048 5A

RADIOISOTOPES
Americium in Intertidal Sediments from the Coastal Environs of Windscale,
W82-02098 5B

RAIN GAGES
Note on Random Raindrops and Sampling Error,
W82-02032 2B

RAINBOW TROUT (SALMO GAIRDNERI)
Standard Procedure for Testing the Acute Lethality of Liquid Effluents.
W82-01905 5A

RAINFALL
A Stochastic Cluster Model of Daily Rainfall Sequences,
W82-01651 2B

Note on Random Raindrops and Sampling Error,
W82-02032 2B

RAINFALL IMPACT
R-Factors for Soil Loss Impact Prediction,
W82-01963 2J

RAINFALL INTENSITY
Simplified Method for Rainfall Intensities,
W82-01978 2B

RAINFALL-RUNOFF RELATIONSHIPS
Can We Model the Rainfall-Runoff Process Today,
W82-01609 2A

Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 2A

Parameter Estimation of Rainfall-Runoff Models with Heteroscedastic Streamflow Errors--The Noninformative Data Case,
W82-01657 2A

RAINWATER
Plant Biotests in the Bioindication of the Rainfall Pollution in an Oil Refinery Region,
W82-02033 5C

Isolation of the Mycobacterium Avium-M. Intracellulare-M. Scrofulaceum Complex from Tank Water in Queensland, Australia,
W82-02069 5A

RAPESEED
Water Use, Yield and Quality of Rapeseed as Influenced by Spacing, Irrigation and Time of Harvest When Raised in a Multiple-Cropping System,
W82-02031 3F

RAVENGLASS ESTUARY
Americium in Intertidal Sediments from the Coastal Environs of Windscale,
W82-02098 5B

RECHARGE
Excess Air in Groundwater,
W82-02099 2F

RECLAIMED WATER
Managing Water at Helicopter Plant,
W82-01974 5D

RECREATION DEMAND
Water Quality and the Demand for Recreation,
W82-01942 6D

RECREATION FACILITIES
Reconstruction of a Small Dam for a Recreational Lake.
W82-01604 4D

RECYCLING
Century-Old Board Mill Operates with Zero Effluent Discharge,
W82-01626 5D

RED RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing; Lower Red River Basin; Arkansas, Louisiana, Oklahoma and Texas,
W82-01754 6D

RED TIDE
Phytoplankton Accumulation in Langmuir Cells,
W82-01946 2H

REGULATED FLOW
Stage-Discharge Relations at Dams on the Illinois and Des Plaines Rivers in Illinois,
W82-01793 4A

REGULATIONS
Stationary Source Pollution Policy and Choices for Reform,
W82-01847 6E

Long-Run Effects of Environmental Regulation,
W82-01848 6A

Pollution Control: Changing Approaches,
W82-01870 6E

Regulation for Environmental Protection: The Nanticoke Industrial Complex, Ontario, Canada,
W82-02024 6E

REMOTE SENSING
Simulation of the Topographic Influence on SLAR Data for Soil Moisture Detection in a Hilly Area,
W82-01605 2G

Remote Sensing in Development,
W82-01719 7B

Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Taylor Creek, Fla., and Litle River, Ga., 1979 Data Report,
W82-01771 7B

The Use of Remote Sensing for an Integrated Inventory of a Semi-Arid Area,
W82-01910 7B

Measurement of Irrigated Acreage in Western Kansas from Landsat Images,
W82-01939 7B

Applications of Aerial Photography,
W82-01988 7B

RESEARCH FACILITIES
A Perspective on Estuarine and Coastal Research Funding,
W82-01803 9A

RESERVOIR
Eutrophication of the Salt Valley Reservoirs, 1968-73. I. The Effects of Eutrophication on Standing Crop and Composition of Phytoplankton,
W82-01653 5C

RESERVOIR CONSTRUCTION
Sulby Reservoir - Providing Water for the Isle of Man,
W82-02068 8A

RESERVOIR DESIGN
Tectonic State: Its Significance and Characterization in the Assessment of Seismic Effects Associated with Reservoir Impounding,
W82-01951 8E

RESERVOIR FILLING
Tectonic State: Its Significance and Characterization in the Assessment of Seismic Effects Associated with Reservoir Impounding,
W82-01951 8E

RESERVOIR OPERATION
Operating Policies for a Surface/Ground Water System,
W82-01741 4B

RESERVOIR RELEASES
Periphytic Community Response to Chronic Nutrient Enrichment by a Reservoir Discharge,
W82-01658 5C

RESERVOIR SILTING
Sediment Transport and a Reservoir Situation Formula for Zimbabwe-Rhodesia,
W82-01736 2J

RESERVOIR STAGES
Sulby Reservoir - Providing Water for the Isle of Man,
W82-02068 8A

RESERVOIRS
Flood Control on the Parana and Paraguay Rivers,
W82-01707 2E

Cape Town Waterworks Service Reservoirs: Plattekloff (1974) and Tygerberg (1964).
W82-01747 8A

Water Resources Appraisal for Hydroelectric Licensing; Kennebec River Basin, Maine.
W82-01755 6D

Eutrophication of the Salt Valley Reservoirs 1968-73. III. The Macroinvertebrate Community: Its Development, Composition, and Change in Response to Eutrophication,
W82-01797 5C

Effect of the Liming of Intensively Exploited Ponds on Phytoplankton Development,
W82-01923 2H

Chromium Levels in Fish from a Lake Chronically Contaminated with Chromates from Cooling Towers,
W82-01941 5B

A Preliminary Study of the Effect of Pumped-Storage Plant Operation on Zooplankton,
W82-01971 5C

Water Sanitation Legislation Regarded as the Basis of Water Quality Monitoring,
W82-01990 6E

Finds of Relict Infusoria in Kiev Reservoir,
W82-02079 2H

The Predicted Content of Organic and Biogenic Matter in the Water of Vilyuy Reservoir and the Extent to Which It Has Been Confirmed,
W82-02080 2H

Bacterioplankton and Phytoplankton in the Kiev Sector of Kanev Reservoir During the Period of Its Formation,
W82-02081 2H

Planktonic Infusoria of Kiev and Kremenchug Reservoirs,
W82-02082 2H

RESIDENCE TIME
Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 2H

RESONANCE
Resonant Oscillation in Duluth-Superior Harbor,
W82-01837 2H

RESOURCES DEVELOPMENT
Integrated Agricultural Development in the Philippines,
W82-01725 6B

RESOURCES MANAGEMENT
Public Opinion and Interest Group Positions on Chesapeake Bay Issues: Implications for Resource Management,
W82-01642 6B

Land-Use Conflict in Wildland Watershed Management: A Multiple Objective Economic Analysis,
W82-01675 6A

RESPIRATION
A Control Mechanism of the Phytoplankton Respiration in a Eutrophic Reservoir,
W82-02030 2H

RETENTION TIME
Simple Retention Time Analysis in Trickling Filters Using Conductivity,
W82-01876 5D

RHINE RIVER
Water Pollution: A Risk to the Future in the Case of the Rhine (Eaux Polluees' Avenir en Danger Dans le Cas du Rhin),
W82-02067 5G

RHIZOSPHERE
Ecological Characteristics of the Rhizosphere Microflora of Myriophyllum Heterophyllum,
W82-01796 4A

RHODESIA
Sediment Transport and a Reservoir Situation Formula for Zimbabwe-Rhodesia,
W82-01736 2J

RIVER BASIN DEVELOPMENT
A Water Quality Assessment of Development in the Senegal River Basin,
W82-01740 6G

A Comprehensive Methodology for Project Appraisal and Environmental Protection in Multinational River Basin Development,
W82-01914 6B

RIVER BASINS
River Basin Sequential Water Use and Salinity Effects on Crop Yield Economics,
W82-01671 3F

RIVERS
Cooling Potential of Missouri River in Missouri,
W82-01654 5B

Flood Control on the Parana and Paraguay Rivers,
W82-01707 2E

Device for Collecting Replicate Artificial Substrate Samples of Benthic Invertebrates in Large Rivers,
W82-01947 7B

Methods of Studying Invertebrate Drift in Rivers,
W82-02074 7A

Hydrologic and Anthropogenic Factors Affecting Water Quality in the Rivers of the Ukrainian Carpathians,
W82-02076 5B

ROCKFILL DAMS
Sulby Reservoir - Providing Water for the Isle of Man,
W82-02068 8A

ROCKS
Groundwater Chemistry of Some Selected Areas in Southeaster Norway,
W82-02020 2K

ROOT DEVELOPMENT
The Effect of Different Water Regimes on Plant Growth and Nodule Structure of Greenhouse-Grown Winged Bean (Psophocarpus Tetragonolobus),
W82-01723 2I

ROOT ZONE
Simulation of Soil Water Within the Root Zone of a Corn Crop,
W82-01834 2G

ROTIFERS
Calculation of Brachionus Rubens Production by the Direct Method and by Edmondson's Method,
W82-01921 2H

RUNOFF
Development and Applications of a Runoff Model for Snowcovered and Glacierized Basins,
W82-01885 2C

Limitations in Hydrological Interpretations of the Snow Coverage,
W82-01889 2C

RUNOFF FORECASTING
Legal Challenge of the Ungaged Watershed,
W82-01664 2E

Predicting Storm Runoff from Small Grassland Watersheds with the USDAHL Hydrologic Model,
W82-01672 2E

Development and Applications of a Runoff Model for Snowcovered and Glacierized Basins,
W82-01885 2C

RUSSIA
Investigation of Turbulence and Langmuir Circulation in Lake Ladoga,
W82-02100 2H

SAFE YIELD
Operating Policies for a Surface/Ground Water System,
W82-01741 4B

SAFFLOWER
Effect of Irrigation Practices and Methods of Sowing-Cum-Irrigation on the Performance of Safflower,
W82-01878 3F

SAGINAW BAY
Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 2H

SAGINAW RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing, Saginaw and Au Sable River Basins Area, Michigan.
W82-01767 6D

SAGUENAY FJORD
Temporal and Spatial Variations of Mercury, Lead, Zinc, and Copper in Sediments of the Saguenay Fjord,
W82-01639 5B

Spatial and Temporal Variations in Cesium-137 and Carbon in Sediments of Saguenay Fjord (Variations Spatiales et Temporelles du Cesium-137 et du Carbone dans des Sediments du Fjord du Saguenay),
W82-01644 2J

SALINE SOILS
Transport of Salts in Catchments and Soils,
W82-01880 2G

A Proposal for Reclamation by Dilution of Irrigation Water,
W82-01943 3C

SALINE WATER
A Proposal for Reclamation by Dilution of Irrigation Water,
W82-01943 3C

SALINE WATER INTRUSION
Numerical Analysis of Transient Salt/Fresh-Water Interface in Coastal Aquifers,
W82-01693 2F

SALINITY
River Basin Sequential Water Use and Salinity Effects on Crop Yield Economics,
W82-01671 3F

Watershed Constituent Loading Analysis Utilizing Empirical Hydro-Chemical Modeling Techniques,
W82-01676 5B

Seasonal and Spring-Neap Tidal Dependence of Axial Dispersion Coefficients in the Severn - A Wide, Vertically Mixed Estuary,
W82-01749 2L

Multi-Saline Sample Distillation Apparatus for Hydrogen Isotope Analyses: Design and Accuracy,
W82-01789 3A

Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 5G

Effect of Different Water Salinity Levels and Organic Matter Application on the Composition of Water Soluble and Exchangeable Bases in a Brackishwater Fish Pond Soil,
W82-02027 2H

Terrain, Groundwater and Secondary Salinity in Victoria, Australia,
W82-02046 2F

SALINITY CURRENTS
Salt Dispersion in the Hudson Estuary,
W82-01615 2L

SALMON
Rearing Pacific Salmon in Saltwater Ponds Fertilized with Domestic Wastewater, Data Report, June 1979 - May 1980,
W82-01906 3C

SALMONELLA
Comparison of Liquid-Liquid Extraction and Resin Adsorption for Concentrating Mutagens in Ames Salmonella/Microsome Assays on Water,
W82-01812 5A

SALT LOADING
Watershed Constituent Loading Analysis Utilizing Empirical Hydro-Chemical Modeling Techniques,
W82-01676 5B

SALT MARSHES
Apparatus to Produce Tidal Fluctuations in a Simulated Salt Marsh System,
W82-01930 2L

SALT VALLEY
Eutrophication of the Salt Valley Reservoirs, 1968-73. I. The Effects of Eutrophication on Standing Crop and Composition of Phytoplankton,
W82-01653 5C

Eutrophication of the Salt Valley Reservoirs 1968-73. III. The Macroinvertebrate Community: Its Development, Composition, and Change in Response to Eutrophication,
W82-01797 5C

SALTS
Transport of Salts in Catchments and Soils,
W82-01880 2G

SAMPLE PRESERVATION
Survival of Enteroviruses Adsorbed on Glass Microfibers During Postal Transport (Survie de Virus Enteriques Adsorbes sur Microfibre de Verre au Cours d'un Transport Postal),
W82-01637 5A

SAMPLING
A Simple Device for Quantitative Pseudoperiphyton Sampling,
W82-01894 7B

Device for Collecting Replicate Artificial Substrate Samples of Benthic Invertebrates in Large Rivers,
W82-01947 7B

Scale-Dependent Dispersion in a Stratified Granular Aquifer,
W82-01986 2F

Note on Random Raindrops and Sampling Error,
W82-02032 2B

SAND MOUNDS
Flow Calculations for Household Effluent Disposal in Elevated Sand Mounds,
W82-01660 5E

SANITATION
Wanted: Water for Development,
W82-02088 6D

SANTEE RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing; Santee River Basin; South Carolina-North Carolina.
W82-01765 6D

SAPROBITY
Experience with a Simple Method for the Biological Evaluation of Surface Water Quality,
W82-02029 5A

SASKATCHEWAN GLACIER
Glacier Surveys in Alberta - 1979,
W82-01855 2C

SATELLITE TECHNOLOGY
Remote Sensing in Development,
W82-01719 7B

Spatial Simulation of Snow Processes,
W82-01887 2C

The Use of Remote Sensing for an Integrated Inventory of a Semi-Arid Area,
W82-01910 7B

Measurement of Irrigated Acreage in Western Kansas from Landsat Images,
W82-01939 7B

SATURATION ZONE
Components of Saturated Zone Thickness in a Nigerian Basement Complex Regolith,
W82-01710 2F

SCOUR
Evaluating Scour at Culvert Outlets,
W82-01934 4D

SEA LEVEL
The Effects of Man on Basin Runoff, and on the Water Balance and Water Stage of the Caspian Sea,
W82-01709 4C

SEASONAL VARIATION
Phytoplankton Photosynthesis and Its Relation to Standing Crop and Nutrients in Two Warm-Monomictic South Island Lakes,
W82-01700 2H

Benthic Macroinvertebrates of Lake Taupo,
W82-01702 2H

SEAWATER
Dissolved Hydrocarbons and Related Microflora in a Fjordal Seaport: Sources, Sinks, Concentrations, and Kinetics,
W82-01816 5B

The Geochemical Control of Seawater (Sillen Revisited),
W82-01936 2K

SECONDARY WASTEWATER TREATMENT
Detroit's WWTP: One of the World's Biggest,
W82-01865 5D

SEDIMENT DEPOSITION
Diffusion of Sediment on the Lee of Dune-Like Bedforms: Theoretical and Numerical Analysis,
W82-01842 2J

SEDIMENT DISCHARGE
A Test Utilizing Sediment Traps, Survey Rods, and Radiographs to Monitor Sediment Accumulation from a Dredging Disposal Operation,
W82-01950 7B

SEDIMENT LOAD
Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01792 7C

SEDIMENT TRANSPORT
Sediment-Contaminant Transport Model,
W82-01614 5B

Note on Two Limit Distributions of Bedload Movement,
W82-01643 2J

Field Observations of the Isotopic Composition of Particulate Organic Carbon in the Southern North Sea and Adjacent Estuaries,
W82-01714 2J

Sediment Transport and a Reservoir Situation Formula for Zimbabwe-Rhodesia,
W82-01736 2J

Sediment Analyses for Selected Sites in the South Platte River in Colorado and Nebraska, and the North Platte and Platte Rivers in Nebraska--Suspended Sediment, Bedload, and Bed Material,
W82-01776 2J

The Application of Radioactive Tracers for Determination of Bed-Load Transport in Alluvial Rivers,
W82-01893 2J

Hydraulic Geometry and Minimum Rate of Energy Dissipation,
W82-01918 2J

Accuracy of Suspended Sediment Measurements in Natural Streamflows,
W82-02002 2J

SEDIMENT YIELD
Estimating Erosion and Sediment Yield on Field-Sized Areas,
W82-01849 2J

SEDIMENTATION RATES
Temporal and Spatial Variations of Mercury, Lead, Zinc, and Copper in Sediments of the Saguenay Fjord,
W82-01639 5B

Spatial and Temporal Variations in Cesium-137 and Carbon in Sediments of Saguenay Fjord (Variations Spatiales et Temporelles du Cesium-137 et du Carbone dans des Sediments du Fjord du Saguenay),
W82-01644 2J

Southern Lake Michigan Sediments: Changes in Accumulation Rate, Mineralogy, and Organic Content,
W82-01958 2J

SEDIMENTS
Sediment Bacterial Indicators in an Urban Shellfishing Substuary of the Lower Chesapeake Bay,
W82-01661 5A

Distribution, Morphology, and Origin of Sedimentary Furrows in Cohesive Sediments, Southampton Water,
W82-01720 2L

Methanogenesis in Freshwater Sediments: Inherent Variability and Effects of Environmental Contaminants,
W82-01825 5C

A Gel Partition Model for Organic Desorption from a Pond Sediment,
W82-01844 5A

Dredged Material Evaluations: Correlations Between Chemical and Biological Evaluation Procedures,
W82-01985 5C

PCB and HCB in the Sediments and Waters of the Tiber Estuary,
W82-02057 2L

SEDIPAC CLARIFIER
Pollution Solutions--The Wire Drawing Industry.
W82-02041 5D

SEEPAGE
Nitrous Oxide in Freshwaters of the Great Lakes Basin,
W82-01841 2H

SEISMICITY
Tectonic State: Its Significance and Characterization in the Assessment of Seismic Effects Associated with Reservoir Impounding,
W82-01951 8E

SELENIUM
Selenium: A Water Pollutant from Flue Gas Desulfurization,
W82-01960 5B

SELF-PURIFICATION
Ecological and Physiological Features of the Root System of Inshore Hydrophytes,
W82-01715 5B

Use of Knopp's Method to Assess Self-Purification Processes in Water Bodies and Water Courses,
W82-02073 5B

SEMIARID LANDS
Irrigation for Brazil's Poligono Das Secas,
W82-01744 3F

Food and Energy Production: Conjunctive Water Planning,
W82-01856 3C

The Use of Remote Sensing for an Integrated Inventory of a Semi-Arid Area,
W82-01910 7B

SENEGAL RIVER
A Water Quality Assessment of Development in the Senegal River Basin,
W82-01740 6G

SEPARATION TECHNIQUES
Water Purification Studies with Activated Carbon and Foam Flotation,
W82-01692 5D

Cycling Zone Adsorption Applied to Purification of Brackish Water with Thermally Regenerable Ion-Exchange Resins,
W82-01696 3A

SESTON
Effect of the Algal Length/Aperture Length Ratio on Coulter Analyses of Lake Seston,
W82-01823 7B

SEVERN ESTUARY
Seasonal and Spring-Neap Tidal Dependence of Axial Dispersion Coefficients in the Severn - A Wide, Vertically Mixed Estuary,
W82-01749 2L

SEVERN RIVER
Severn Barrage Scheme Gets Favourable Response.
W82-02089 6B

SEWERAGE
The Sewerage Policy of Thames Water,
W82-02040 6E

SEWERS
Recording Underground,
W82-02036 8A

SHARPTOWN
The Hazards of Hazardous Waste Management,
W82-01940 6E

SHELLFISH
Relating Population Growth to Shellfish Bed Closures: A Case Study from North Carolina,
W82-01641 5C

SHRIMP
Acute Toxicity of Increased pH to Freshwater Shrimp Paratya Curvirostris,
W82-01645 5C

SILENIUM
Interlaboratory Quality Control Study No. 26, Arsenic and Selenium in Water,
W82-01854 5A

SILTING
Estuarine Dredge and Fill Activities: A Review of Impacts,
W82-01805 2L

Effects of Sedimentation on the Gravels of an Industrial River System,
W82-01881 5C

SIMULATION ANALYSIS
Hydrogeology of Well-Field Areas Near Tampa, Florida, Phase 1--Development and Documentation of a Two-Dimensional Finite-Difference Model for Simulation of Steady-State Ground-Water Flow,
W82-01780 6A

An Aquifer Simulation Program for Micro-Based Processors,
W82-01879 2F

SINKS
Inorganic Chemistry of Particulate Matter from the Nearshore Zone of Lake Michigan,
W82-01959 2H

SITE SELECTION
Geologic and Hydrologic Implications of Hazardous Wastes Management Rules on Siting in North Carolina,
W82-01630 5E

Role of the Geotechnical Consultant in Siting Suitable Areas for Hazardous Waste Disposal,
W82-01636 5E

SITES
Water-Resources Investigations of the U.S. Geological Survey in Montana, October 1980 through September 1981,
W82-01787 7C

SLOPE STABILITY
Probabilistic Stability Analysis of Earth Slopes,
W82-01952 8D

The Accuracy of Equilibrium Methods of Slope Stability Analysis,
W82-01954 8D

SLUDGE DISPOSAL
Detroit's WWTP: One of the World's Biggest,
W82-01865 5D

Industrial Waste Dumping at Deepwater Sites in the Gulf of Mexico,
W82-01903 5E

Centrifugal Dewatering,
W82-01912 5E

SLUDGE DRYING
Centrifugal Dewatering,
W82-01912 5E

SLUDGE LAGOONS
Parasite Ova in Anaerobically Digested Sludge,
W82-02018 5B

SNOW ACCUMULATION
Spatial Simulation of Snow Processes,
W82-01887 2C

SNOW COVER
Evaporation from a Snow Cover--Review and Discussion of Measurements,
W82-01888 2D

Limitations in Hydrological Interpretations of the Snow Coverage,
W82-01889 2C

SNOWMELT
On the Values and Variability of Degree-Day Melting Factor in Finland,
W82-01735 2C

Development and Applications of a Runoff Model for Snowcovered and Glacierized Basins,
W82-01885 2C

Spatial Simulation of Snow Processes,
W82-01887 2C

Limitations in Hydrological Interpretations of the Snow Coverage,
W82-01889 2C

Morphology, Hydrology and Hydrochemistry of Karst in Permafrost Terrain Near Great Bear Lake, Northwest Territories,
W82-01904 2F

SOCIAL ASPECTS
Gulf of Mexico: A Socioeconomic View of Competing Resources,
W82-01901 6B

Water: A Low-Priced But High-Cost Resource,
W82-02061 6C

SODIUM POLYSULFIDE
Removal of Elemental Mercury from Wastewaters Using Polysulfides,
W82-01800 5D

SOIL ABSORPTION CAPACITY
Flow Calculations for Household Effluent Disposal in Elevated Sand Mounds,
W82-01660 5E

SOIL COLUMNS
Leaching of Fertilizer Ions in a Ultisol from the High Rainfall Tropics: Leaching Through Undisturbed Soil Columns,
W82-01721 2G

SOIL CONSERVATION
Impressions of Soil and Water Conservation in China,
W82-01730 4D

Agricultural Conservation Program: An Evaluation,
W82-02019 3F

SOIL EROSION
Impressions of Soil and Water Conservation in China,
W82-01730 4D

Crop Residue Removal and Tillage; Effects on Soil Erosion and Nutrient Loss in the Corn Belt,
W82-01770 2J

R-Factors for Soil Loss Impact Prediction,
W82-01963 2J

SOIL GASES
Excess Air in Groundwater,
W82-02099 2F

SOIL MOISTURE
Soil Moisture Updating and Microwave Remote Sensing for Hydrological Simulation,
W82-01611 2G

Simulation of Water and Nitrogen Movement and Nitrogen Transformations in Forest Soils,
W82-01668 2G

Investigations into the Dynamics of Water Movement on a Low Relief Landscape on the Eastern Shore of Maryland,
W82-01673 2F

Effect of Periods of Moisture Availability on Groundnut Crop in the Saurashtra Region of Gujarat,
W82-01708 2G

SOIL PROPERTIES
Transport of Salts in Catchments and Soils,
W82-01880 2G

Effect of Field Variability in Soil Hydraulic Properties on Solutions of Unsaturated Water and Salt Flows,
W82-01898 2G

Terrain, Groundwater and Secondary Salinity in Victoria, Australia,
W82-02046 2F

SOIL RECLAMATION
A Proposal for Reclamation by Dilution of Irrigation Water,
W82-01943 3C

SOIL WATER
Simulation of the Topographic Influence on SLAR Data for Soil Moisture Detection in a Hilly Area,
W82-01605 2G

Simple In Situ Determination of Hydraulic Conductivity by Power Function Descriptions of Drainage,
W82-01666 2G

Soil Water Studies on Small Lucerne Plots,
W82-01713 2I

Note on the Role of Irrigation Frequencies on the Regrowth of Berseem,
W82-01745 2I

Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Taylor Creek, Fla., and Litle River, Ga., 1979 Data Report,
W82-01771 7B

Effect of Bulk Density on Calibration of Neutron Moisture Probe for Organic Soils,
W82-01861 2G

Penetration and Distribution of Tritiated Water in Soils of a Lysimeter,
W82-01886 2G

Properties of the Sorptivity for Exponential Diffusivity and Application to the Measurement of the Soil Water Diffusivity,
W82-01897 2G

Effect of Field Variability in Soil Hydraulic Properties on Solutions of Unsaturated Water and Salt Flows,
W82-01898 2G

The Influence of Tillage on Soil Water Behavior,
W82-02022 2G

Effect of Profile Soil Moisture and Phosphorus Levels on the Growth and Yield of Anonutrient Uptake by Chickpea,
W82-02042 2I

Effect of Soil-Moisture Tensions and Preceding Winter Crops on the Yield and Water-Use Efficiency of Succeeding Crop of Tossa Jute,
W82-02045 2I

SOIL-WATER-PLANT RELATIONSHIPS
Effect of Periods of Moisture Availability on Groundnut Crop in the Saurashtra Region of Gujarat,
W82-01708 2G

Soil Water Studies on Small Lucerne Plots,
W82-01713 2I

The Effect of Different Water Regimes on Plant Growth and Nodule Structure of Greenhouse-Grown Winged Bean (Psophocarpus Tetragonolobus),
W82-01723 2I

Environmental and Physiological Control of Water Flux Through Pinus Contorta,
W82-01827 2D

Simulation of Soil Water Within the Root Zone of a Corn Crop,
W82-01834 2G

SOLUTE TRANSPORT
Composition of Leachage from Surface-Retorted and Unretorted Colorado Oil Shale,
W82-01810 5B

Scale-Dependent Dispersion in a Stratified Granular Aquifer,
W82-01986 2F

SORGHUM
Double and Monocropped Wheat and Grain Sorghum Under Different Tillage and Row Spacings,
W82-01862 2I

Responses of Grain Sorghum to Variable Water Supply Under Two Irrigation Frequencies,
W82-01944 3F

SORPTION
Transport of Nonpolar Organic Compounds from Surface Water to Groundwater. Laboratory Sorption Studies,
W82-01873 5B

Properties of the Sorptivity for Exponential Diffusivity and Application to the Measurement of the Soil Water Diffusivity,
W82-01897 2G

SOUTH AFRICA
Destratification and Reaeration as Tools for In-Lake Management,
W82-01648 5G

Health Aspects of Organic Substances in South African Waters - Opinions and Realities,
W82-01712 5A

Soil Water Studies on Small Lucerne Plots,
W82-01713 2I

The Relationship Between Macro-Topography and the Groundwater Quality in the Great Fish River Basin, Eastern Cape Province,
W82-01718 2F

Comparison of Liquid-Liquid Extraction and Resin Adsorption for Concentrating Mutagens in Ames Salmonella/Microsome Assays on Water,
W82-01812 5A

Phosphorus Cycling in a Dense Potamogeton Pectinatus L. Bed,
W82-02070 2H

Towards an Understanding of the Effects of Orography on the Distribution of Precipitation Over the Cape Peninsula,
W82-02085 2B

SOUTH DAKOTA
Records of Water Levels in Unconsolidated Deposits in Eastern South Dakota,
W82-01788 7C

SOUTHAMPTON
Slowhill Copse Sewage Treatment Works.
W82-01727 5D

SOYBEANS
Effect of Soil Moisture Stress on Legume-Rhizobium Symbiosis in Soybeans,
W82-01846 2I

SPATIAL DISTRIBUTION
Geographic Variations in Water Quality and Recreational Use Along the Upper Wallowa River and Selected Tributaries,
W82-01681 5A

SPECIES COMPOSITION
Some Effects of Sewage Discharge Upon Phytoplankton in Hong Kong,
W82-02095 5C

SPECIES DIVERSITY
Zooplankton Species Diversity in Lake St. Clair, Ontario, Canada,
W82-01937 5C

Phytoplankton Distributions Observed During a 3 1/2 Days Fixed-Station in the Lower St. Lawrence Estuary,
W82-01938 2L

LIBRARY U. OF ILL. URBANA-CHAMPAIGN

SPECIFIC CONDUCTIVITY
The Use of Specific Conductance in Studies of Natural Waters and Soil Solutions,
W82-01646 7A

SPOIL DISPOSAL
A Test Utilizing Sediment Traps, Survey Rods, and Radiographs to Monitor Sediment Accumulation from a Dredging Disposal Operation,
W82-01950 7B

Dredged Material Evaluations: Correlations Between Chemical and Biological Evaluation Procedures,
W82-01985 5C

SPRINGS
Groundwater Discharge Through Springs with Well-Defined Outlets--A Case Study from Jeloya-Moss, S. Norway,
W82-01748 2F

SPRINKLE IRRIGATION
Influence of Trickle and Sprinkle Irrigation on Golden Delicious Apple Quality,
W82-02001 3F

ST. LAWRENCE ESTUARY
Phytoplankton Distributions Observed During a 3 1/2 Days Fixed-Station in the Lower St. Lawrence Estuary,
W82-01938 2L

STABILITY ANALYSIS
Probabilistic Stability Analysis of Earth Slopes,
W82-01952 8D

Current Methods of Dynamic Analysis for Seismic Stability of Earth Dams,
W82-01953 8D

The Accuracy of Equilibrium Methods of Slope Stability Analysis,
W82-01954 8D

STABILIZATION PONDS
Hydraulic Modeling for Waste Stabilization Ponds,
W82-01965 5D

STAGE-DISCHARGE RELATIONS
Stage-Discharge Relations at Dams on the Illinois and Des Plaines Rivers in Illinois,
W82-01793 4A

STANDING CROPS
Eutrophication of the Salt Valley Reservoirs, 1968-73. I. The Effects of Eutrophication on Standing Crop and Composition of Phytoplankton,
W82-01653 5C

STATISTICAL MECHANICS
The Statistical Mechanical Theory of Groundwater Flow,
W82-01982 2F

STATISTICAL METHODS
Statistical Determination of Design Low Flows,
W82-01858 2E

STATISTICS
Resource Inventory--Sheet, Rill and Wind Erosion,
W82-01850 2J

STOCHASTIC PROCESS
A Stochastic Cluster Model of Daily Rainfall Sequences,
W82-01651 2B

STOMATAL TRANSPIRATION
Environmental and Physiological Control of Water Flux Through Pinus Contorta,
W82-01827 2D

STORM-OVERFLOW SEWERS
Simulating Effects of Combined Sewer Overflows,
W82-01864 6A

STORM RUNOFF
Predicting Storm Runoff from Small Grassland Watersheds with the USDAHL Hydrologic Model,
W82-01672 2E

Investigations into the Dynamics of Water Movement on a Low Relief Landscape on the Eastern Shore of Maryland,
W82-01673 2F

Modeling Stormwater Storage/Treatment Transients: Theory,
W82-01980 2A

Modeling Stormwater Storage/Treatment Transients: Applications,
W82-01981 2E

STORM WATER
Streamlined Regulations Could Help Make New Stormwater Management Concepts Part of the Tradition,
W82-02000 4A

STREAM BIOTA
Biological Consequences of Stream Routing Through a Final-Cut Strip Mine Pit: Benthic Macroinvertebrates,
W82-01948 4A

STREAM DISCHARGE
Long Term Responses of Streamflow Following Clearcutting and Regrowth,
W82-01610 4C

Discharge Measurements by a New-Formed Relative Salt-Dilution Method in Small Turbulent Streams,
W82-01891 7B

STREAMFLOW
Low-Flow Frequency and Flow Duration of Tennessee Streams,
W82-01779 2E

Low-Flow Characteristics of Streams in the Deschutes River Basin, Washington,
W82-01781 2E

Quality of Water and Time of Travel in Part of Tillatoba Creek Basin, Mississippi, October 1974 to September 1980,
W82-01791 7C

Stage-Discharge Relations at Dams on the Illinois and Des Plaines Rivers in Illinois,
W82-01793 4A

Accuracy of Suspended Sediment Measurements in Natural Streamflows,
W82-02002 2J

STREAMFLOW FORECASTING
Low-Flow Characteristics of Streams in the Deschutes River Basin, Washington,
W82-01781 2E

STREAMS
Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01792 7C

Variations and Mechanisms of Asbestos Fibre Distribution in Stream Water,
W82-01853 5A

STREPTOCOCCUS BOVIS
A Selective Medium for the Enumeration of Streptococcus Bovis by Membrane Filtration,
W82-01620 5A

SUBARCTIC ZONE
Some Environmental and Social Impacts of the James Bay Hydroelectric Project, Canada,
W82-01908 6G

SUBSIDENCE
Mathematical Model for Regional Land Subsidence Due to Pumping 1. Integrated Aquifer Subsidence Equations Based on Vertical Displacement Only,
W82-01926 2F

Mathematical Model for Regional Land Subsidence Due to Pumping 2 Integrated Aquifer Subsidence Equations for Vertical and Horizontal Displacements,
W82-01927 2F

SUBSTRATES
Substrate Flux into Biofilms of Any Thickness,
W82-01964 5D

SULFUR
Deposition of Sulphur Gases from Multiple Scattered Sources in Alberta,
W82-01868 5B

SULFUR CYCLE
The Role of Phototrophic Bacteria in the Sulfur Cycle of a Meromictic Lake,
W82-01831 2H

SUMAS RIVER BASIN
Variations and Mechanisms of Asbestos Fibre Distribution in Stream Water,
W82-01853 5A

SURFACE-GROUNDWATER RELATIONS
Hydraulic Connection Between Lake Michigan and a Shallow Ground-Water Aquifer,
W82-02010 2F

SURFACE TENSION
The Containment of an Oil Slick by a Boom Placed Across a Uniform Stream,
W82-01956 1B

SURFACE WATER
U.S. Geological Survey Reports on the Water Resources of Florida, 1886-1980, Second Edition,
W82-01778 10C

Water Quality Study -- Southwest Minnesota Public Water Supplies,
W82-01795 2K

SURFACE WATERS
Toxic Substances in Water: Patterns of Contamination and Policy Implications,
W82-01695 5A

SURFACTANTS
Extraction of Copper with Liquid Surfactant Membranes,
W82-01896 5D

Effect of Sodium Dodecylsulfate on Unicellular Green Algae of the Genus Chlorella,
W82-01920 5C

Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 5B

SURGES
Furrow Advance Rates Under Surge Flow Systems,
W82-01612 3F

SURVEYS
Case Studies of Agricultural Water Conservation,
W82-01667 3F

SUSPENDED SEDIMENT
Hydrology of Okarito Lagoon and the Inferred Effects of Selective Logging in Okarito Forest,
W82-01703 4C

Sediment Analyses for Selected Sites in the South Platte River in Colorado and Nebraska, and the North Platte and Platte Rivers in Nebraska--Suspended Sediment, Bedload, and Bed Material,
W82-01776 2J

SUSPENDED SEDIMENTS
Accuracy of Suspended Sediment Measurements in Natural Streamflows,
W82-02002 2J

SWAMPS
Ecological and Physiological Features of the Root System of Inshore Hydrophytes,
W82-01715 5B

SWARTVLEI LAKE
Phosphorus Cycling in a Dense Potamogeton Pectinatus L. Bed,
W82-02070 2H

SWEDEN
The Mercury Cycle,
W82-01869 5B

Evaporation from a Snow Cover--Review and Discussion of Measurements,
W82-01888 2D

SWIMMING POOLS
Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
W82-01835 5A

SWITZERLAND
On The Use of Carotenoid Stratigraphy in Lake Sediments for Detecting Past Developments of Phytoplankton,
W82-01706 2H

Limitations in Hydrological Interpretations of the Snow Coverage,
W82-01889 2C

Evaluation of a Precipitation Map Using a Smoothed Elevation-Precipitation Relationship and Optimal Estimates (Kriging),
W82-01892 2B

SYMBIOSIS
Effect of Soil Moisture Stress on Legume-Rhizobium Symbiosis in Soybeans,
W82-01846 2I

SYSTEMS ANALYSIS
The Lake Tahoe Basin: A Systems Analysis of Its Characteristics and Human Carrying Capacity,
W82-01807 6A

TAIWAN
Mathematical Modeling of Stream Water Quality by a New Moment Method: Field Investigation of a Tidal River,
W82-01995 7B

TANNERY WASTES
Aquatic Microbiology with Reference to Tannin Degradation,
W82-02028 5B

TANNINS
Aquatic Microbiology with Reference to Tannin Degradation,
W82-02028 5B

TAXONOMY
Numerical Taxonomy Analysis of Bacteria Isolated from the Completed 'Most Probable Numbers' Test for Coliform Bacilli,
W82-01911 5A

TECHNICAL SOCIETIES
Environmental Studies: Their Implications and the Special Case of Egypt,
W82-02062 6G

TECTONICS
Tectonic State: Its Significance and Characterization in the Assessment of Seismic Effects Associated with Reservoir Impounding,
W82-01951 8E

TEES RIVER
Economic Instruments for Controlling Effluent Discharges to the River Tees Estuary,
W82-02060 2L

Phytobenthos of the River Tees and Its Tributaries,
W82-02065 2K

TEMPERATURE EFFECTS
River Thermal Standards Costs in the Upper Midwest,
W82-01655 6B

The Contributions of Temperature and the Input of Organic Matter in Controlling Rates of Sediment Methanogenesis,
W82-01832 2H

Mixing Zone Analysis for River Plumes,
W82-01961 5B

TENNESSEE
Low-Flow Frequency and Flow Duration of Tennessee Streams,
W82-01779 2E

Hydrogeology of the Gatlinburg Area, Tennessee,
W82-01782 2F

Chromium Levels in Fish from a Lake Chronically Contaminated with Chromates from Cooling Towers,
W82-01941 5B

TENNESSEE RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing: Tennessee River Basin; Virginia-Tennessee-North Carolina-Mississippi, Georgia-Kentucky-Alabama.
W82-01766 6D

TERRACING
Erosion and Sediment Control in China's Yellow River Basin,
W82-01729 4D

TEST WELLS
Selected Drill-Stem-Test Data from the Northern Great Plains Area of Montana,
W82-01774 7C

TEXTILE MILL WASTES
Kinetics and Diffusion Processes in Colour Removal from Effluent Using Wood as an Adsorbent,
W82-02047 5D

THAMES WATER AUTHORITY
The Sewerage Policy of Thames Water,
W82-02040 6E

THEORETICAL ANALYSIS
The Economics of Cooperation Over Collective Bads,
W82-01909 6A

THERMAL POLLUTION
River Thermal Standards Costs in the Upper Midwest,
W82-01655 6B

Mixing Zone Analysis for River Plumes,
W82-01961 5B

Dynamics of Carp Growth and Biosynthetic Processes in the Liver of the Carp Reared in Containers in Heated Waste Water from Themal Power Stations,
W82-01998 5C

THERMAL POWERPLANTS
Environmental Design and Operation of Nanticoke Thermal Generating Station,
W82-01907 5D

THERMAL PROPERTIES
Cooling Potential of Missouri River in Missouri,
W82-01654 5B

THERMAL STRATIFICATION PREVENTION
Destratification and Reaeration as Tools for In-Lake Management,
W82-01648 5G

THERMAL WATER
Thermophillic and Thermotolerant Fungi Isolated from the Thermal Effluent of Nuclear Power Generating Reactors: Disposal of Human Opportunistic and Veterinary Pathogenic Fungi,
W82-01928 5B

THERMOCLINE
Effects of Thermocline Displacement Upon Subsurface Chlorophyll Maxima in Lake Michigan,
W82-01957 2H

THUNDERSTORMS
Observations of Two Colorado Thunderstorms by Means of a Zenith-Pointing Doppler Radar,
W82-01967 2B

TIBER RIVER
PCB and HCB in the Sediments and Waters of the Tiber Estuary,
W82-02057 2L

TIDAL EFFECTS
Salt Dispersion in the Hudson Estuary,
W82-01615 2L

Seasonal and Spring-Neap Tidal Dependence of Axial Dispersion Coefficients in the Severn - A Wide, Vertically Mixed Estuary,
W82-01749 2L

Tide-Induced Residual Flow in Shallow Bays,
W82-02003 2L

TIDAL POWERPLANTS
Severn Barrage Scheme Gets Favourable Response.
W82-02089 6B

TIDAL RIVERS
Mathematical Modeling of Stream Water Quality by a New Moment Method: Field Investigation of a Tidal River,
W82-01995 7B

TIDES
Apparatus to Produce Tidal Fluctuations in a Simulated Salt Marsh System,
W82-01930 2L

TILLATOBA CREEK BASIN
Quality of Water and Time of Travel in Part of Tillatoba Creek Basin, Mississippi, October 1974 to September 1980,
W82-01791 7C

TIME OF TRAVEL
Quality of Water and Time of Travel in Part of Tillatoba Creek Basin, Mississippi, October 1974 to September 1980,
W82-01791 7C

TIME SERIES ANALYSIS
Upland Marsh for Water Quality Control,
W82-01962 5B

TITANIUM
Determination of Germanium, Vanadium, and Titanium by Carbon Furnace Atomic Absorption Spectrometry,
W82-01836 5A

TOLO HARBOUR
Degree of Pollution of Several Major Streams Entering Tolo Harbour, Hong Kong,
W82-02058 5B

TOMATOES
Environmental Fate of Methyl Eugenol,
W82-02013 5B

TOMBIGBEE-WARRIOR RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing; Tombigbee-Warrior River Basin; Alabama-Mississippi.
W82-01757 6D

TOPOGRAPHY
The Relationship Between Macro-Topography and the Groundwater Quality in the Great Fish River Basin, Eastern Cape Province,
W82-01718 2F

TORONTO
Streamlined Regulations Could Help Make New Stormwater Management Concepts Part of the Tradition,
W82-02000 4A

TOXICITY
Increased Toxicity of Ammonia to Rainbow Trout (Salmo Gairdneri) Resulting from Reduced Concentrations of Dissolved Oxygen,
W82-01629 5C

Acute Toxicity of Increased pH to Freshwater Shrimp Paratya Curvirostris,
W82-01645 5C

The Effects of Chlorinated Sea Water on the Blue Crab, Callinectes Sapidus,
W82-01679 5C

Toxic Substances in Water: Patterns of Contamination and Policy Implications,
W82-01695 5A

Effect of the Copper Content of Distillery Spent Wash on Its Utilization for Single-Cell Protein Production by Geotrichum Candidum, Hansenula Anomala and Candida Kruzei,
W82-01750 5C

Acute Toxicity of an In Situ Shale Oil Process Wastewater and It's Major Components to Daphnia Magna,
W82-01811 5C

Toxicity and BOD Effluents Derived from Kraft Pulping of Aged Wood Chips,
W82-01845 5B

Interlaboratory Quality Control Study No. 26, Arsenic and Selenium in Water,
W82-01854 5A

Acute Toxicities of the Herbicides Komeen and Hydrothol-191 to Golden Shiner (Notemigonus Crysoleucas),
W82-01882 5C

Activated Sludge Nickel Toxicity Studies,
W82-01895 5D

A New Method for Assessing the Lethal Impact of Short-Term, High-Level Discharges of Pollutants on Aquatic Animals,
W82-01993 5C

TRACE METALS
Determination of Free Metal Ion Concentrations Using Bioassays,
W82-01821 5A

Simultaneous Determination of Trace Metals in Sewage and Sewage Effluents by Inductively Coupled Argon Plasma Atomic Emission Spectrometry,
W82-01828 5A

Inorganic Chemistry of Particulate Matter from the Nearshore Zone of Lake Michigan,
W82-01959 2H

Variations in Trace Metal Content of the Mussel Choromytilus Meridionalis (Kr.) with Season and Sex,
W82-01969 5A

An Analysis of the Aquatic Macrophyte, Myriophyllum Exalbescens, as an Indicator of Metal Contamination of Aquatic Ecosystems near a Base Metal Smelter,
W82-02016 5A

TRACERS
Simple Retention Time Analysis in Trickling Filters Using Conductivity,
W82-01876 5D

TREES
Environmental and Physiological Control of Water Flux Through Pinus Contorta,
W82-01827 2D

TRICHLOROETHYLENE
Tying Up TCE,
W82-01866 5G

TRICKLE IRRIGATION
Influence of Trickle and Sprinkle Irrigation on Golden Delicious Apple Quality,
W82-02001 3F

TRICKLING FILTERS
Simple Retention Time Analysis in Trickling Filters Using Conductivity,
W82-01876 5D

TRIHALOMETHANES
A Survey of Trihalomethanes in the Drinking Water System of Murjreesboro, Tennessee,
W82-01817 5B

Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
W82-01835 5A

TRITIUM
Penetration and Distribution of Tritiated Water in Soils of a Lysimeter,
W82-01886 2G

TROPHIC LEVEL
Relationships Between Nannoplankton and Lake Trophic Status,
W82-01640 5C

Quantification of the Lake Trophic Typologies of Naumann (Surface Quality) and Thienemann (Oxygen) with Special Reference to the Great Lakes,
W82-02004 2H

TROUT
Increased Toxicity of Ammonia to Rainbow Trout (Salmo Gairdneri) Resulting from Reduced Concentrations of Dissolved Oxygen,
W82-01629 5C

Effect of an Aerial Application of Carbaryl on Brook Trout (Salvelinus Fontinalis),
W82-01818 5C

TUCSON
An Economic and Institutional Assessment of the Water Problem Facing the Tucson Basin,
W82-01698 6B

TURBULENT FLOW
Phytoplankton Distributions Observed During a 3 1/2 Days Fixed-Station in the Lower St. Lawrence Estuary,
W82-01938 2L

UKRAINE
Hydrologic and Anthropogenic Factors Affecting Water Quality in the Rivers of the Ukrainian Carpathians,
W82-02076 5B

ULTRAFILTRATION
Water Reuse: Ultrafiltration of Industrial and Municipal Wastewaters,
W82-01652 5D

Selective Removal of Heavy Metal Ions from Aqueous Solutions by Diafiltration of Macromolecular Complexes,
W82-01900 5D

UNITED KINGDOM
Charging Policies for Water Services,
W82-01734 6C

Seasonal and Spring-Neap Tidal Dependence of Axial Dispersion Coefficients in the Severn - A Wide, Vertically Mixed Estuary,
W82-01749 2L

Centrifugal Dewatering,
W82-01912 5E

The Value of Ecological Monitoring in the Management of Petroleum Industry Effluent Discharges: Experience in Esso Petroleum Company U.K. Refineries,
W82-01913 5G

Water Quality Indices: An Additional Management Tool,
W82-01994 5G

Hydrocarbon Concentrations in Water and Sediments from UK Marine Waters, Determined by Fluorescence Spectroscopy,
W82-02097 5B

UNSATURATED FLOW
Effect of Field Variability in Soil Hydraulic Properties on Solutions of Unsaturated Water and Salt Flows,
W82-01898 2G

USER CHARGES
Charging Policies for Water Services,
W82-01734 6C

USSR
Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 5B

Biological Pollution and Pollution Control in Canals Diverting Flow from One River Basin to Another,
W82-01922 5C

Estimation of the Production of Planktonic Infusorians in Connection with Fluctuations in Their Abundance,
W82-02072 2H

Use of Knopp's Method to Assess Self-Purification Processes in Water Bodies and Water Courses,
W82-02073 5B

Methods of Studying Invertebrate Drift in Rivers,
W82-02074 7A

UTAH
Corn and Alfalfa Production as Influenced by Limited Irrigation,
W82-01945 3F

VANADIUM
Determination of Germanium, Vanadium, and Titanium by Carbon Furnace Atomic Absorption Spectrometry,
W82-01836 5A

VARIABILITY
Methanogenesis in Freshwater Sediments: Inherent Variability and Effects of Environmental Contaminants,
W82-01825 5C

VARIATION COEFFICIENTS
Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 2H

VELOCITY
An Integral Transform Method for the Linearized Boussinesq Groundwater Flow Equation,
W82-01984 2F

VIBRIO
Gauze Filtration and Enrichment Procedures for Recovery of Vibrio Cholerae From Contaminated Waters,
W82-01815 5A

VIBRIO PARAHAEMOLYTICUS
Distribution of Vibrio Parahaemolyticus in Finfish Harvested from Porto Novo (S. India) Environs: A Seasonal Study,
W82-01737 5A

VICTORIA
Terrain, Groundwater and Secondary Salinity in Victoria, Australia,
W82-02046 2F

VILYUY RESERVOIR
The Predicted Content of Organic and Biogenic Matter in the Water of Vilyuy Reservoir and the Extent to Which It Has Been Confirmed,
W82-02080 2H

VIRUSES
Survival of Enteroviruses Adsorbed on Glass Microfibers During Postal Transport (Survie de Virus Enteriques Adsorbes sur Microfibre de Verre au Cours d'un Transport Postal),
W82-01637 5A

VOLCANOES
Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01792 7C

VOLGA DELTA
Effect of Fertilizers on the Primary and Bacterial Production of Rearing Ponds in the Volga Delta,
W82-02077 2H

WABIGOON RIVER BASIN
Mercury Methylation by Fish Intestinal Contents,
W82-01830 5C

WALES
Charging for Water Supply in England and Wales in the 1980s,
W82-01722 6C

Effects of Sedimentation on the Gravels of an Industrial River System,
W82-01881 5C

WARNING SYSTEMS
The Day That the Rain Came Down,
W82-02064 2E

WASHINGTON
Low-Flow Characteristics of Streams in the Deschutes River Basin, Washington,
W82-01781 2E

Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01792 7C

WASTE DISPOSAL
A Graphical Approach to Prediction of Groundwater Pollutant Movement,
W82-01634 5B

Perspective on Management and Disposal of Hazardous Wastes,
W82-01635 5E

Role of the Geotechnical Consultant in Siting Suitable Areas for Hazardous Waste Disposal,
W82-01636 5E

Organic Compounds Found Near Dump Sites in Niagara Falls, New York,
W82-01802 5B

Geologic Aspects of Waste Disposal Site Evaluations,
W82-02011 5E

Waste Disposal--Choosing and Licensing Site,
W82-02035 5G

WASTE DUMPS
Organic Compounds Found Near Dump Sites in Niagara Falls, New York,
W82-01802 5B

WASTE MANAGEMENT
Geologic and Hydrologic Implications of Hazardous Wastes Management Rules on Siting in North Carolina,
W82-01630 5E

The Hazards of Hazardous Waste Management,
W82-01940 6E

WASTE RECOVERY
Century-Old Board Mill Operates with Zero Effluent Discharge,
W82-01626 5D

WASTE STORAGE
Geologic and Hydrologic Implications of Hazardous Wastes Management Rules on Siting in North Carolina,
W82-01630 5E

WASTE TREATMENT
Pollution from Farms,
W82-02039 5D

WASTES
Loading Estimates to Lake Erie, 1967-1976,
W82-01852 5A

WASTEWATER
On the Presence of Fecal Steroids in Sediments from Two Mexican Harbors,
W82-02012 5A

WASTEWATER ANALYSIS
Survival of Enteroviruses Adsorbed on Glass Microfibers During Postal Transport (Survie de Virus Enteriques Adsorbes sur Microfibre de Verre au Cours d'un Transport Postal),
W82-01637 5A

Simultaneous Determination of Trace Metals in Sewage and Sewage Effluents by Inductively Coupled Argon Plasma Atomic Emission Spectrometry,
W82-01828 5A

WASTEWATER DISPOSAL
Influence on Groundwater from the Bermed Infiltration Pond,
W82-01622 5D

Flow Calculations for Household Effluent Disposal in Elevated Sand Mounds,
W82-01660 5E

Some Effects of Sewage Discharge Upon Phytoplankton in Hong Kong,
W82-02095 5C

WASTEWATER FACILITIES
Slowhill Copse Sewage Treatment Works.
W82-01727 5D

Detroit's WWTP: One of the World's Biggest,
W82-01865 5D

Technical and Economic Implications of Installing an Industrial Waste-Water Pretreatment Plant,
W82-02044 5D

WASTEWATER LAGOONS
Limnology and Performance of Waste Treatment Lagoons,
W82-02026 5D

WASTEWATER POLLUTION
Simulating Effects of Combined Sewer Overflows,
W82-01864 6A

WASTEWATER RENOVATION
Rearing Pacific Salmon in Saltwater Ponds Fertilized with Domestic Wastewater, Data Report, June 1979 - May 1980,
W82-01906 3C

WASTEWATER TREATMENT
Step Fed Plug Flow Reactor for Biological Wastewater Treatment Versus Continuous Flow Stirred Tank Reactor (CFSTR),
W82-01618 5D

Influence on Groundwater from the Bermed Infiltration Pond,
W82-01622 5D

Nitrous Oxide Emission from Simulated Overland Flow Wastewater Treatment Systems,
W82-01624 5D

Using Zeta Potential to Optimize Coagulating Aid Doses Used to Treat Food Processing Wastes,
W82-01627 5D

Removal of Organics from Water by Granular Activated Carbon and Microorganisms,
W82-01628 5D

Water Purification Studies with Activated Carbon and Foam Flotation,
W82-01692 5D

Slowhill Copse Sewage Treatment Works.
W82-01727 5D

Parasite Egg and Cyst Reduction in Oxidation Ditches and Aerated Lagoons,
W82-01733 5D

Removal of Elemental Mercury from Wastewaters Using Polysulfides,
W82-01800 5D

Precipitate Flotation Studies with Monolauryl Phosphate and Monolauryldithiocarbamate,
W82-01863 5D

Simulating Effects of Combined Sewer Overflows,
W82-01864 6A

Detroit's WWTP: One of the World's Biggest,
W82-01865 5D

Simple Retention Time Analysis in Trickling Filters Using Conductivity,
W82-01876 5D

A Multilevel Model and Algorithm for Some Multiobjective Problems,
W82-01884 6A

Extraction of Copper with Liquid Surfactant Membranes,
W82-01896 5D

Technology and Performance of the Hi-Capacity Thickener,
W82-01929 5D

Substrate Flux into Biofilms of Any Thickness,
W82-01964 5D

Hydraulic Modeling for Waste Stabilization Ponds,
W82-01965 5D

Modeling Stormwater Storage/Treatment Transients: Theory,
W82-01980 2A

Combining Sewer Water Purification Processes to Treat Effluents Produced by Transient Populations,
W82-01992 5D

Control of Bark Landfill Leachates with an Anaerobic Treatment System,
W82-02006 5D

The Flowering of Wastewater Treatment,
W82-02015 5D

Developments in Instrumentation and Automation in Sewage Treatment,
W82-02043 5D

Technical and Economic Implications of Installing an Industrial Waste-Water Pretreatment Plant,
W82-02044 5D

Production of Aromatic Acids During Anaerobic Digestion of Citrus Peel,
W82-02049 5D

WATER ALLOCATION
Optimization of Water Resources for Irrigation in East Jordan,
W82-01742 6A

Intraseasonal Water Allocation in Deficit Irrigation,
W82-01916 3F

WATER ANALYSIS
Rapid, Quantitative Separation of Chlorophylls and Their Degradation Products by High-Performance Liquid Chromatography,
W82-01619 5A

Survival of Enteroviruses Adsorbed on Glass Microfibers During Postal Transport (Survie de Virus Enteriques Adsorbes sur Microfibre de Verre au Cours d'un Transport Postal),
W82-01637 5A

Characterization of an Enzymatic Determination of Arsenic(V) Based on Response Surface Methodology,
W82-01656 5A

Interlaboratory Quality Control Study No. 26, Arsenic and Selenium in Water,
W82-01854 5A

On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 5A

Measurement of Heavy Water Concentration with a Density Meter,
W82-02009 5A

Use of Knopp's Method to Assess Self-Purification Processes in Water Bodies and Water Courses,
W82-02073 5B

The Use of Leeches to Identify Pesticides in Water,
W82-02075 5A

Hydrocarbon Concentrations in Water and Sediments from UK Marine Waters, Determined by Fluorescence Spectroscopy,
W82-02097 5B

WATER BALANCE
A Model of the Antarctic Sink for Stratospheric Water Vapor,
W82-01686 2A

WATER CIRCULATION
A Method of Objective Analysis for Currents in a Lake with Application to Lake Ontario,
W82-01616 2H

Phytoplankton Accumulation in Langmuir Cells,
W82-01946 2H

Investigation of Turbulence and Langmuir Circulation in Lake Ladoga,
W82-02100 2H

WATER CONSERVATION
Case Studies of Agricultural Water Conservation,
W82-01667 3F

Shortening the Irrigation Interval as a Means of Saving Water in a Banana Plantation,
W82-02093 3F

WATER CONVEYANCE
Logistics of Farm Water Supply.
W82-02037 6A

WATER COOLING
Addendum to: Sources of Powerplant Cooling Water in the Desert Area of Southern California--Reconnaissance Study,
W82-01773 6B

WATER COSTS
Managing Water at Helicopter Plant,
W82-01974 5D

WATER CURRENTS
Salt Dispersion in the Hudson Estuary,
W82-01615 2L

Distribution, Morphology, and Origin of Sedimentary Furrows in Cohesive Sediments, Southampton Water,
W82-01720 2L

WATER DEFICIT
Optimization of Water Resources for Irrigation in East Jordan,
W82-01742 6A

WATER DEMAND
Water Resources Appraisal for Hydroelectric Licensing: Altamaha River Basin, Georgia,
W82-01764 6D

WATER HAMMER
Power Spectral Analysis of a Forcemain Failure Caused by Waterhammer,
W82-01826 7B

WATER HYACINTH
The Flowering of Wastewater Treatment,
W82-02015 5D

WATER LEVEL
Recent Changes in Level of Lake Victoria,
W82-01711 4A

Groundwater Levels in Nebraska 1980,
W82-01785 2F

Records of Water Levels in Unconsolidated Deposits in Eastern South Dakota,
W82-01788 7C

WATER LEVEL FLUCTUATIONS
The Effects of Man on Basin Runoff, and on the Water Balance and Water Stage of the Caspian Sea,
W82-01709 4C

Groundwater Levels in Nebraska 1980,
W82-01785 2F

WATER MAINS
Recording Underground,
W82-02036 8A

WATER MANAGEMENT
Water Management in the Colorado River Basin: An Application of Nonlinear Transportation Algorithms,
W82-01677 6A

The Management of Water Resources: A Synthesis of Goal Programming and Input-Output Analysis with Application to the Iowa Economy,
W82-01685 6A

The California State Water Project--Current Activities and Future Management Plans.
W82-01851 6E

Structural Aspects of the Water Supply in the Federal Republic of Germany,
W82-02066 6E

WATER MANAGMENT
Streamlined Regulations Could Help Make New Stormwater Management Concepts Part of the Tradition,
W82-02000 4A

WATER METERING
Charging for Water Supply in England and Wales in the 1980s,
W82-01722 6C

WATER POLICY
The National Water Policy Review and Western Water Rights Law Reform: An Overview,
W82-01659 6E

The National Commission on Water Quality: A Case Study in Congressional Policy Analysis,
W82-01669 6B

The Technology Transfer Process in Water Resources R&D Management,
W82-01694 6A

Charging Policies for Water Services,
W82-01734 6C

The Sewerage Policy of Thames Water,
W82-02040 6E

Water: A Low-Priced But High-Cost Resource,
W82-02061 6C

WATER POLLUTION
The Effects of Chlorinated Sea Water on the Blue Crab, Callinectes Sapidus,
W82-01679 5C

Reverse Phase Concentration of Trace Polycyclic Aromatic Hydrocarbons in Water,
W82-01689 5A

Toxic Substances in Water: Patterns of Contamination and Policy Implications,
W82-01695 5A

The Removal of Organic Matter from Surface Water Supplies by Anion Exchange Resins,
W82-01697 5F

The Mercury Cycle,
W82-01869 5B

Gulf of Mexico: A Socioeconomic View of Competing Resources,
W82-01901 6B

WATER POLLUTION CONTROL
Pollution Permits and Markets for Water Quality,
W82-01699 6A

Controlling Runoff for Livestock Feedlots; A State of the Art,
W82-01769 5G

Stationary Source Pollution Policy and Choices for Reform,
W82-01847 6E

Long-Run Effects of Environmental Regulation,
W82-01848 6A

Pollution Control: Changing Approaches,
W82-01870 6E

Ion Flotation-Spectrophotometric Determination of Traces of Chromium (VI),
W82-02007 5A

Reviving the Rio Reconquista,
W82-02014 5G

Economic Instruments for Controlling Effluent Discharges to the River Tees Estuary,
W82-02060 2L

Poland: Coming to Grips with Pollution,
W82-02092 5G

WATER POLLUTION EFFECTS

Planning with Great Uncertainty: A Review and Case Study of the Safe Drinking Water Controversy,
W82-01606 5A

Acid Precipitation,
W82-01607 5C

An Alternative for Meeting the Nitrate Standard for Public Water Supplies,
W82-01623 5C

Relating Population Growth to Shellfish Bed Closures: A Case Study from North Carolina,
W82-01641 5C

Infectious Waterborne Diseases,
W82-01784 5A

Microbiology of the Aquatic Environment,
W82-01786 5C

Effect of an Aerial Application of Carbaryl on Brook Trout (Salvelinus Fontinalis),
W82-01818 5C

Methanogenesis in Freshwater Sediments: Inherent Variability and Effects of Environmental Contaminants,
W82-01825 5C

Effect of Sodium Dodecylsulfate on Unicellular Green Algae of the Genus Chlorella,
W82-01920 5C

A New Method for Assessing the Lethal Impact of Short-Term, High-Level Discharges of Pollutants on Aquatic Animals,
W82-01993 5C

Dynamics of Carp Growth and Biosynthetic Processes in the Liver of the Carp Reared in Containers in Heated Waste Water from Themal Power Stations,
W82-01998 5C

Comparative Limnology of Inner Long Point Bay, Lake Erie, and Adjacent Waters of the Outer Bay,
W82-02005 5B

Effect of Different Water Salinity Levels and Organic Matter Application on the Composition of Water Soluble and Exchangeable Bases in a Brackishwater Fish Pond Soil,
W82-02027 2H

The Effects of Mine Drainage and Organic Enrichment on Benthos in the River Nent System, Northern Pennines,
W82-02053 5C

Effects of Pollution Upon the Benthos of Belfast Lough,
W82-02059 5C

Seasonal Variations in the Actual Fecundity of Daphnia Magna in a Laboratory Culture,
W82-02083 5C

WATER POLLUTION PREVENTION

Protecting Virginia's Waterways,
W82-01608 5G

Waste Disposal--Choosing and Licensing Site,
W82-02035 5G

WATER POLLUTION SOURCES

Organic Compounds Found Near Dump Sites in Niagara Falls, New York,
W82-01802 5B

Environmental Assessment of Industrial Discharges Based on Multiplicative Models,
W82-01808 5B

Deposition of Sulphur Gases from Multiple Scattered Sources in Alberta,
W82-01868 5B

The Hazards of Hazardous Waste Management,
W82-01940 6E

The Modeling of Aquatic Ecological Systems,
W82-01972 5B

Plant Biotests in the Bioindication of the Rainfall Pollution in an Oil Refinery Region,
W82-02033 5C

Degree of Pollution of Several Major Streams Entering Tolo Harbour, Hong Kong,
W82-02058 5B

Hydrologic and Anthropogenic Factors Affecting Water Quality in the Rivers of the Ukrainian Carpathians,
W82-02076 5B

Stream Pollution in Hong Kong - An Appraisal,
W82-02084 5B

Poland: Coming to Grips with Pollution,
W82-02092 5G

WATER PRESSURE

Power Spectral Analysis of a Forcemain Failure Caused by Waterhammer,
W82-01826 7B

WATER QUALITY

The National Commission on Water Quality: A Case Study in Congressional Policy Analysis,
W82-01669 6B

Biological and Physical Investigations of Bodies of Water Beneath Dense Water Hyacinth Populations Before and After Chemical Treatment,
W82-01678 5B

Geographic Variations in Water Quality and Recreational Use Along the Upper Wallowa River and Selected Tributaries,
W82-01681 5A

The Effects of Secondary Sewage Effluent on the Water Quality, Nutrient Cycles and Mass Balances, and Accumulation of Soil Organic Matter in Cypress Domes,
W82-01687 5G

Random Differential Equations in Water Quality Modeling,
W82-01688 6A

Pollution Permits and Markets for Water Quality,
W82-01699 6A

Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 5B

A Water Quality Assessment of Development in the Senegal River Basin,
W82-01740 6G

Organic Substances in Water,
W82-01783 5A

Infectious Waterborne Diseases,
W82-01784 5A

Microbiology of the Aquatic Environment,
W82-01786 5C

Quality of Water and Time of Travel in Part of Tillatoba Creek Basin, Mississippi, October 1974 to September 1980,
W82-01791 7C

Biota and Biological Parameters as Environmental Indicators,
W82-01794 5C

Water Quality Study -- Southwest Minnesota Public Water Supplies,
W82-01795 2K

The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State,
W82-01924 2H

Water Quality and the Demand for Recreation,
W82-01942 6D

Mathematical Modeling of Stream Water Quality by a New Moment Method: Field Investigation of a Tidal River,
W82-01995 7B

Groundwater Chemistry of Some Selected Areas in Southeaster Norway,
W82-02020 2K

Experience with a Simple Method for the Biological Evaluation of Surface Water Quality,
W82-02029 5A

Hydrologic and Anthropogenic Factors Affecting Water Quality in the Rivers of the Ukrainian Carpathians,
W82-02076 5B

Water Quality Management of Lake Neusiedler, Austria,
W82-02090 5C

WATER QUALITY CONTROL

Protecting Virginia's Waterways,
W82-01608 5G

Effluent Fees, An Alternative System for Achieving Water Quality: A Case Study,
W82-01665 6F

A Limnological Investigation of a Tropical Fresh-Water Ecosystem: The Belize River, Belize, Central America,
W82-01682 5G

Regulating the Quality of Drinking Water: An Economic Analysis of the Safe Drinking Water Act of 1974,
W82-01691 5G

The Removal of Organic Matter from Surface Water Supplies by Anion Exchange Resins,
W82-01697 5F

Upland Marsh for Water Quality Control,
W82-01962 5B

Water Pollution: A Risk to the Future in the Case of the Rhine (Eaux Polluees' Avenir en Danger Dans le Cas du Rhin),
W82-02067 5G

WATER QUALITY INDICES

Water Quality Indices: An Additional Management Tool,
W82-01994 5G

WATER QUALITY MANAGEMENT
Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 5G

Water Quality Indices: An Additional Management Tool,
W82-01994 5G

WATER QUALITY STANDARDS
Water Sanitation Legislation Regarded as the Basis of Water Quality Monitoring,
W82-01990 6E

WATER RATES
Charging for Water Supply in England and Wales in the 1980s,
W82-01722 6C

WATER REQUIREMENTS
Water Requirements and Man-Induced Climate Change,
W82-01633 2D

Intraseasonal Water Allocation in Deficit Irrigation,
W82-01916 3F

Water Use, Yield and Quality of Rapeseed as Influenced by Spacing, Irrigation and Time of Harvest When Raised in a Multiple-Cropping System,
W82-02031 3F

Turnover of Tritiated Water in Calamondin Plants,
W82-02048 5A

WATER RESOURCES
Water Management in the Colorado River Basin: An Application of Nonlinear Transportation Algorithms,
W82-01677 6A

The Technology Transfer Process in Water Resources R&D Management,
W82-01694 6A

Water Quality Study -- Southwest Minnesota Public Water Supplies,
W82-01795 2K

WATER RESOURCES DEVELOPMENT
A Structural Systems Analysis Approach to Determine Optimum Operating Policies for Irrigation and Hydropower Generation for Water Resources, Systems,
W82-01680 6A

The Management of Water Resources: A Synthesis of Goal Programming and Input-Output Analysis with Application to the Iowa Economy,
W82-01685 6A

Remote Sensing in Development,
W82-01719 7B

Impressions of Soil and Water Conservation in China,
W82-01730 4D

Sustaining the Growth of Provence.
W82-01738 6D

Water Resources Appraisals for Hydroelectric Licensing: Allegheny River Basin; Pennsylvania-New York.
W82-01751 6D

Water Resources Appraisals for Hydroelectric Licensing; Colorado River Basin, Texas.
W82-01752 6D

Water Resources Appraisal for Hydroelectric Licensing; Menominee River Basin; Michigan, Wisconsin,
W82-01753 6D

Water Resources Appraisals for Hydroelectric Licensing; Lower Red River Basin; Arkansas, Louisiana, Oklahoma and Texas,
W82-01754 6D

Water Resources Appraisal for Hydroelectric Licensing; Kennebec River Basin, Maine.
W82-01755 6D

Water Resources Appraisals for Hydroelectric Licensing; Cumberland River Basin; Kentucky-Tennessee.
W82-01756 6D

Water Resources Appraisals for Hydroelectric Licensing; Tombigbee-Warrior River Basin; Alabama-Mississippi.
W82-01757 6D

Water Resources Appraisals for Hydroelectric Licensing; Black River Basin, New York.
W82-01758 6D

Water Resources Appraisals for Hydroelectric Licensing; Grand River Basin, Michigan,
W82-01759 6D

Water Resources Appraisal for Hydroelectric Licensing; Potomac River Basin; Pennsylvania, Maryland, West Virginia, Virginia, and District of Columbia,
W82-01760 6D

Water Resources Appraisals for Hydroelectric Licensing: Upper Arkansas River Basin; Colorado, Kansas, and New Mexico.
W82-01761 6D

Water Resources Appraisals for Hydroelectric Licensing; Western Great Lakes Tributaries; Michigan, Wisconsin, Indiana and Illinois.
W82-01762 6D

Water Resources Appraisal for Hydroelectric Licensing: Penobscot River Basin, Maine,
W82-01763 6D

Water Resources Appraisal for Hydroelectric Licensing: Altamaha River Basin, Georgia,
W82-01764 6D

Water Resources Appraisals for Hydroelectric Licensing; Santee River Basin; South Carolina-North Carolina.
W82-01765 6D

Water Resources Appraisals for Hydroelectric Licensing: Tennessee River Basin; Virginia-Tennessee-North Carolina-Mississippi, Georgia-Kentucky-Alabama.
W82-01766 6D

Water Resources Appraisals for Hydroelectric Licensing, Saginaw and Au Sable River Basins Area, Michigan.
W82-01767 6D

WATER RESOURCES MANAGEMENT
Experience with Lake and Reservoir Restoration Techniques in the German Democratic Republic,
W82-02054 2H

WATER REUSE
Century-Old Board Mill Operates with Zero Effluent Discharge,
W82-01626 5D

Water Reuse: Ultrafiltration of Industrial and Municipal Wastewaters,
W82-01652 5D

Food and Energy Production: Conjunctive Water Planning,
W82-01856 3C

WATER RIGHTS
The National Water Policy Review and Western Water Rights Law Reform: An Overview,
W82-01659 6E

WATER SAMPLING
Multi-Saline Sample Distillation Apparatus for Hydrogen Isotope Analyses: Design and Accuracy,
W82-01789 3A

Determination of Hexachlorocyclopentadiene at the Nanogram Per Liter Level in Drinking Water,
W82-01819 5A

A Simple Device for Quantitative Pseudoperiphyton Sampling,
W82-01894 7B

WATER SOURCES
Analysis of the Origin of Water Which Forms Large Aufeis Fields on the Arctic Slope of Alaska Using Ground and Landsat Data,
W82-01690 2C

WATER STORAGE
Electronic Measurement and Recording of Evaporation Loss,
W82-01602 7B

WATER STRESS
The Effect of Different Water Regimes on Plant Growth and Nodule Structure of Greenhouse-Grown Winged Bean (Psophocarpus Tetragonolobus),
W82-01723 2I

Effect of Soil Moisture Stress on Legume-Rhizobium Symbiosis in Soybeans,
W82-01846 2I

Responses of Grain Sorghum to Variable Water Supply Under Two Irrigation Frequencies,
W82-01944 3F

WATER SUPPLY
An Economic and Institutional Assessment of the Water Problem Facing the Tucson Basin,
W82-01698 6B

Hydrogeology of the Gatlinburg Area, Tennessee,
W82-01782 2F

Water Quality Study -- Southwest Minnesota Public Water Supplies,
W82-01795 2K

Structural Aspects of the Water Supply in the Federal Republic of Germany,
W82-02066 6E

WATER SUPPLY DEVELOPMENT
Morocco's Largest Multipurpose Scheme,
W82-01724 8A

Impressions of Soil and Water Conservation in China,
W82-01730 4D

Sustaining the Growth of Provence.
W82-01738 6D

Wanted: Water for Development,
W82-02088 6D

WATER TABLE
Drawdowns at the Free Water Table During Pumping Tests in Artesian and Semiartesian Aquifers,
W82-01890 2F

WATER TANKS
Isolation of the Mycobacterium Avium-M. Intracellulare-M. Scrofulaceum Complex from Tank Water in Queensland, Australia,
W82-02069 5A

WATER TREATMENT
Planning with Great Uncertainty: A Review and Case Study of the Safe Drinking Water Controversy,
W82-01606 5A

Removal of Organics from Water by Granular Activated Carbon and Microorganisms,
W82-01628 5D

Drinking Water and Its Treatment: An Interview with Professor Sontheimer,
W82-01728 5F

Cape Town Waterworks Service Reservoirs: Plattekloff (1974) and Tygerberg (1964).
W82-01747 8A

A Survey of Trihalomethanes in the Drinking Water System of Murjreesboro, Tennessee,
W82-01817 5B

Aluminum Sulfate Treatment: Short-Term Effect on Complex Phosphorus Compounds in a Eutrophic Lake,
W82-01833 5F

Tying Up TCE,
W82-01866 5G

Tackling the Nitrate Problem.
W82-01874 5F

WATER USE
Water Resources Appraisals for Hydroelectric Licensing; Lower Red River Basin; Arkansas, Louisiana, Oklahoma and Texas,
W82-01754 6D

Water Resources Appraisal for Hydroelectric Licensing; Kennebec River Basin, Maine.
W82-01755 6D

Hydropower vs. Salmon: The Struggle of the Pacific Northwest's Anadromous Fish Resources for a Peaceful Coexistence with the Federal Columbia River Power System,
W82-01804 6E

WATER USERS
An Economic and Institutional Assessment of the Water Problem Facing the Tucson Basin,
W82-01698 6B

WATER VAPOR
A Model of the Antarctic Sink for Stratospheric Water Vapor,
W82-01686 2A

Photometric Investigations of Precipitable Water and Optical Depth Wavelength Exponents in an Urban Area,
W82-01966 2B

WATERSHED MANAGEMENT
Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 2A

Sediment Analyses for Selected Sites in the South Platte River in Colorado and Nebraska, and the North Platte and Platte Rivers in Nebraska--Suspended Sediment, Bedload, and Bed Material,
W82-01776 2J

WATERSHED MODELS
The Natural Acidity of Some Unpolluted Waters in Southeastern Alaska and Potential Impacts of Acid Rain,
W82-01867 5B

WATERSHEDS
Nutrient Runoff from Agricultural and Non-Agricultural Watersheds,
W82-01662 5B

Predicting Storm Runoff from Small Grassland Watersheds with the USDAHL Hydrologic Model,
W82-01672 2E

Land-Use Conflict in Wildland Watershed Management: A Multiple Objective Economic Analysis,
W82-01675 6A

Watershed Constituent Loading Analysis Utilizing Empirical Hydro-Chemical Modeling Techniques,
W82-01676 5B

Transport of Salts in Catchments and Soils,
W82-01880 2G

WAVE ACTION
Coherence Between Wind and Current Events in a Nearshore, Shallow Water, Wave Dominated Environment,
W82-01674 2L

WEATHER PATTERNS
Anomalies in Temperature and Rainfall During Warm Arctic Seasons as a Guide to the Formulation of Climate Scenarios,
W82-01975 2B

WELL DATA
Selected Hydrogeologic Data from the Northern Great Plains Area of Montana,
W82-01777 7C

WELLS
Groundwater Levels in Nebraska 1980,
W82-01785 2F

WESER RIVER
On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 5A

WETLANDS
Gulf of Mexico Wetlands: Value, State of Knowledge and Research Needs,
W82-01902 2L

WHEAT
Double and Monocropped Wheat and Grain Sorghum Under Different Tillage and Row Spacings,
W82-01862 2I

The Influence of Tillage on Soil Water Behavior,
W82-02022 2G

WHISKEY DISTILLERY WASTEWATER
Effect of the Copper Content of Distillery Spent Wash on Its Utilization for Single-Cell Protein Production by Geotrichum Candidum, Hansenula Anomala and Candida Kruzei,
W82-01750 5C

WILD RIVERS
Water Resources Appraisals for Hydroelectric Licensing, Saginaw and Au Sable River Basins Area, Michigan.
W82-01767 6D

WILDLIFE
Impacts of Navigational Dredging on Fish and Wildlife: A Literature Review,
W82-01768 6G

WIND-DRIVEN CURRENTS
A Method of Objective Analysis for Currents in a Lake with Application to Lake Ontario,
W82-01616 2H

Coherence Between Wind and Current Events in a Nearshore, Shallow Water, Wave Dominated Environment,
W82-01674 2L

WIRE INDUSTRY
Pollution Solutions--The Wire Drawing Industry.
W82-02041 5D

WOOD
Kinetics and Diffusion Processes in Colour Removal from Effluent Using Wood as an Adsorbent,
W82-02047 5D

WOOD WASTES
Control of Bark Landfill Leachates with an Anaerobic Treatment System,
W82-02006 5D

WYOMING
Biological Consequences of Stream Routing Through a Final-Cut Strip Mine Pit: Benthic Macroinvertebrates,
W82-01948 4A

YELLOW RIVER BASIN
Erosion and Sediment Control in China's Yellow River Basin,
W82-01729 4D

ZETA POTENTIAL
Using Zeta Potential to Optimize Coagulating Aid Doses Used to Treat Food Processing Wastes,
W82-01627 5D

ZINC
Voltammetric Studies on the Stability of the ZN(II) Chelates with NTA and EDTA and the Kinetics of their Formation in Lake Ontario Water,
W82-01839 2H

The Effects of Mine Drainage and Organic Enrichment on Benthos in the River Nent System, Northern Pennines,
W82-02053 5C

ZOOPLANKTON
The Relative Importance of Protozoans, Rotifers, and Crustaceans in a Freshwater Zooplankton Community,
W82-01840 2H

Zooplankton Species Diversity in Lake St. Clair, Ontario, Canada,
W82-01937 5C

Ecological and Physiological Characteristics of Dikerogammarus Haemobaphes in the Areas in Which Heated Water Is Discharged from the Tripol'ye Power Station,
W82-01970 5C

A Preliminary Study of the Effect of Pumped-Storage Plant Operation on Zooplankton,
W82-01971 5C

AUTHOR INDEX

ABEL, P. D.
A New Method for Assessing the Lethal Impact of Short-Term, High-Level Discharges of Pollutants on Aquatic Animals,
W82-01993 5C

ABRAHAM, M.
Distribution of Vibrio Parahaemolyticus in Finfish Harvested from Porto Novo (S. India) Environs: A Seasonal Study,
W82-01737 5A

ABT, S. R.
Evaluating Scour at Culvert Outlets,
W82-01934 4D

AHMED, Q. S.
Gauze Filtration and Enrichment Procedures for Recovery of Vibrio Cholerae From Contaminated Waters,
W82-01815 5A

AHUJA, L. R.
Simple In Situ Determination of Hydraulic Conductivity by Power Function Descriptions of Drainage,
W82-01666 2G

AIKEN, J. D.
The National Water Policy Review and Western Water Rights Law Reform: An Overview,
W82-01659 6E

ALEXANDER, W. J.
Geologic Aspects of Waste Disposal Site Evaluations,
W82-02011 5E

ALHONEN-HONGISTO, L.
Penetration and Distribution of Tritiated Water in Soils of a Lysimeter,
W82-01886 2G

ALLANSON, B. R.
Phosphorus Cycling in a Dense Potamogeton Pectinatus L. Bed,
W82-02070 2H

ALLEN, C. P.
Chromium Levels in Fish from a Lake Chronically Contaminated with Chromates from Cooling Towers,
W82-01941 5B

ALLEN, G. H.
Rearing Pacific Salmon in Saltwater Ponds Fertilized with Domestic Wastewater, Data Report, June 1979 - May 1980,
W82-01906 3C

ALLEN, K. O.
Impacts of Navigational Dredging on Fish and Wildlife: A Literature Review,
W82-01768 6G

ALLEN, L. H. JR.
Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Taylor Creek, Fla., and Litle River, Ga., 1979 Data Report,
W82-01771 7B

ALLEN, M. P.
Simulating Effects of Combined Sewer Overflows,
W82-01864 6A

ALLEN, N. L.
Furrow Advance Rates Under Surge Flow Systems,
W82-01612 3F

ALMBERG, L.
Oxygen Bleaching Shows Potential for Reducing Costs, Effluent Problems,
W82-01899 5D

ALSEN, C.
Detection of Organophosphate Insecticide by an Immobilized-Enzyme System,
W82-02025 5A

ALTHER, G. R.
A Test Utilizing Sediment Traps, Survey Rods, and Radiographs to Monitor Sediment Accumulation from a Dredging Disposal Operation,
W82-01950 7B

AMOROS, C.
A Simple Device for Quantitative Pseudoperiphyton Sampling,
W82-01894 7B

ANDERSON, D.
Technical and Economic Implications of Installing an Industrial Waste-Water Pretreatment Plant,
W82-02044 5D

AOYAMA, M.
Ion Flotation-Spectrophotometric Determination of Traces of Chromium (VI),
W82-02007 5A

APONASENKO, A. D.
Phytoplankton Distribution in the Southern and Middle Parts of Lake Baikal,
W82-02078 2H

APPLETON, A. R. JR.
Effect of Reagent Mixing Rate on Adsorption Process for Am-Fe2O3.H2O,
W82-01799 5F

ARAKEL, A. V.
Geochemistry and Hydrodynamics in the Hutt and Leeman Evaporitic Lagoons, Western Australia: A Comparative Study,
W82-01746 2L

ARENS, H-J.
Structural Aspects of the Water Supply in the Federal Republic of Germany,
W82-02066 6E

ARMITAGE, P. D.
The Effects of Mine Drainage and Organic Enrichment on Benthos in the River Nent System, Northern Pennines,
W82-02053 5C

ARNOLD, M. D.
Floodplain Management: A Flood and Land Planning System,
W82-01872 6F

ARSLANOVA, T. P.
Estimation of the Production of Planktonic Infusorians in Connection with Fluctuations in Their Abundance,
W82-02072 2H

ARTHER, R. G.
Parasite Ova in Anaerobically Digested Sludge,
W82-02018 5B

ASPILA, K. I.
Interlaboratory Quality Control Study No. 26, Arsenic and Selenium in Water,
W82-01854 5A

ASTON, S. R.
Americium in Intertidal Sediments from the Coastal Environs of Windscale,
W82-02098 5B

AUSTIN, B.
Numerical Taxonomy Analysis of Bacteria Isolated from the Completed 'Most Probable Numbers' Test for Coliform Bacilli,
W82-01911 5A

AVADHANULU, R. V.
An Aquifer Simulation Program for Micro-Based Processors,
W82-01879 2F

BABENKO, I. A.
Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 5B

BAETJER, K.
On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 5A

BAGNYUK, L. I.
Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 5B

BAIN, G. L.
Geologic and Hydrologic Implications of Hazardous Wastes Management Rules on Siting in North Carolina,
W82-01630 5E

BAKER, J. P.
Effect of Aluminum Speciation on Fish in Dilute Acidified Waters,
W82-01663 5C

BALARAJU, M.
Water Use, Yield and Quality of Rapeseed as Influenced by Spacing, Irrigation and Time of Harvest When Raised in a Multiple-Cropping System,
W82-02031 3F

BALE, J. B.
The Use of Remote Sensing for an Integrated Inventory of a Semi-Arid Area,
W82-01910 7B

BANDY, J. T.
R-Factors for Soil Loss Impact Prediction,
W82-01963 2J

BANNINK, B. A.
Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 5G

BARBEAU, C.
Spatial and Temporal Variations in Cesium-137 and Carbon in Sediments of Saguenay Fjord (Variations Spatiales et Temporelles du Cesium-137 et du Carbone dans des Sediments du Fjord du Saguenay),
W82-01644 2J

Temporal and Spatial Variations of Mercury, Lead, Zinc, and Copper in Sediments of the Saguenay Fjord,
W82-01639 5B

BARDSLEY, W. E.
Note on Random Raindrops and Sampling Error,
W82-02032 2B

Note on Two Limit Distributions of Bedload Movement,
W82-01643 2J

BARKER, T. W.
Effect of the Copper Content of Distillery Spent Wash on Its Utilization for Single-Cell Protein Production by Geotrichum Candidum, Hansenula Anomala and Candida Kruzei,
W82-01750 5C

BARON, D. M.
Screened Auger Aids Investigation,
W82-02096 7B

BARROW, G. I.
Microbial Pollution of Coasts and Estuaries: The Public Health Implications,
W82-02051 5C

BATHURST, E. T. J.
Bromide in Canterbury Ground Water,
W82-02056 5B

BATTAN, L. J.
Observations of Two Colorado Thunderstorms by Means of a Zenith-Pointing Doppler Radar,
W82-01967 2B

BATTERMAN, A. R.
Determination of Mineral Fiber Concentrations in Fish Tissues,
W82-01822 5C

BEAR, J.
Mathematical Model for Regional Land Subsidence Due to Pumping 1. Integrated Aquifer Subsidence Equations Based on Vertical Displacement Only,
W82-01926 2F

Mathematical Model for Regional Land Subsidence Due to Pumping 2 Integrated Aquifer Subsidence Equations for Vertical and Horizontal Displacements,
W82-01927 2F

BEAUCHAMP, J. J.
Chromium Levels in Fish from a Lake Chronically Contaminated with Chromates from Cooling Towers,
W82-01941 5B

BEAVIS, B.
Economic Instruments for Controlling Effluent Discharges to the River Tees Estuary,
W82-02060 2L

BEDNAR, G. A.
Quality of Water and Time of Travel in Part of Tillatoba Creek Basin, Mississippi, October 1974 to September 1980,
W82-01791 7C

BEECH, J. A.
Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
W82-01835 5A

BELOBABA, E. G.
Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 5B

BENGTSON, R. L.
Predicting Storm Runoff from Small Grassland Watersheds with the USDAHL Hydrologic Model,
W82-01672 2E

BENGTSSON, L.
Evaporation from a Snow Cover--Review and Discussion of Measurements,
W82-01888 2D

BENNDORF, J.
A Control Mechanism of the Phytoplankton Respiration in a Eutrophic Reservoir,
W82-02030 2H

BENOIT, F. M.
Determination of Hexachlorocyclopentadiene at the Nanogram Per Liter Level in Drinking Water,
W82-01819 5A

BERKES, F.
Some Environmental and Social Impacts of the James Bay Hydroelectric Project, Canada,
W82-01908 6G

BEUKES, D. J.
Soil Water Studies on Small Lucerne Plots,
W82-01713 2I

BHAN, S.
Water Use, Yield and Quality of Rapeseed as Influenced by Spacing, Irrigation and Time of Harvest When Raised in a Multiple-Cropping System,
W82-02031 3F

BHATTACHARYA, S.
Detection of Organophosphate Insecticide by an Immobilized-Enzyme System,
W82-02025 5A

BIGGS, R. B.
A Perspective on Estuarine and Coastal Research Funding,
W82-01803 9A

BISCHOF, R. B.
Morocco's Largest Multipurpose Scheme,
W82-01724 8A

BISHOP, A. A.
Furrow Advance Rates Under Surge Flow Systems,
W82-01612 3F

BISOGNI, J. J. JR.
Effect of Aluminum Speciation on Fish in Dilute Acidified Waters,
W82-01663 5C

BJERVE, L.
Discharge Measurements by a New-Formed Relative Salt-Dilution Method in Small Turbulent Streams,
W82-01891 7B

BLENK, J. B.
Simulating Effects of Combined Sewer Overflows,
W82-01864 6A

BLOCK, J. C.
Survival of Enteroviruses Adsorbed on Glass Microfibers During Postal Transport (Survie de Virus Enteriques Adsorbes sur Microfibre de Verre au Cours d'un Transport Postal),
W82-01637 5A

BLOKHINA, N. P.
Calculation of Brachionus Rubens Production by the Direct Method and by Edmondson's Method,
W82-01921 2H

BLOMQUIST, G.
Water Quality and the Demand for Recreation,
W82-01942 6D

BLOTNICK, J. R.
Ecological Characteristics of the Rhizosphere Microflora of Myriophyllum Heterophyllum,
W82-01796 4A

BLUMM, M. C.
Hydropower vs. Salmon: The Struggle of the Pacific Northwest's Anadromous Fish Resources for a Peaceful Coexistence with the Federal Columbia River Power System,
W82-01804 6E

BOLES, K. E.
Water Management in the Colorado River Basin: An Application of Nonlinear Transportation Algorithms,
W82-01677 6A

BONACCI, O.
Accuracy of Suspended Sediment Measurements in Natural Streamflows,
W82-02002 2J

BONELLI, J. E.
Applications of Stripping Analysis to Metal Determinations in Natural Waters,
W82-01670 1A

BORDOVSKY, J. P.
Low Energy Precision Application (LEPA) Irrigation System,
W82-01859 3F

BORGMANN, U.
Determination of Free Metal Ion Concentrations Using Bioassays,
W82-01821 5A

BORMAN, R. G.
Effects of a Cattle Feedlot on Ground-Water Quality in the South Platte River Valley Near Greeley, Colorado,
W82-01790 5B

BORROWS, P.
Reviving the Rio Reconquista,
W82-02014 5G

BOTHA, B. J. V.
The Relationship Between Macro-Topography and the Groundwater Quality in the Great Fish River Basin, Eastern Cape Province,
W82-01718 2F

BOUGIE, R.
Spatial and Temporal Variations in Cesium-137 and Carbon in Sediments of Saguenay Fjord (Variations Spatiales et Temporelles du Cesium-137 et du Carbone dans des Sediments du Fjord du Saguenay),
W82-01644 2J

Temporal and Spatial Variations of Mercury, Lead, Zinc, and Copper in Sediments of the Saguenay Fjord,
W82-01639 5B

BOURBONNIERE, R. A.
Southern Lake Michigan Sediments: Changes in Accumulation Rate, Mineralogy, and Organic Content,
W82-01958 2J

BOWERS, J. A.
Effects of Thermocline Displacement Upon Subsurface Chlorophyll Maxima in Lake Michigan,
W82-01957 2H

BOYLE, T. P.
Effects of the Aquatic Herbicide 2,4-D DMA on the Ecology of Experimental Ponds,
W82-01949 5C

BRADDOCK, R. D.
Properties of the Sorptivity for Exponential Diffusivity and Application to the Measurement of the Soil Water Diffusivity,
W82-01897 2G

BRADEN, J. B.
The Economics of Cooperation Over Collective Bads,
W82-01909 6A

BRADFORD, W. L.
Records of Water Levels in Unconsolidated Deposits in Eastern South Dakota,
W82-01788 7C

BRALTS, V. F.
Drip Irrigation Uniformity Considering Emitter Plugging,
W82-01860 3F

BRANICA, M.
Voltammetric Studies on the Stability of the ZN(II) Chelates with NTA and EDTA and the Kinetics of their Formation in Lake Ontario Water,
W82-01839 2H

BRAS, R. L.
Intraseasonal Water Allocation in Deficit Irrigation,
W82-01916 3F

BRESLER, E.
Effect of Field Variability in Soil Hydraulic Properties on Solutions of Unsaturated Water and Salt Flows,
W82-01898 2G

BRIGGS, R.
Where Do We Go from Here.
W82-02086 7A

BRIZ-KISHORE, B. H.
An Aquifer Simulation Program for Micro-Based Processors,
W82-01879 2F

BROCK, T. D.
The Role of Phototrophic Bacteria in the Sulfur Cycle of a Meromictic Lake,
W82-01831 2H

BROMLEY, D. W.
The Economics of Cooperation Over Collective Bads,
W82-01909 6A

BROSSET, C.
The Mercury Cycle,
W82-01869 5B

BROWER, W. W. II.
Biological and Physical Investigations of Bodies of Water Beneath Dense Water Hyacinth Populations Before and After Chemical Treatment,
W82-01678 5B

BROWN, H. S.
Perspective on Management and Disposal of Hazardous Wastes,
W82-01635 5E

BROWN, J. A. H.
A Mathematical Model of the Hydrologic Regime of the Upper Nile Basin,
W82-01857 2A

BRYSON, A. W.
A Mechanistic Model of a Packed-Bed Electrode Cell to Remove Metal Ions from Dilute Effluent Solutions,
W82-02050 5D

BUCHAN, R. M.
Acute Toxicity of an In Situ Shale Oil Process Wastewater and It's Major Components to Daphnia Magna,
W82-01811 5C

BUDAGOVSKII, A. I.
Ways of Successive Refinement of Methods of Calculating the Duty of Water,
W82-02094 2D

BUDWEG, F. M. G.
Irrigation for Brazil's Poligono Das Secas,
W82-01744 3F

BULL, D. L.
Environmental Fate of Methyl Eugenol,
W82-02013 5B

BURESH, R. J.
Nitrate Reduction to Ammonium and Organic Nitrogen in an Estuarine Sediment,
W82-01625 5B

BURGER, J. S.
Comparison of Liquid-Liquid Extraction and Resin Adsorption for Concentrating Mutagens in Ames Salmonella/Microsome Assays on Water,
W82-01812 5A

BURNHAM, L. N.
Acute Toxicity of an In Situ Shale Oil Process Wastewater and It's Major Components to Daphnia Magna,
W82-01811 5C

BURNS, C. W.
Phytoplankton Photosynthesis and Its Relation to Standing Crop and Nutrients in Two Warm-Monomictic South Island Lakes,
W82-01700 2H

BUTTON, D. K.
Dissolved Hydrocarbons and Related Microflora in a Fjordal Seaport: Sources, Sinks, Concentrations, and Kinetics,
W82-01816 5B

CANALE, R. P.
Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 2H

CARLSON, T. W.
Contourites in Lake Superior,
W82-01935 2H

CASTEIGNAU, G.
Combining Sewer Water Purification Processes to Treat Effluents Produced by Transient Populations,
W82-01992 5D

CASTLE, R. O.
Tectonic State: Its Significance and Characterization in the Assessment of Seismic Effects Associated with Reservoir Impounding,
W82-01951 8E

CETINKAYA, M.
On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 5A

CHAKRABARTI, C.
Diffusion of Sediment on the Lee of Dune-Like Bedforms: Theoretical and Numerical Analysis,
W82-01842 2J

CHALMERS, D. J.
Control of Peach Tree Growth and Productivity by Regulated Water Supply, Tree Density, and Summer Pruning,
W82-01883 2I

CHAM, V.
Interlaboratory Quality Control Study No. 26, Arsenic and Selenium in Water,
W82-01854 5A

CHANUT, J. P.
Phytoplankton Distributions Observed During a 3 1/2 Days Fixed-Station in the Lower St. Lawrence Estuary,
W82-01938 2L

CHAPMAN, M. A.
Limnology of Lake Rerewhakaaitu,
W82-01705 2H

CHAPRA, S. C.
Quantification of the Lake Trophic Typologies of Naumann (Surface Quality) and Thienemann (Oxygen) with Special Reference to the Great Lakes,
W82-02004 2H

CHARBONNEAU, J. O. G.
Glacier Surveys in Alberta - 1979,
W82-01855 2C

CHATTOPADHYAY, G. N.
Effect of Different Water Salinity Levels and Organic Matter Application on the Composition of Water Soluble and Exchangeable Bases in a Brackishwater Fish Pond Soil,
W82-02027 2H

CHEN, R. L.
Nitrous Oxide Emission from Simulated Overland Flow Wastewater Treatment Systems,
W82-01624 5D

CHEN, Y. H.
Hydraulic Testing of Plastic Filter Fabrics,
W82-01613 8G

CHERKAUER, D. S.
Hydraulic Connection Between Lake Michigan and a Shallow Ground-Water Aquifer,
W82-02010 2F

CHERNITSKAYA, L. N.
Bacterioplankton and Phytoplankton in the Kiev Sector of Kanev Reservoir During the Period of Its Formation,
W82-02081 2H

CHEUNG, L. S.
A Gel Partition Model for Organic Desorption from a Pond Sediment,
W82-01844 5A

CHHONKAR, P. K.
Effect of Soil Moisture Stress on Legume-Rhizobium Symbiosis in Soybeans,
W82-01846 2I

CHIU, A. A.
Tide-Induced Residual Flow in Shallow Bays,
W82-02003 2L

CHONG, S. K.
Simple In Situ Determination of Hydraulic Conductivity by Power Function Descriptions of Drainage,
W82-01666 2G

CHRISTENSEN, E. R.
Water Reuse: Ultrafiltration of Industrial and Municipal Wastewaters,
W82-01652 5D

CHRISTMAS, A. D.
The Use of Specific Conductance in Studies of Natural Waters and Soil Solutions,
W82-01646 7A

CHRISTY, M. S.
Investigations into the Dynamics of Water Movement on a Low Relief Landscape on the Eastern Shore of Maryland,
W82-01673 2F

CHU, S. Y.
The Statistical Mechanical Theory of Groundwater Flow,
W82-01982 2F

CHYNOWETH, D. P.
The Contributions of Temperature and the Input of Organic Matter in Controlling Rates of Sediment Methanogenesis,
W82-01832 2H

CLAIBORNE, M.
U.S. Geological Survey Reports on the Water Resources of Florida, 1886-1980, Second Edition,
W82-01778 10C

CLARK, B. D.
The Lake Tahoe Basin: A Systems Analysis of Its Characteristics and Human Carrying Capacity,
W82-01807 6A

CLARK, M. M.
Tectonic State: Its Significance and Characterization in the Assessment of Seismic Effects Associated with Reservoir Impounding,
W82-01951 8E

CLARK, R. N.
Controlling Runoff for Livestock Feedlots; A State of the Art,
W82-01769 5G

CLARKE, W. B.
Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 2H

CLEMMENS, A. J.
Development of Solutions for Level-Basin Design,
W82-01976 3F

CLYMA, W.
Optimal Design of Border Irrigation Systems,
W82-01977 3F

COBLE, L. W. JR.
Influence on Groundwater from the Bermed Infiltration Pond,
W82-01622 5D

CODNER, G. P.
A Mathematical Model of the Hydrologic Regime of the Upper Nile Basin,
W82-01857 2A

COLEMAN, G. A.
Soil Moisture Updating and Microwave Remote Sensing for Hydrological Simulation,
W82-01611 2G

COLWELL, R. R.
Numerical Taxonomy Analysis of Bacteria Isolated from the Completed 'Most Probable Numbers' Test for Coliform Bacilli,
W82-01911 5A

CONLEY, C. D.
Measurement of Irrigated Acreage in Western Kansas from Landsat Images,
W82-01939 7B

COOK, P. M.
Determination of Mineral Fiber Concentrations in Fish Tissues,
W82-01822 5C

CORAPCIOGLU, M. Y.
Mathematical Model for Regional Land Subsidence Due to Pumping 1. Integrated Aquifer Subsidence Equations Based on Vertical Displacement Only,
W82-01926 2F

Mathematical Model for Regional Land Subsidence Due to Pumping 2 Integrated Aquifer Subsidence Equations for Vertical and Horizontal Displacements,
W82-01927 2F

CORCORAN, E. F.
Potential for Biodegradation of Phthalic Acid Esters in Marine Regions,
W82-01829 5B

CORDOVA, J. R.
Intraseasonal Water Allocation in Deficit Irrigation,
W82-01916 3F

COTE, J-E.
Spatial and Temporal Variations in Cesium-137 and Carbon in Sediments of Saguenay Fjord (Variations Spatiales et Temporelles du Cesium-137 et du Carbone dans des Sediments du Fjord du Saguenay),
W82-01644 2J

Temporal and Spatial Variations of Mercury, Lead, Zinc, and Copper in Sediments of the Saguenay Fjord,
W82-01639 5B

COULTER, J. B.
The Hazards of Hazardous Waste Management,
W82-01940 6E

COX, R. G.
The Containment of an Oil Slick by a Boom Placed Across a Uniform Stream,
W82-01956 1B

The Spreading of Thin Liquid Films on a Water-Air Interface,
W82-01955 1B

CRABTREE, R. J.
Double and Monocropped Wheat and Grain Sorghum Under Different Tillage and Row Spacings,
W82-01862 2I

CRAIG, K. S.
Dissolved Hydrocarbons and Related Microflora in a Fjordal Seaport: Sources, Sinks, Concentrations, and Kinetics,
W82-01816 5B

CRAUN, G. F.
An Alternative for Meeting the Nitrate Standard for Public Water Supplies,
W82-01623 5C

CRIPE, C. R.
Apparatus to Produce Tidal Fluctuations in a Simulated Salt Marsh System,
W82-01930 2L

CRISP, R.
Water Resources Appraisal for Hydroelectric Licensing: Altamaha River Basin, Georgia,
W82-01764 6D

CROLEY, T. E.
River Thermal Standards Costs in the Upper Midwest,
W82-01655 6B

CRONIN, L. E.
A Perspective on Estuarine and Coastal Research Funding,
W82-01803 9A

CROWLEY, P.
Simulation of Soil Water Within the Root Zone of a Corn Crop,
W82-01834 2G

CUMMANS, J. E.
Low-Flow Characteristics of Streams in the Deschutes River Basin, Washington,
W82-01781 2E

CURRY, R. W.
Potential for Biodegradation of Phthalic Acid Esters in Marine Regions,
W82-01829 5B

CURTIS, C. R.
Streamlined Regulations Could Help Make New Stormwater Management Concepts Part of the Tradition,
W82-02000 4A

DABROWSKI, H.
Tracing Food Webs with Stable Hydrogen Isotopes,
W82-02021 6G

DAKERS, J. L.
The Sewerage Policy of Thames Water,
W82-02040 6E

DALY, C. J.
An Integral Transform Method for the Linearized Boussinesq Groundwater Flow Equation,
W82-01984 2F

DARDIS, K. A.
A Mechanistic Model of a Packed-Bed Electrode Cell to Remove Metal Ions from Dilute Effluent Solutions,
W82-02050 5D

DAVANZO, A. C.
Detroit's WWTP: One of the World's Biggest,
W82-01865 5D

DAY, J. C.
Regulation for Environmental Protection: The Nanticoke Industrial Complex, Ontario, Canada,
W82-02024 6E

DE VOS, C. P.
Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 5G

DEDRICK, A. R.
Development of Solutions for Level-Basin Design,
W82-01976 3F

DELLEUR, J. W.
A Stochastic Cluster Model of Daily Rainfall Sequences,
W82-01651 2B

DELPHIA, L. M.
Matacil Residue Determination in Foliage, Fish, Soil and Water,
W82-01621 5A

DEMERY, P. M.
Hydraulic Testing of Plastic Filter Fabrics,
W82-01613 8G

DEMONTMOLLIN, F. A.
Evaluation of a Precipitation Map Using a Smoothed Elevation-Precipitation Relationship and Optimal Estimates (Kriging),
W82-01892 2B

DENDY, B. B.
Case Studies of Agricultural Water Conservation,
W82-01667 3F

DENISOVA, A. I.
The Predicted Content of Organic and Biogenic Matter in the Water of Vilyuy Reservoir and the Extent to Which It Has Been Confirmed,
W82-02080 2H

DI PIETRO, N. D.
The Containment of an Oil Slick by a Boom Placed Across a Uniform Stream,
W82-01956 1B

DIAZ, R.
Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
W82-01835 5A

DIBBLE, W. E. JR.
Non-Equilibrium Water/Rock Interactions,
W82-01684 1A

DICK, A. C.
Deposition of Sulphur Gases from Multiple Scattered Sources in Alberta,
W82-01868 5B

DIDERIKSEN, R. I.
Resource Inventory--Sheet, Rill and Wind Erosion,
W82-01850 2J

DIERBERG, F. E.
The Effects of Secondary Sewage Effluent on the Water Quality, Nutrient Cycles and Mass Balances, and Accumulation of Soil Organic Matter in Cypress Domes,
W82-01687 5G

DINEHART, R. L.
Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01792 7C

DINIA, N.
Morocco's Largest Multipurpose Scheme,
W82-01724 8A

DISHER, J. W.
Power Spectral Analysis of a Forcemain Failure Caused by Waterhammer,
W82-01826 7B

DITWILER, C. D.
Water: A Low-Priced But High-Cost Resource,
W82-02061 6C

DOBSON, H. F. H.
Quantification of the Lake Trophic Typologies of Naumann (Surface Quality) and Thienemann (Oxygen) with Special Reference to the Great Lakes,
W82-02004 2H

DOGADINA, T. V.
The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State,
W82-01924 2H

DORAS, N.
Various Kinetic Energy Characteristics of Hail-patterns in the Grossversuch IV Experiment,
W82-01732 2B

DOUGLASS, A. R.
A Model of the Antarctic Sink for Stratospheric Water Vapor,
W82-01686 2A

DOWNES, M. T.
Nitrate Accumulation in Aerobic Hypolimnia: Relative Importance of Benthic and Planktonic Nitrifiers in an Oligotrophic Lake,
W82-02023 2H

DOWNS, C. E.
The Technology Transfer Process in Water Resources R&D Management,
W82-01694 6A

DRABBE, J. A.
Electronic Measurement and Recording of Evaporation Loss,
W82-01602 7B

DRAKE, R. A. R.
Developments in Instrumentation and Automation in Sewage Treatment,
W82-02043 5D

DRAKE, S. R.
Influence of Trickle and Sprinkle Irrigation on Golden Delicious Apple Quality,
W82-02001 3F

DRESSCHER, TH. G. N.
Experience with a Simple Method for the Biological Evaluation of Surface Water Quality,
W82-02029 5A

DRISCOLL, C. T. JR.
Effect of Aluminum Speciation on Fish in Dilute Acidified Waters,
W82-01663 5C

DUBKO, N. V.
Use of Knopp's Method to Assess Self-Purification Processes in Water Bodies and Water Courses,
W82-02073 5B

DUESZELN, J.
On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 5A

DUKE, W.
Water Resources Appraisal for Hydroelectric Licensing: Altamaha River Basin, Georgia,
W82-01764 6D

DUNCAN, J. M.
The Accuracy of Equilibrium Methods of Slope Stability Analysis,
W82-01954 8D

DZHAMALOV, R. G.
Groundwater Discharge to the Pacific Ocean,
W82-01647 2F

DZHOGAN, L. YA.
Ways of Successive Refinement of Methods of Calculating the Duty of Water,
W82-02094 2D

EAGLE, G. A.
Variations in Trace Metal Content of the Mussel Choromytilus Meridionalis (Kr.) with Season and Sex,
W82-01969 5A

ECCLES, P. G.
Sulby Reservoir - Providing Water for the Isle of Man,
W82-02068 8A

EL-SABH, M.
Phytoplankton Distributions Observed During a 3 1/2 Days Fixed-Station in the Lower St. Lawrence Estuary,
W82-01938 2L

ELDER, V. A.
Organic Compounds Found Near Dump Sites in Niagara Falls, New York,
W82-01802 5B

ELLIS, J. B.
Water Quality Indices: An Additional Management Tool,
W82-01994 5G

ELWOOD, J. W.
Chromium Levels in Fish from a Lake Chronically Contaminated with Chromates from Cooling Towers,
W82-01941 5B

EMMETT, R. C.
Technology and Performance of the Hi-Capacity Thickener,
W82-01929 5D

ENGLUND, J-O.
Groundwater Chemistry of Some Selected Areas in Southeaster Norway,
W82-02020 2K

Groundwater Discharge Through Springs with Well-Defined Outlets--A Case Study from Jeloya-Moss, S. Norway,
W82-01748 2F

ENGMAN, E. T.
Soil Moisture Updating and Microwave Remote Sensing for Hydrological Simulation,
W82-01611 2G

ERASMUS, D. A.
Towards an Understanding of the Effects of Orography on the Distribution of Precipitation Over the Cape Peninsula,
W82-02085 2B

ERKENBRECHER, C. W. JR.
Sediment Bacterial Indicators in an Urban Shellfishing Substuary of the Lower Chesapeake Bay,
W82-01661 5A

ESCALONA, R. L.
On the Presence of Fecal Steroids in Sediments from Two Mexican Harbors,
W82-02012 5A

ESTEP, M. F.
Tracing Food Webs with Stable Hydrogen Isotopes,
W82-02021 6G

EVANS, G. T.
Phytoplankton Accumulation in Langmuir Cells,
W82-01946 2H

EVANS, J. C. W.
Century-Old Board Mill Operates with Zero Effluent Discharge,
W82-01626 5D

EVANS, J. E.
Contourites in Lake Superior,
W82-01935 2H

FACI, J. M.
Responses of Grain Sorghum to Variable Water Supply Under Two Irrigation Frequencies,
W82-01944 3F

FAHRENTHOLD, P. D.
Predicting Priority Pollutants from Petrochemical Processes,
W82-01809 5B

FALKOWSKI, P. G.
Rapid, Quantitative Separation of Chlorophylls and Their Degradation Products by High-Performance Liquid Chromatography,
W82-01619 5A

FAPOHUNDA, H. O.
River Basin Sequential Water Use and Salinity Effects on Crop Yield Economics,
W82-01671 3F

FERERES, E.
Responses of Grain Sorghum to Variable Water Supply Under Two Irrigation Frequencies,
W82-01944 3F

FERRARA, R. A.
Hydraulic Modeling for Waste Stabilization Ponds,
W82-01965 5D

FIFIELD, J. S.
Watershed Constituent Loading Analysis Utilizing Empirical Hydro-Chemical Modeling Techniques,
W82-01676 5B

FILATOV, N. N.
Investigation of Turbulence and Langmuir Circulation in Lake Ladoga,
W82-02100 2H

FINDLAY, D. M.
Removal of Elemental Mercury from Wastewaters Using Polysulfides,
W82-01800 5D

FINLAYSON, B. J.
Acute Toxicities of the Herbicides Komeen and Hydrothol-191 to Golden Shiner (Notemigonus Crysoleucas),
W82-01882 5C

FINNEY, B. A.
Random Differential Equations in Water Quality Modeling,
W82-01688 6A

FISHELSON, G.
Water Quality and the Demand for Recreation,
W82-01942 6D

FITZGERALD, P. R.
Parasite Ova in Anaerobically Digested Sludge,
W82-02018 5B

FLECKSEDER, H.
Water Quality Management of Lake Neusiedler, Austria,
W82-02090 5C

FLEROV, B. A.
The Use of Leeches to Identify Pesticides in Water,
W82-02075 5A

FLINT, E. A.
Limnology of Lake Rerewhakaaitu,
W82-01705 2H

FLOOD, R. D.
Distribution, Morphology, and Origin of Sedimentary Furrows in Cohesive Sediments, Southampton Water,
W82-01720 2L

FLORESTANO, P. S.
Public Opinion and Interest Group Positions on Chesapeake Bay Issues: Implications for Resource Management,
W82-01642 6B

FODA, M.
The Spreading of Thin Liquid Films on a Water-Air Interface,
W82-01955 1B

FODOR-CSANYI, P.
Penetration and Distribution of Tritiated Water in Soils of a Lysimeter,
W82-01886 2G

FORSYTH, D. J.
Benthic Macroinvertebrates of Lake Taupo,
W82-01702 2H

FOSTER, G. R.
Estimating Erosion and Sediment Yield on Field-Sized Areas,
W82-01849 2J

FOSTER, I. D. L.
The Use of Specific Conductance in Studies of Natural Waters and Soil Solutions,
W82-01646 7A

FOSTER, K. E.
The Use of Remote Sensing for an Integrated Inventory of a Semi-Arid Area,
W82-01910 7B

FOX, J. C.
Parasite Ova in Anaerobically Digested Sludge,
W82-02018 5B

FRANCKO, D. A.
Aluminum Sulfate Treatment: Short-Term Effect on Complex Phosphorus Compounds in a Eutrophic Lake,
W82-01833 5F

FRANK, N. A.
Phytoplankton Distribution in the Southern and Middle Parts of Lake Baikal,
W82-02078 2H

FRANKLIN, A. G.
Current Methods of Dynamic Analysis for Seismic Stability of Earth Dams,
W82-01953 8D

FRANZIN, W. G.
An Analysis of the Aquatic Macrophyte, Myriophyllum Exalbescens, as an Indicator of Metal Contamination of Aquatic Ecosystems near a Base Metal Smelter,
W82-02016 5A

FRASER, A. S.
Loading Estimates to Lake Erie, 1967-1976,
W82-01852 5A

FREEMAN, D. H.
A Gel Partition Model for Organic Desorption from a Pond Sediment,
W82-01844 5A

FREEMAN, L.
The Day That the Rain Came Down,
W82-02064 2E

FRENCH, C. O.
Gulf of Mexico: A Socioeconomic View of Competing Resources,
W82-01901 6B

FREVERT, T.
Dissolved Oxygen Dependent Phosphorus Release from Profundal Sediments of Lake Constance (Obersee),
W82-02055 2H

FRITTON, D. D.
Flow Calculations for Household Effluent Disposal in Elevated Sand Mounds,
W82-01660 5E

FROEHLICH, D. C.
Legal Challenge of the Ungaged Watershed,
W82-01664 2E

FURUTANI, A.
Mercury Methylation by Fish Intestinal Contents,
W82-01830 5C

GAGE, J.
Water Resources Appraisal for Hydroelectric Licensing; Menominee River Basin; Michigan, Wisconsin,
W82-01753 6D

GALAGAN, N. P.
Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 5B

GASS, T.
Applications of Aerial Photography,
W82-01988 7B

GAVIN, J.
Summer Ice and Carbon Dioxide,
W82-01843 2C

GAVRISHOVA, N. A.
Bacterioplankton and Phytoplankton in the Kiev Sector of Kanev Reservoir During the Period of Its Formation,
W82-02081 2H

GERHART, J. M.
Hydrogeology of Well-Field Areas Near Tampa, Florida, Phase 1--Development and Documentation of a Two-Dimensional Finite-Difference Model for Simulation of Steady-State Ground-Water Flow,
W82-01780 6A

GERHOLD, R.
Thermophillic and Thermotolerant Fungi Isolated from the Thermal Effluent of Nuclear Power Generating Reactors: Disposal of Human Opportunistic and Veterinary Pathogenic Fungi,
W82-01928 5B

GHILDYAL, B. P.
Effect of Soil Moisture Stress on Legume-Rhizobium Symbiosis in Soybeans,
W82-01846 2I

GIANQUINTA, A. R.
River Thermal Standards Costs in the Upper Midwest,
W82-01655 6B

GIAQUINTA, A. R.
Cooling Potential of Missouri River in Missouri,
W82-01654 5B

GILBERTSON, C. B.
Controlling Runoff for Livestock Feedlots; A State of the Art,
W82-01769 5G

GILLILAND, M. W.
The Lake Tahoe Basin: A Systems Analysis of Its Characteristics and Human Carrying Capacity,
W82-01807 6A

GITLIN, H. M.
Drip Irrigation Uniformity Considering Emitter Plugging,
W82-01860 3F

GLOVER, E. W. JR.
Role of the Geotechnical Consultant in Siting Suitable Areas for Hazardous Waste Disposal,
W82-01636 5E

GOGGINS, C.
Water Resources Appraisal for Hydroelectric Licensing; Potomac River Basin; Pennsylvania, Maryland, West Virginia, Virginia, and District of Columbia,
W82-01760 6D

GOLD, R. L.
Low-Flow Frequency and Flow Duration of Tennessee Streams,
W82-01779 2E

GOLDSCHMIDT, E. E.
Turnover of Tritiated Water in Calamondin Plants,
W82-02048 5A

GONZALES-VILLARREAL, F. J.
A Structural Systems Analysis Approach to Determine Optimum Operating Policies for Irrigation and Hydropower Generation for Water Resources, Systems,
W82-01680 6A

GONZALEZ, V. J. B.
A Limnological Investigation of a Tropical Fresh-Water Ecosystem: The Belize River, Belize, Central America,
W82-01682 5G

GOODE, S. R.
Characterization of an Enzymatic Determination of Arsenic(V) Based on Response Surface Methodology,
W82-01656 5A

GOPPERS, V. M.
Water Quality Study -- Southwest Minnesota Public Water Supplies,
W82-01795 2K

GOROBETS, L. V.
Effect of the Liming of Intensively Exploited Ponds on Phytoplankton Development,
W82-01923 2H

GOTTLIEB, L.
Development and Applications of a Runoff Model for Snowcovered and Glacierized Basins,
W82-01885 2C

GOULD, M. S.
A Water Quality Assessment of Development in the Senegal River Basin,
W82-01740 6G

GRABOW, W. O. K.
Comparison of Liquid-Liquid Extraction and Resin Adsorption for Concentrating Mutagens in Ames Salmonella/Microsome Assays on Water,
W82-01812 5A

GRANTZ, A.
Tectonic State: Its Significance and Characterization in the Assessment of Seismic Effects Associated with Reservoir Impounding,
W82-01951 8E

GRAY, N. F.
Simple Retention Time Analysis in Trickling Filters Using Conductivity,
W82-01876 5D

GREEN, A.
Variations in Trace Metal Content of the Mussel Choromytilus Meridionalis (Kr.) with Season and Sex,
W82-01969 5A

GREEN, M.
Step Fed Plug Flow Reactor for Biological Wastewater Treatment Versus Continuous Flow Stirred Tank Reactor (CFSTR),
W82-01618 5D

GREEN, R. E.
Simple In Situ Determination of Hydraulic Conductivity by Power Function Descriptions of Drainage,
W82-01666 2G

GREENBERG, M. R.
Planning with Great Uncertainty: A Review and Case Study of the Safe Drinking Water Controversy,
W82-01606 5A

GREESON, P. E.
Infectious Waterborne Diseases,
W82-01784 5A

GRIEVE, I. C.
The Use of Specific Conductance in Studies of Natural Waters and Soil Solutions,
W82-01646 7A

GRIFFIN, A. H.
An Economic and Institutional Assessment of the Water Problem Facing the Tucson Basin,
W82-01698 6B

GRISAK, G. E.
Scale-Dependent Dispersion in a Stratified Granular Aquifer,
W82-01986 2F

GROTERUD, O.
Discharge Measurements by a New-Formed Relative Salt-Dilution Method in Small Turbulent Streams,
W82-01891 7B

GRUSHKO, YA. M.
Toxicant Accumulation in Hydrobiont Tissues Following Effluent Discharge,
W82-01919 5C

GUNNER, H. B.
Ecological Characteristics of the Rhizosphere Microflora of Myriophyllum Heterophyllum,
W82-01796 4A

GUPTA, S. C.
Crop Residue Removal and Tillage; Effects on Soil Erosion and Nutrient Loss in the Corn Belt,
W82-01770 2J

HADALA, P. F.
Current Methods of Dynamic Analysis for Seismic Stability of Earth Dams,
W82-01953 8D

HAGERHALL, B.
International Cooperation to Protect the Baltic, W82-02087 6E

HAGLUND, P.
Control of Bark Landfill Leachates with an Anaerobic Treatment System, W82-02006 5D

HAINES, T. A.
Effect of an Aerial Application of Carbaryl on Brook Trout (Salvelinus Fontinalis), W82-01818 5C

HALL, D. K.
Analysis of the Origin of Water Which Forms Large Aufeis Fields on the Arctic Slope of Alaska Using Ground and Landsat Data, W82-01690 2C

HAMBLIN, A. P.
The Influence of Tillage on Soil Water Behavior, W82-02022 2G

HAMMOND, D. E.
Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure, W82-01838 2H

HANKS, R. J.
Corn and Alfalfa Production as Influenced by Limited Irrigation, W82-01945 3F

HANSEN, P.
Geologic and Hydrologic Implications of Hazardous Wastes Management Rules on Siting in North Carolina, W82-01630 5E

HARDY, J. W.
Impacts of Navigational Dredging on Fish and Wildlife: A Literature Review, W82-01768 6G

HARGREAVES, G. H.
Simplified Method for Rainfall Intensities, W82-01978 2B

Water Requirements and Man-Induced Climate Change, W82-01633 2D

HARLEMAN, D. R. F.
Hydraulic Modeling for Waste Stabilization Ponds, W82-01965 5D

HARRINGTON, W.
Stationary Source Pollution Policy and Choices for Reform, W82-01847 6E

HARRISON, P.
Wanted: Water for Development, W82-02088 6D

HASSAN, A. A.
Multi-Saline Sample Distillation Apparatus for Hydrogen Isotope Analyses: Design and Accuracy, W82-01789 3A

HAYDEN, T.
Simulation of Soil Water Within the Root Zone of a Corn Crop, W82-01834 2G

HEANEY, J. P.
Modeling Stormwater Storage/Treatment Transients: Applications, W82-01981 2E

Modeling Stormwater Storage/Treatment Transients: Theory, W82-01980 2A

HEATH, M.
Thermophillic and Thermotolerant Fungi Isolated from the Thermal Effluent of Nuclear Power Generating Reactors: Disposal of Human Opportunistic and Veterinary Pathogenic Fungi, W82-01928 5B

HEATH, R. T.
Aluminum Sulfate Treatment: Short-Term Effect on Complex Phosphorus Compounds in a Eutrophic Lake, W82-01833 5F

HEATON, T. H. E.
Excess Air in Groundwater, W82-02099 2F

HECKER, G. M.
Coherence Between Wind and Current Events in a Nearshore, Shallow Water, Wave Dominated Environment, W82-01674 2L

HEDGEPETH, J.
Rearing Pacific Salmon in Saltwater Ponds Fertilized with Domestic Wastewater, Data Report, June 1979 - May 1980, W82-01906 3C

HENDERSON-SELLERS, B.
Destratification and Reaeration as Tools for In-Lake Management, W82-01648 5G

HENNART, J. P.
Extension of the Integrodifferential Approach to Inhomogeneous Multiaquifer Systems, W82-02017 2F

HENNESSY, R. R.
Power Spectral Analysis of a Forcemain Failure Caused by Waterhammer, W82-01826 7B

HENNIG, H. F-K. O.
Variations in Trace Metal Content of the Mussel Choromytilus Meridionalis (Kr.) with Season and Sex, W82-01969 5A

HENRY, J. R.
Agricultural Conservation Program: An Evaluation, W82-02019 3F

HERBAUTS, J.
Direct Evidence of Water-Soluble Organic Matter Leaching in Brown Earths and Slightly Podzolized Soils, W82-02034 2G

HERGENRADER, G. L.
Eutrophication of the Salt Valley Reservoirs, 1968-73. I. The Effects of Eutrophication on Standing Crop and Composition of Phytoplankton, W82-01653 5C

Eutrophication of the Salt Valley Reservoirs 1968-73. III. The Macroinvertebrate Community: Its Development, Composition, and Change in Response to Eutrophication, W82-01797 5C

HERRERA, I.
Extension of the Integrodifferential Approach to Inhomogeneous Multiaquifer Systems, W82-02017 2F

HERRINGTON, P. R.
Charging Policies for Water Services, W82-01734 6C

HILEMAN, B.
Acid Precipitation, W82-01607 5C

HILNER, C. A.
Comparison of Liquid-Liquid Extraction and Resin Adsorption for Concentrating Mutagens in Ames Salmonella/Microsome Assays on Water, W82-01812 5A

HINDE, R. C.
Streamlined Regulations Could Help Make New Stormwater Management Concepts Part of the Tradition, W82-02000 4A

HINKINS, S. M.
Increased Toxicity of Ammonia to Rainbow Trout (Salmo Gairdneri) Resulting from Reduced Concentrations of Dissolved Oxygen, W82-01629 5C

HINRICHSEN, D.
Poland: Coming to Grips with Pollution, W82-02092 5G

HITES, R. A.
Organic Compounds Found Near Dump Sites in Niagara Falls, New York, W82-01802 5B

Oxidation of Phenolic Antioxidants in a River System, W82-01801 5B

HO, J.
Some Effects of Sewage Discharge Upon Phytoplankton in Hong Kong, W82-02095 5C

HO, KC.
Degree of Pollution of Several Major Streams Entering Tolo Harbour, Hong Kong, W82-02058 5B

HOBO, T.
Ion Flotation-Spectrophotometric Determination of Traces of Chromium (VI), W82-02007 5A

HODGKISS, I. J.
Stream Pollution in Hong Kong - An Appraisal, W82-02084 5B

HOLBECHE, J. D.
Isolation of the Mycobacterium Avium-M. Intracellulare-M. Scrofulaceum Complex from Tank Water in Queensland, Australia, W82-02069 5A

HOLMES, N. T. H.
Phytobenthos of the River Tees and Its Tributaries, W82-02065 2K

HOLT, R. F.
Crop Residue Removal and Tillage; Effects on Soil Erosion and Nutrient Loss in the Corn Belt, W82-01770 2J

HORVATH, G. L.
Penetration and Distribution of Tritiated Water in Soils of a Lysimeter, W82-01886 2G

HOUSE, M.
Water Quality Indices: An Additional Management Tool, W82-01994 5G

HOWARD, P. M.
Impressions of Soil and Water Conservation in China, W82-01730 4D

HOWARD-WILLIAMS, C.
Phosphorus Cycling in a Dense Potamogeton Pectinatus L. Bed, W82-02070 2H

HOY, N. D.
U.S. Geological Survey Reports on the Water Resources of Florida, 1886-1980, Second Edition, W82-01778 10C

HRUBOVACK, J. M.
Legal Challenge of the Ungaged Watershed,
W82-01664 2E

HUBER, W. C.
Modeling Stormwater Storage/Treatment Transients: Applications,
W82-01981 2E

Modeling Stormwater Storage/Treatment Transients: Theory,
W82-01980 2A

HUCKINS, J. N.
Fate of Kepone and Mirex in a Model Aquatic Environment: Sediment, Fish, and Diet,
W82-01820 5B

HUMPHRIES, C.
Recording Underground,
W82-02036 8A

HUNKINS, K.
Salt Dispersion in the Hudson Estuary,
W82-01615 2L

HUSSONG, D.
Numerical Taxonomy Analysis of Bacteria Isolated from the Completed 'Most Probable Numbers' Test for Coliform Bacilli,
W82-01911 5A

HUTCHINSON, C. B.
Hydrogeology of Well-Field Areas Near Tampa, Florida, Phase 1--Development and Documentation of a Two-Dimensional Finite-Difference Model for Simulation of Steady-State Ground-Water Flow,
W82-01780 6A

IL'CHENKO, N. I.
The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State,
W82-01924 2H

INKINA, G. A.
Use of Knopp's Method to Assess Self-Purification Processes in Water Bodies and Water Courses,
W82-02073 5B

INOUE, Y.
Measurement of Heavy Water Concentration with a Density Meter,
W82-02009 5A

ISAACSON, P. A.
Occult Hemoglobin as an Indicator of Impingement Stress in Fishes,
W82-01931 5C

ISAKOVA, YE. F.
Seasonal Variations in the Actual Fecundity of Daphnia Magna in a Laboratory Culture,
W82-02083 5C

IVAKHNENKO, A. G.
The Modeling of Aquatic Ecological Systems,
W82-01972 5B

JACKSON, T. J.
Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Taylor Creek, Fla., and Litle River, Ga., 1979 Data Report,
W82-01771 7B

Soil Moisture Updating and Microwave Remote Sensing for Hydrological Simulation,
W82-01611 2G

JACOBSON, J. S.
Acid Rain and Environmental Policy,
W82-01987 5B

JAMES, W.
Power Spectral Analysis of a Forcemain Failure Caused by Waterhammer,
W82-01826 7B

JAMIESON, A.
Oxygen Bleaching Shows Potential for Reducing Costs, Effluent Problems,
W82-01899 5D

JANA, P. K.
Effect of Soil-Moisture Tensions and Preceding Winter Crops on the Yield and Water-Use Efficiency of Succeeding Crop of Tossa Jute,
W82-02045 2I

JANISZEWSKI, M.
Water Resources Appraisal for Hydroelectric Licensing: Penobscot River Basin, Maine,
W82-01763 6D

JENKINS, J. J.
Terrain, Groundwater and Secondary Salinity in Victoria, Australia,
W82-02046 2F

JENNINGS, M.
Rearing Pacific Salmon in Saltwater Ponds Fertilized with Domestic Wastewater, Data Report, June 1979 - May 1980,
W82-01906 3C

JESSEN, S.
Regulation for Environmental Protection: The Nanticoke Industrial Complex, Ontario, Canada,
W82-02024 6E

JOB, S. V.
Seasonal and Diurnal Changes of Chlorophyll in a Tropical Fresh Water Impoundment,
W82-02052 2H

JOBLING, M.
Temperature Tolerance and the Final Preferendum - Rapid Methods for the Assessment of Optimum Growth Temperatures,
W82-01996 5C

JOHNSON, B. T.
Fate of Kepone and Mirex in a Model Aquatic Environment: Sediment, Fish, and Diet,
W82-01820 5B

JOHNSON, D. M.
Hydrogeology of Well-Field Areas Near Tampa, Florida, Phase 1--Development and Documentation of a Two-Dimensional Finite-Difference Model for Simulation of Steady-State Ground-Water Flow,
W82-01780 6A

JOHNSON, D. W.
The Natural Acidity of Some Unpolluted Waters in Southeastern Alaska and Potential Impacts of Acid Rain,
W82-01867 5B

JOHNSON, M. S.
Groundwater Levels in Nebraska 1980,
W82-01785 2F

JOHNSON, T. C.
Contourites in Lake Superior,
W82-01935 2H

JOHNSTON, S. A. JR.
Estuarine Dredge and Fill Activities: A Review of Impacts,
W82-01805 2L

JOLLY, V. H.
Limnology of Lake Rerewhakaaitu,
W82-01705 2H

JONES, J. G.
The Population Ecology of Iron Bacteria (Genus Ochrobium) in a Stratified Eutrophic Lake,
W82-01997 2H

JONES, J. R.
Fate of Kepone and Mirex in a Model Aquatic Environment: Sediment, Fish, and Diet,
W82-01820 5B

JORDAN, T. F.
Resonant Oscillation in Duluth-Superior Harbor,
W82-01837 2H

JORET, J. C.
Survival of Enteroviruses Adsorbed on Glass Microfibers During Postal Transport (Survie de Virus Enteriques Adsorbes sur Microfibre de Verre au Cours d'un Transport Postal),
W82-01637 5A

JOSEPHSON, J.
Protecting Virginia's Waterways,
W82-01608 5G

JUO, A. S. R.
Leaching of Fertilizer Ions in a Ultisol from the High Rainfall Tropics: Leaching Through Undisturbed Soil Columns,
W82-01721 2G

JURY, W. A.
A Proposal for Reclamation by Dilution of Irrigation Water,
W82-01943 3C

KAERGAARD, H.
Drawdowns at the Free Water Table During Pumping Tests in Artesian and Semiartesian Aquifers,
W82-01890 2F

KALFF, J.
Relationships Between Nannoplankton and Lake Trophic Status,
W82-01640 5C

KALMAR, D.
Shortening the Irrigation Interval as a Means of Saving Water in a Banana Plantation,
W82-02093 3F

KANNAN, V.
Seasonal and Diurnal Changes of Chlorophyll in a Tropical Fresh Water Impoundment,
W82-02052 2H

KAO, J-F.
Mathematical Modeling of Stream Water Quality by a New Moment Method: Field Investigation of a Tidal River,
W82-01995 7B

KASIDA, Y.
Measurement of Heavy Water Concentration with a Density Meter,
W82-02009 5A

KASSO, W. B.
A Survey of Trihalomethanes in the Drinking Water System of Murjreesboro, Tennessee,
W82-01817 5B

KAVVAS, M. L.
A Stochastic Cluster Model of Daily Rainfall Sequences,
W82-01651 2B

KEENE, K. M.
Measurement of Irrigated Acreage in Western Kansas from Landsat Images,
W82-01939 7B

KELLER, V. W.
Water-Ice and Water-Updraft Relationships Near -10 Degrees C Within Populations of Florida Cumuli,
W82-01968 2B

KELLER, W.
Flood Control on the Parana and Paraguay Rivers,
W82-01707 2E

KELLY, C. A.
The Contributions of Temperature and the Input of Organic Matter in Controlling Rates of Sediment Methanogenesis,
W82-01832 2H

KHARITONOVA, N. N.
Effect of the Liming of Intensively Exploited Ponds on Phytoplankton Development,
W82-01923 2H

KIBLER, D. F.
Legal Challenge of the Ungaged Watershed,
W82-01664 2E

KING, J. W.
The Dynamics of Anaerobic Phenol Biodegradation in Lower Greenland,
W82-02071 5B

KINNERSLEY, D.
Charging for Water Supply in England and Wales in the 1980s,
W82-01722 6C

KINNEY, W. C.
Land-Use Conflict in Wildland Watershed Management: A Multiple Objective Economic Analysis,
W82-01675 6A

KIRCHER, J. E.
Sediment Analyses for Selected Sites in the South Platte River in Colorado and Nebraska, and the North Platte and Platte Rivers in Nebraska--Suspended Sediment, Bedload, and Bed Material,
W82-01776 2J

KITE, G. W.
Recent Changes in Level of Lake Victoria,
W82-01711 4A

KITITSYNA, L. A.
Ecological and Physiological Characteristics of Dikerogammarus Haemobaphes in the Areas in Which Heated Water Is Discharged from the Tripol'ye Power Station,
W82-01970 5C

KLAPPER, H.
Experience with Lake and Reservoir Restoration Techniques in the German Democratic Republic,
W82-02054 2H

KLEINSTREUER, C.
Generalized Computer Simulation Model for the Impact Assessment of Industrial Water Use on Fish Populations,
W82-01915 5C

KLEPPER, R. P.
Technology and Performance of the Hi-Capacity Thickener,
W82-01929 5D

KNAEBEL, K. S.
Cycling Zone Adsorption Applied to Purification of Brackish Water with Thermally Regenerable Ion-Exchange Resins,
W82-01696 3A

KNIGHT, J. H.
Steady Periodic Flow Through a Rectangular Dam,
W82-01983 2F

KNOTT, J. M.
Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01792 7C

KOEHLER, J. H.
Addendum to: Sources of Powerplant Cooling Water in the Desert Area of Southern California--Reconnaissance Study,
W82-01773 6B

KONDO, K.
Extraction of Copper with Liquid Surfactant Membranes,
W82-01896 5D

KOVAL'CHUK, A. A.
Finds of Relict Infusoria in Kiev Reservoir,
W82-02079 2H

KOZHOVA, O. M.
Toxicant Accumulation in Hydrobiont Tissues Following Effluent Discharge,
W82-01919 5C

KRASOVSKY, G. N.
Water Sanitation Legislation Regarded as the Basis of Water Quality Monitoring,
W82-01990 6E

KRISHNAMOORTHI, K. P.
Parasite Egg and Cyst Reduction in Oxidation Ditches and Aerated Lagoons,
W82-01733 5D

KRUPNICK, A. J.
Stationary Source Pollution Policy and Choices for Reform,
W82-01847 6E

KRUSE, H.
Detection of Organophosphate Insecticide by an Immobilized-Enzyme System,
W82-02025 5A

KRYLOVA, E. V.
Grout Curtain in the Foundation of the Arch Dam of the Inguri Hydroelectric Station,
W82-01973 8A

KUDRYAVTSEV, V. M.
Abundance Dynamics of Microorganisms in the Decomposition of Macrophytes,
W82-01999 2H

KUKLA, G.
Summer Ice and Carbon Dioxide,
W82-01843 2C

KUMAR, A.
Note on the Role of Irrigation Frequencies on the Regrowth of Berseem,
W82-01745 2I

KUUSISTO, E.
On the Values and Variability of Degree-Day Melting Factor in Finland,
W82-01735 2C

KUZNETSOVA, M. A.
Estimation of the Production of Planktonic Infusorians in Connection with Fluctuations in Their Abundance,
W82-02072 2H

KWOK, TT.
Degree of Pollution of Several Major Streams Entering Tolo Harbour, Hong Kong,
W82-02058 5B

LABUTINA, T. M.
The Predicted Content of Organic and Biogenic Matter in the Water of Vilyuy Reservoir and the Extent to Which It Has Been Confirmed,
W82-02080 2H

LAFLEN, J. M.
Estimating Erosion and Sediment Yield on Field-Sized Areas,
W82-01849 2J

LAHAV, E.
Shortening the Irrigation Interval as a Means of Saving Water in a Banana Plantation,
W82-02093 3F

LAHL, U.
On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 5A

LAIRD, C. E.
The Effects of Chlorinated Sea Water on the Blue Crab, Callinectes Sapidus,
W82-01679 5C

LAM, C. W. Y.
Ecological Studies of Phytoplankton in the Waikato River and Its Catchment,
W82-01704 5C

LANE, A. G.
Production of Aromatic Acids During Anaerobic Digestion of Citrus Peel,
W82-02049 5D

LANE, L. J.
Estimating Erosion and Sediment Yield on Field-Sized Areas,
W82-01849 2J

LAPKINA, L. N.
The Use of Leeches to Identify Pesticides in Water,
W82-02075 5A

LARSON, W. E.
Crop Residue Removal and Tillage; Effects on Soil Erosion and Nutrient Loss in the Corn Belt,
W82-01770 2J

LASKOWSKI-HOKE, R. A.
Dredged Material Evaluations: Correlations Between Chemical and Biological Evaluation Procedures,
W82-01985 5C

LAW, R. J.
Hydrocarbon Concentrations in Water and Sediments from UK Marine Waters, Determined by Fluorescence Spectroscopy,
W82-02097 5B

LAYLA, R. I.
Numerical Analysis of Transient Salt/Fresh-Water Interface in Coastal Aquifers,
W82-01693 2F

LEACH, J. H.
Comparative Limnology of Inner Long Point Bay, Lake Erie, and Adjacent Waters of the Outer Bay,
W82-02005 5B

LEADBETTER, M. R.
Environmental Assessment of Industrial Discharges Based on Multiplicative Models,
W82-01808 5B

LEBEL, G. L.
A National Survey of Tri(Haloalkyl)-, Trialkyl-, and Triarylphosphates in Canadian Drinking Water,
W82-01989 5B

LECKIE, J. O.
Effect of Reagent Mixing Rate on Adsorption Process for Am-Fe2O3.H2O,
W82-01799 5F

LEE, G. F.
Persistence of 3-(Trifluoromethyl)-4-Nitrophenol in Aquatic Environments,
W82-01798 5B

LEENTVAAR, J.
Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 5G

LEGRAND, H. E.
Perspective on Management and Disposal of Hazardous Wastes,
W82-01635 5E

LEMLIN, J. S.
The Value of Ecological Monitoring in the Management of Petroleum Industry Effluent Discharges: Experience in Esso Petroleum Company U.K. Refineries,
W82-01913 5G

LEMON, D.
Nitrous Oxide in Freshwaters of the Great Lakes Basin,
W82-01841 2H

LEMON, E.
Nitrous Oxide in Freshwaters of the Great Lakes Basin,
W82-01841 2H

LENOVA, L. I.
Effect of Sodium Dodecylsulfate on Unicellular Green Algae of the Genus Chlorella,
W82-01920 5C

LEONI, V.
PCB and HCB in the Sediments and Waters of the Tiber Estuary,
W82-02057 2L

LESSIG, D. C.
Eutrophication of the Salt Valley Reservoirs 1968-73. III. The Macroinvertebrate Community: Its Development, Composition, and Change in Response to Eutrophication,
W82-01797 5C

LEVINGS, G. W.
Selected Drill-Stem-Test Data from the Northern Great Plains Area of Montana,
W82-01774 7C

Selected Hydrogeologic Data from the Northern Great Plains Area of Montana,
W82-01777 7C

LIEDY, R. B.
Investigation of Selective Uptake of Polychlorinated Biphenyls by Spartina Alterniflora Loisel,
W82-01813 5B

LINDSTROM, K. P.
Case Studies of Agricultural Water Conservation,
W82-01667 3F

LINDSTROM, M. J.
Crop Residue Removal and Tillage; Effects on Soil Erosion and Nutrient Loss in the Corn Belt,
W82-01770 2J

LINK, A. N.
Effluent Fees, An Alternative System for Achieving Water Quality: A Case Study,
W82-01665 6F

LISLE, I. G.
Properties of the Sorptivity for Exponential Diffusivity and Application to the Measurement of the Soil Water Diffusivity,
W82-01897 2G

LITVINOV, N. N.
Water Sanitation Legislation Regarded as the Basis of Water Quality Monitoring,
W82-01990 6E

LOGAN, B. E.
Generalized Computer Simulation Model for the Impact Assessment of Industrial Water Use on Fish Populations,
W82-01915 5C

LOPEZ-AVILA, V.
Oxidation of Phenolic Antioxidants in a River System,
W82-01801 5B

LORAH, W. L.
Food and Energy Production: Conjunctive Water Planning,
W82-01856 3C

LOUCKS, D. P.
A Multilevel Model and Algorithm for Some Multiobjective Problems,
W82-01884 6A

LOWE, D. R.
Diffusion of Sediment on the Lee of Dune-Like Bedforms: Theoretical and Numerical Analysis,
W82-01842 2J

LYLE, W. M.
Low Energy Precision Application (LEPA) Irrigation System,
W82-01859 3F

MACCUBBIN, A. E.
Petroleum Degradation by Naturally Occurring Populations of Marine Bacteria from Middle Atlantic Outer Continental Shelf Waters,
W82-01683 5G

MACKO, C. A.
The Removal of Organic Matter from Surface Water Supplies by Anion Exchange Resins,
W82-01697 5F

MACPHERSON, J. M.
Hydrology of Okarito Lagoon and the Inferred Effects of Selective Logging in Okarito Forest,
W82-01703 4C

MADES, D. M.
Stage-Discharge Relations at Dams on the Illinois and Des Plaines Rivers in Illinois,
W82-01793 4A

MAHADEVAN, A.
Aquatic Microbiology with Reference to Tannin Degradation,
W82-02028 5B

MAHAN, M. O.
Influence of Trickle and Sprinkle Irrigation on Golden Delicious Apple Quality,
W82-02001 3F

MAIOLO, J. R.
Relating Population Growth to Shellfish Bed Closures: A Case Study from North Carolina,
W82-01641 5C

MAITY, S. P.
Effect of Soil-Moisture Tensions and Preceding Winter Crops on the Yield and Water-Use Efficiency of Succeeding Crop of Tossa Jute,
W82-02045 2I

MAKONNEN, G. A.
Double and Monocropped Wheat and Grain Sorghum Under Different Tillage and Row Spacings,
W82-01862 2I

MALLORY, M. J.
Addendum to: Sources of Powerplant Cooling Water in the Desert Area of Southern California--Reconnaissance Study,
W82-01773 6B

MALONEY, L. M.
Abiotic Versus Biotic Uptake of Radiophosphorus in Lake Water,
W82-01824 2H

MAMONTOVA, L. M.
Toxicant Accumulation in Hydrobiont Tissues Following Effluent Discharge,
W82-01919 5C

MANDAL, L. N.
Effect of Different Water Salinity Levels and Organic Matter Application on the Composition of Water Soluble and Exchangeable Bases in a Brackishwater Fish Pond Soil,
W82-02027 2H

MANDELLI, E. F.
On the Presence of Fecal Steroids in Sediments from Two Mexican Harbors,
W82-02012 5A

MANTELL, A.
Turnover of Tritiated Water in Calamondin Plants,
W82-02048 5A

MARA, D. D.
A Selective Medium for the Enumeration of Streptococcus Bovis by Membrane Filtration,
W82-01620 5A

MARCHANT, R.
Effect of the Copper Content of Distillery Spent Wash on Its Utilization for Single-Cell Protein Production by Geotrichum Candidum, Hansenula Anomala and Candida Kruzei,
W82-01750 5C

MARCUS, M. D.
Periphytic Community Response to Chronic Nutrient Enrichment by a Reservoir Discharge,
W82-01658 5C

MARCUSON, W. F. III
Current Methods of Dynamic Analysis for Seismic Stability of Earth Dams,
W82-01953 8D

MARSH, D. G.
Reverse Phase Concentration of Trace Polycyclic Aromatic Hydrocarbons in Water,
W82-01689 5A

MARTINEC, J.
Limitations in Hydrological Interpretations of the Snow Coverage,
W82-01889 2C

MASCARENHAS, A. C.
Remote Sensing in Development,
W82-01719 7B

MATTHEWS, R. J.
Characterization of an Enzymatic Determination of Arsenic(V) Based on Response Surface Methodology,
W82-01656 5A

MATVIYENKO, A. M.
The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State,
W82-01924 2H

MCCALLUM, I. D.
Benthic Macroinvertebrates of Lake Taupo,
W82-01702 2H

MCCARTY, P. L.
Substrate Flux into Biofilms of Any Thickness,
W82-01964 5D

MCDOWELL, T. R.
Geographic Variations in Water Quality and Recreational Use Along the Upper Wallowa River and Selected Tributaries,
W82-01681 5A

MCDUFF, R. E.
The Geochemical Control of Seawater (Sillen Revisited),
W82-01936 2K

MCFARLANE, G. A.
An Analysis of the Aquatic Macrophyte, Myriophyllum Exalbescens, as an Indicator of Metal Contamination of Aquatic Ecosystems near a Base Metal Smelter,
W82-02016 5A

MCKAY, G.
Kinetics and Diffusion Processes in Colour Removal from Effluent Using Wood as an Adsorbent,
W82-02047 5D

MCKEE, P.
Water Resources Appraisals for Hydroelectric Licensing; Lower Red River Basin; Arkansas, Louisiana, Oklahoma and Texas,
W82-01754 6D

MCKELLAR, H. N. JR.
A Sensitivity Analysis of an Ecosystem Model of Estuarine Carbon Flow,
W82-01875 2L

MCLEAN, R. A. N.
Removal of Elemental Mercury from Wastewaters Using Polysulfides,
W82-01800 5D

MCMAHON, T. A.
Log Pearson III Distribution - An Empirically-Derived Plotting Position,
W82-01650 2E

Log Pearson III Distribution - Effect of Dependence, Distribution Parameters and Sample Size on Peak Annual Flood Estimates,
W82-01649 2E

Log Pearson III Distribution - Is It Applicable to Flood Frequency Analysis of Australian Streams,
W82-01731 2E

MEDINA, M. A. JR.
Modeling Stormwater Storage/Treatment Transients: Applications,
W82-01981 2E

Modeling Stormwater Storage/Treatment Transients: Theory,
W82-01980 2A

MEIER, R.
Simulation of the Topographic Influence on SLAR Data for Soil Moisture Detection in a Hilly Area,
W82-01605 2G

MELVIN, W. W.
Acute Toxicity of an In Situ Shale Oil Process Wastewater and It's Major Components to Daphnia Magna,
W82-01811 5C

MENSAH, E. K.
The Management of Water Resources: A Synthesis of Goal Programming and Input-Output Analysis with Application to the Iowa Economy,
W82-01685 6A

MESHCHERYAKOVA, R. I.
The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State,
W82-01924 2H

MEYER, E. R.
Industrial Waste Dumping at Deepwater Sites in the Gulf of Mexico,
W82-01903 5E

MEYER, K. F.
Groundwater Discharge Through Springs with Well-Defined Outlets--A Case Study from Jeloya-Moss, S. Norway,
W82-01748 2F

MEYERS, P. A.
Southern Lake Michigan Sediments: Changes in Accumulation Rate, Mineralogy, and Organic Content,
W82-01958 2J

MEZEIX, J. F.
Various Kinetic Energy Characteristics of Hail-patterns in the Grossversuch IV Experiment,
W82-01732 2B

MIDDLEBROOKS, E. J.
The Flowering of Wastewater Treatment,
W82-02015 5D

MIETTINEN, J. K.
Penetration and Distribution of Tritiated Water in Soils of a Lysimeter,
W82-01886 2G

MILLER, D. G. JR.
Geologic Aspects of Waste Disposal Site Evaluations,
W82-02011 5E

MILLER, S.
Drinking Water and Its Treatment: An Interview with Professor Sontheimer,
W82-01728 5F

MILLER, T. S.
Surficial Geology of Dugway Quadrangle, Oswego County, New York,
W82-01775 7C

MISTRY, P. D.
Effect of Periods of Moisture Availability on Groundnut Crop in the Saurashtra Region of Gujarat,
W82-01708 2G

MITCHELL, P. D.
Control of Peach Tree Growth and Productivity by Regulated Water Supply, Tree Density, and Summer Pruning,
W82-01883 2I

MITCHELL, S. F.
Phytoplankton Photosynthesis and Its Relation to Standing Crop and Nutrients in Two Warm-Monomictic South Island Lakes,
W82-01700 2H

MOLOF, A. H.
A Comprehensive Methodology for Project Appraisal and Environmental Protection in Multinational River Basin Development,
W82-01914 6B

MONDADA, G.
Flood Control on the Parana and Paraguay Rivers,
W82-01707 2E

MONSELISE, S. P.
Turnover of Tritiated Water in Calamondin Plants,
W82-02048 5A

MOODY, J. L.
Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 2H

MOOK, W. G.
Field Observations of the Isotopic Composition of Particulate Organic Carbon in the Southern North Sea and Adjacent Estuaries,
W82-01714 2J

MOREL, F. M. M.
The Geochemical Control of Seawater (Sillen Revisited),
W82-01936 2K

MOREL-SEYTOUX, H. J.
An Integral Transform Method for the Linearized Boussinesq Groundwater Flow Equation,
W82-01984 2F

MORGAN, J. J.
Kinetics for the Aquatic Environment,
W82-01631 2K

Kinetics for the Aquatic Environment,
W82-01806 2K

MORGAN, M. D.
Abundance, Life History, and Growth of Introduced Populations of the Opossum Shrimp (Mysis Relicta) in Subalpine California Lakes,
W82-01638 2H

MORGAN, S. L.
Characterization of an Enzymatic Determination of Arsenic(V) Based on Response Surface Methodology,
W82-01656 5A

MORRIS, W. T.
Perseverance Produces County Park,
W82-01932 6D

MORRISSON, N. J. III.
Occult Hemoglobin as an Indicator of Impingement Stress in Fishes,
W82-01931 5C

MOSELHY, M. M.
Simultaneous Determination of Trace Metals in Sewage and Sewage Effluents by Inductively Coupled Argon Plasma Atomic Emission Spectrometry,
W82-01828 5A

MOTT, T. D.
Flow Calculations for Household Effluent Disposal in Elevated Sand Mounds,
W82-01660 5E

MOUAT, D. A.
The Use of Remote Sensing for an Integrated Inventory of a Semi-Arid Area,
W82-01910 7B

MROZED JR, E.
Investigation of Selective Uptake of Polychlorinated Biphenyls by Spartina Alterniflora Loisel,
W82-01813 5B

MUMALLAH, N. A.
Precipitate Flotation Studies with Monolauryl Phosphate and Monolauryldithiocarbamate,
W82-01863 5D

MUMALLAH, N. A. K.
Water Purification Studies with Activated Carbon and Foam Flotation,
W82-01692 5D

MUTHUKUMAR, G.
Aquatic Microbiology with Reference to Tannin Degradation,
W82-02028 5B

MYHRSTAD, J. A.
Groundwater Chemistry of Some Selected Areas in Southeaster Norway,
W82-02020 2K

NAEF, F.
Can We Model the Rainfall-Runoff Process Today,
W82-01609 2A

NAIR, G. B.
Distribution of Vibrio Parahaemolyticus in Finfish Harvested from Porto Novo (S. India) Environs: A Seasonal Study,
W82-01737 5A

NAKASHIO, F.
Extraction of Copper with Liquid Surfactant Membranes,
W82-01896 5D

NATARAJAN, R.
Distribution of Vibrio Parahaemolyticus in Finfish Harvested from Porto Novo (S. India) Environs: A Seasonal Study,
W82-01737 5A

NEBRAT, A. A.
Planktonic Infusoria of Kiev and Kremenchug Reservoirs,
W82-02082 2H

NELSON, J. G.
Regulation for Environmental Protection: The Nanticoke Industrial Complex, Ontario, Canada,
W82-02024 6E

NICKS, A. D.
Soil Moisture Updating and Microwave Remote Sensing for Hydrological Simulation,
W82-01611 2G

NOWLIN, J. D.
Estimating Erosion and Sediment Yield on Field-Sized Areas,
W82-01849 2J

NURNBERG, H. W.
Voltammetric Studies on the Stability of the ZN(II) Chelates with NTA and EDTA and the Kinetics of their Formation in Lake Ontario Water,
W82-01839 2H

NWA, E. U.
Using the Bamboo (Bambusa Vulgaris) as Field Drainage Material,
W82-01743 4A

NYBORG, M.
Deposition of Sulphur Gases from Multiple Scattered Sources in Alberta,
W82-01868 5B

NYE, J. C.
Controlling Runoff for Livestock Feedlots; A State of the Art,
W82-01769 5G

O'NEILL, P.
Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Taylor Creek, Fla., and Litle River, Ga., 1979 Data Report,
W82-01771 7B

O'NEILL, W. B.
Pollution Permits and Markets for Water Quality,
W82-01699 6A

OFFICER, C. B.
A Perspective on Estuarine and Coastal Research Funding,
W82-01803 9A

OKSIYUK, O. P.
Biological Pollution and Pollution Control in Canals Diverting Flow from One River Basin to Another,
W82-01922 5C

Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 5B

OLEYNIK, G. N.
Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 5B

OLIVIER, R. J.
Evaluation of a Precipitation Map Using a Smoothed Elevation-Precipitation Relationship and Optimal Estimates (Kriging),
W82-01892 2B

OMORINBOLA, E. O.
Components of Saturated Zone Thickness in a Nigerian Basement Complex Regolith,
W82-01710 2F

ONISHI, Y.
Sediment-Contaminant Transport Model,
W82-01614 5B

ONSTAD, C. A.
Crop Residue Removal and Tillage; Effects on Soil Erosion and Nutrient Loss in the Corn Belt,
W82-01770 2J

ORAGUI, J. I.
A Selective Medium for the Enumeration of Streptococcus Bovis by Membrane Filtration,
W82-01620 5A

ORCUTT, J. D. JR.
The Relative Importance of Protozoans, Rotifers, and Crustaceans in a Freshwater Zooplankton Community,
W82-01840 2H

ORDAZ, C.
Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
W82-01835 5A

OREMLAND, R. S.
Denitrification Associated With Periphyton Communities,
W82-01814 5B

ORREN, M. J.
Variations in Trace Metal Content of the Mussel Choromytilus Meridionalis (Kr.) with Season and Sex,
W82-01969 5A

OUTEN, R. B.
The National Commission on Water Quality: A Case Study in Congressional Policy Analysis,
W82-01669 6B

PACE, M. L.
The Relative Importance of Protozoans, Rotifers, and Crustaceans in a Freshwater Zooplankton Community,
W82-01840 2H

PAGE, G. W.
Planning with Great Uncertainty: A Review and Case Study of the Safe Drinking Water Controversy,
W82-01606 5A

PAGE, G. W. III.
Toxic Substances in Water: Patterns of Contamination and Policy Implications,
W82-01695 5A

PAGE, H. R. S.
Developments in Instrumentation and Automation in Sewage Treatment,
W82-02043 5D

PALOMEQUE, B.
Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
W82-01835 5A

PANDOZZI, J.
Rearing Pacific Salmon in Saltwater Ponds Fertilized with Domestic Wastewater, Data Report, June 1979 - May 1980,
W82-01906 3C

PANICKER, P. V. R. C.
Parasite Egg and Cyst Reduction in Oxidation Ditches and Aerated Lagoons,
W82-01733 5D

PANKOW, J. F.
Kinetics for the Aquatic Environment,
W82-01631 2K

PANKOW, J. R.
Kinetics for the Aquatic Environment,
W82-01806 2K

PARKER, J. G.
Effects of Pollution Upon the Benthos of Belfast Lough,
W82-02059 5C

PARKIN, T. B.
The Role of Phototrophic Bacteria in the Sulfur Cycle of a Meromictic Lake,
W82-01831 2H

PARLANGE, J. Y.
Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 2A

Properties of the Sorptivity for Exponential Diffusivity and Application to the Measurement of the Soil Water Diffusivity,
W82-01897 2G

PATEL, K. R.
Effect of Periods of Moisture Availability on Groundnut Crop in the Saurashtra Region of Gujarat,
W82-01708 2G

PATRICK, P. H.
Zooplankton Species Diversity in Lake St. Clair, Ontario, Canada,
W82-01937 5C

PATRICK, W. H. JR.
Nitrate Reduction to Ammonium and Organic Nitrogen in an Estuarine Sediment,
W82-01625 5B

Nitrous Oxide Emission from Simulated Overland Flow Wastewater Treatment Systems,
W82-01624 5D

PAUL, C. K.
Remote Sensing in Development,
W82-01719 7B

PAWLIKOWSKI, W.
Water Resources Appraisals for Hydroelectric Licensing; Grand River Basin, Michigan,
W82-01759 6D

PEDERSEN, D.
Methanogenesis in Freshwater Sediments: Inherent Variability and Effects of Environmental Contaminants,
W82-01825 5C

PEDERSON, D. T.
Groundwater Levels in Nebraska 1980,
W82-01785 2F

PENG, T-H.
Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 2H

PETERSEN, G. W.
Flow Calculations for Household Effluent Disposal in Elevated Sand Mounds,
W82-01660 5E

PHILLIPS, G. R.
Increased Toxicity of Ammonia to Rainbow Trout (Salmo Gairdneri) Resulting from Reduced Concentrations of Dissolved Oxygen,
W82-01629 5C

PHILLIPS, R. E.
Simulation of Soil Water Within the Root Zone of a Corn Crop,
W82-01834 2G

PIALY, P. P.
Mixing Zone Analysis for River Plumes,
W82-01961 5B

PICKENS, J. F.
Scale-Dependent Dispersion in a Stratified Granular Aquifer,
W82-01986 2F

PLAUMANN, K. W.
Water Reuse: Ultrafiltration of Industrial and Municipal Wastewaters,
W82-01652 5D

PLEYSIER, J. L.
Leaching of Fertilizer Ions in a Ultisol from the High Rainfall Tropics: Leaching Through Undisturbed Soil Columns,
W82-01721 2G

POOLE, G. J.
Furrow Advance Rates Under Surge Flow Systems,
W82-01612 3F

POOTS, V. J. P.
Kinetics and Diffusion Processes in Colour Removal from Effluent Using Wood as an Adsorbent,
W82-02047 5D

POTAPOVA, N. A.
Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 5B

POTGIETER, H. J.
Composition of Fruit and Vegetable Processing Wastes,
W82-01601 5D

POWERS, W. F.
Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 2H

PRAKASH, A.
Statistical Determination of Design Low Flows,
W82-01858 2E

PRATER, B. L.
Dredged Material Evaluations: Correlations Between Chemical and Biological Evaluation Procedures,
W82-01985 5C

PRIOR, B. A.
Composition of Fruit and Vegetable Processing Wastes,
W82-01601 5D

PROCTOR, B. L.
Organic Compounds Found Near Dump Sites in Niagara Falls, New York,
W82-01802 5B

PROEBSTING, E. L. JR.
Influence of Trickle and Sprinkle Irrigation on Golden Delicious Apple Quality,
W82-02001 3F

PUCCETTI, G.
PCB and HCB in the Sediments and Waters of the Tiber Estuary,
W82-02057 2L

PUGH, C. A.
Intakes and Outlets for Low-Head Hydropower,
W82-01979 8C

QUINN, J. P.
Effect of the Copper Content of Distillery Spent Wash on Its Utilization for Single-Cell Protein Production by Geotrichum Candidum, Hansenula Anomala and Candida Kruzei,
W82-01750 5C

RADCLIFFE, D.
Simulation of Soil Water Within the Root Zone of a Corn Crop,
W82-01834 2G

RADFORD, P. J.
Seasonal and Spring-Neap Tidal Dependence of Axial Dispersion Coefficients in the Severn - A Wide, Vertically Mixed Estuary,
W82-01749 2L

RAHI, G. S.
Effect of Bulk Density on Calibration of Neutron Moisture Probe for Organic Soils,
W82-01861 2G

RAI, S. D.
Note on the Role of Irrigation Frequencies on the Regrowth of Berseem,
W82-01745 2I

RAJPUT, R. K.
Effect of Irrigation Practices and Methods of Sowing-Cum-Irrigation on the Performance of Safflower,
W82-01878 3F

RAM, V.
Water Use, Yield and Quality of Rapeseed as Influenced by Spacing, Irrigation and Time of Harvest When Raised in a Multiple-Cropping System,
W82-02031 3F

RAO, D. B.
A Method of Objective Analysis for Currents in a Lake with Application to Lake Ontario,
W82-01616 2H

RASHID, H. A-H.
Optimization of Water Resources for Irrigation in East Jordan,
W82-01742 6A

RASPOR, B.
Voltammetric Studies on the Stability of the ZN(II) Chelates with NTA and EDTA and the Kinetics of their Formation in Lake Ontario Water,
W82-01839 2H

RATHBUN, P. A.
Public Opinion and Interest Group Positions on Chesapeake Bay Issues: Implications for Resource Management,
W82-01642 6B

RATHFELDER, E. L.
The Effect of Different Water Regimes on Plant Growth and Nodule Structure of Greenhouse-Grown Winged Bean (Psophocarpus Tetragonolobus),
W82-01723 2I

RATHORE, T. R.
Effect of Soil Moisture Stress on Legume-Rhizobium Symbiosis in Soybeans,
W82-01846 2I

RATUSHNAYA, M. YA.
Effect of Sodium Dodecylsulfate on Unicellular Green Algae of the Genus Chlorella,
W82-01920 5C

RAUCHER, R. L.
Regulating the Quality of Drinking Water: An Economic Analysis of the Safe Drinking Water Act of 1974,
W82-01691 5G

REA, D. K.
Southern Lake Michigan Sediments: Changes in Accumulation Rate, Mineralogy, and Organic Content,
W82-01958 2J

REDDY, J. M.
Optimal Design of Border Irrigation Systems,
W82-01977 3F

REED, S. C.
The Flowering of Wastewater Treatment,
W82-02015 5D

REES, J. F.
The Dynamics of Anaerobic Phenol Biodegradation in Lower Greenland,
W82-02071 5B

REID, I. A.
Glacier Surveys in Alberta - 1979,
W82-01855 2C

REMENYAK, M. B.
Grout Curtain in the Foundation of the Arch Dam of the Inguri Hydroelectric Station,
W82-01973 8A

REMFRY, J. E.
Centrifugal Dewatering,
W82-01912 5E

RETTA, A.
Corn and Alfalfa Production as Influenced by Limited Irrigation,
W82-01945 3F

RHO, J.
Ecological Characteristics of the Rhizosphere Microflora of Myriophyllum Heterophyllum,
W82-01796 4A

RIBENY, F. M. J.
A Mathematical Model of the Hydrologic Regime of the Upper Nile Basin,
W82-01857 2A

RIDKER, R. G.
Long-Run Effects of Environmental Regulation,
W82-01848 6A

RIGGINS, R. E.
R-Factors for Soil Loss Impact Prediction,
W82-01963 2J

RIHA, S. J.
Simulation of Water and Nitrogen Movement and Nitrogen Transformations in Forest Soils,
W82-01668 2G

RIPPON, J. W.
Thermophillic and Thermotolerant Fungi Isolated from the Thermal Effluent of Nuclear Power Generating Reactors: Disposal of Human Opportunistic and Veterinary Pathogenic Fungi,
W82-01928 5B

RITTER, J. R.
Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01792 7C

RITTMANN, B. E.
Substrate Flux into Biofilms of Any Thickness,
W82-01964 5D

RJANZHIN, S. V.
Investigation of Turbulence and Langmuir Circulation in Lake Ladoga,
W82-02100 2H

ROBERTSON, B. R.
Dissolved Hydrocarbons and Related Microflora in a Fjordal Seaport: Sources, Sinks, Concentrations, and Kinetics,
W82-01816 5B

ROBINSON, A. R.
Erosion and Sediment Control in China's Yellow River Basin,
W82-01729 4D

ROMANENKO, V. D.
Dynamics of Carp Growth and Biosynthetic Processes in the Liver of the Carp Reared in Containers in Heated Waste Water from Themal Power Stations,
W82-01998 5C

ROSALES, M. T. L.
On the Presence of Fecal Steroids in Sediments from Two Mexican Harbors,
W82-02012 5A

ROSE, B.
Managing Water at Helicopter Plant,
W82-01974 5D

ROSE, C. W.
Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 2A

ROSSMANN, R.
Inorganic Chemistry of Particulate Matter from the Nearshore Zone of Lake Michigan,
W82-01959 2H

ROWLEY, C. K.
Economic Instruments for Controlling Effluent Discharges to the River Tees Estuary,
W82-02060 2L

RUDD, J. W.
Mercury Methylation by Fish Intestinal Contents,
W82-01830 5C

RUFF, J. F.
Evaluating Scour at Culvert Outlets,
W82-01934 4D

RUNNELLS, D. D.
Composition of Leachage from Surface-Retorted and Unretorted Colorado Oil Shale,
W82-01810 5B

RUNNING, S. W.
Environmental and Physiological Control of Water Flux Through Pinus Contorta,
W82-01827 2D

RUSHTON, K. R.
Operating Policies for a Surface/Ground Water System,
W82-01741 4B

RUSSELL, R. B.
Learning from the Skipton Flood,
W82-02063 2E

RUSSO, D.
Effect of Field Variability in Soil Hydraulic Properties on Solutions of Unsaturated Water and Salt Flows,
W82-01898 2G

RUSSO, R. C.
Increased Toxicity of Ammonia to Rainbow Trout (Salmo Gairdneri) Resulting from Reduced Concentrations of Dissolved Oxygen,
W82-01629 5C

RYDIN, S.
Control of Bark Landfill Leachates with an Anaerobic Treatment System,
W82-02006 5D

RYDZEWSKI, J. R.
Optimization of Water Resources for Irrigation in East Jordan,
W82-01742 6A

RYTHER, J. H.
A Perspective on Estuarine and Coastal Research Funding,
W82-01803 9A

RZOSKA, J.
Environmental Studies: Their Implications and the Special Case of Egypt,
W82-02062 6G

SACHAN, R. S.
Effect of Soil Moisture Stress on Legume-Rhizobium Symbiosis in Soybeans,
W82-01846 2I

SALOMONS, W.
Field Observations of the Isotopic Composition of Particulate Organic Carbon in the Southern North Sea and Adjacent Estuaries,
W82-01714 2J

SANDER, G.
Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 2A

SAVAGE, J. C.
Tectonic State: Its Significance and Characterization in the Assessment of Seismic Effects Associated with Reservoir Impounding,
W82-01951 8E

SAVVINA, O. V.
The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State,
W82-01924 2H

SAWAR, S.
Water Resources Appraisal for Hydroelectric Licensing; Menominee River Basin; Michigan, Wisconsin,
W82-01753 6D

SAX, R. I.
Water-Ice and Water-Updraft Relationships Near -10 Degrees C Within Populations of Florida Cumuli,
W82-01968 2B

SAYLER, G. S.
Methanogenesis in Freshwater Sediments: Inherent Variability and Effects of Environmental Contaminants,
W82-01825 5C

SAYRE, W. G.
Selenium: A Water Pollutant from Flue Gas Desulfurization,
W82-01960 5B

SCAVIA, D.
Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 2H

SCHALEKAMP, M.
Water Pollution: A Risk to the Future in the Case of the Rhine (Eaux Polluees' Avenir en Danger Dans le Cas du Rhin),
W82-02067 5G

SCHMUGGE, T. J.
Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Taylor Creek, Fla., and Litle River, Ga., 1979 Data Report,
W82-01771 7B

Soil Moisture Updating and Microwave Remote Sensing for Hydrological Simulation,
W82-01611 2G

SCHOFIELD, C. L.
Effect of Aluminum Speciation on Fish in Dilute Acidified Waters,
W82-01663 5C

SCHREIER, H.
Variations and Mechanisms of Asbestos Fibre Distribution in Stream Water,
W82-01853 5A

SCHROEDER, S. H.
Pollution Control: Changing Approaches,
W82-01870 6E

SCHWAB, D. J.
A Method of Objective Analysis for Currents in a Lake with Application to Lake Ontario,
W82-01616 2H

SCHWARZENBACH, R. P.
Transport of Nonpolar Organic Compounds from Surface Water to Groundwater. Laboratory Sorption Studies,
W82-01873 5B

SCOTT, F. A.
Effluent Fees, An Alternative System for Achieving Water Quality: A Case Study,
W82-01665 6F

SELBY, K.
Waste Disposal--Choosing and Licensing Site,
W82-02035 5G

SEN, H.
Effect of Soil-Moisture Tensions and Preceding Winter Crops on the Yield and Water-Use Efficiency of Succeeding Crop of Tossa Jute,
W82-02045 2I

SHAPIRO, H. M.
Simulating Effects of Combined Sewer Overflows,
W82-01864 6A

SHARMA, B. M.
Effect of Irrigation Practices and Methods of Sowing-Cum-Irrigation on the Performance of Safflower,
W82-01878 3F

SHARMA, H. C.
Effect of Profile Soil Moisture and Phosphorus Levels on the Growth and Yield of Anonutrient Uptake by Chickpea,
W82-02042 2I

SHAVER, T. N.
Environmental Fate of Methyl Eugenol,
W82-02013 5B

SHAW, T. L.
Acute Toxicity of Increased pH to Freshwater Shrimp Paratya Curvirostris,
W82-01645 5C

SHCHUR, L. A.
Phytoplankton Distribution in the Southern and Middle Parts of Lake Baikal,
W82-02078 2H

SHELEF, G.
Step Fed Plug Flow Reactor for Biological Wastewater Treatment Versus Continuous Flow Stirred Tank Reactor (CFSTR),
W82-01618 5D

SHERRARD, J. H.
Activated Sludge Nickel Toxicity Studies,
W82-01895 5D

SHERTON, C. C.
Preserving Instream Flows in Oregon's Rivers and Streams,
W82-01871 6E

SHIH, S. F.
Effect of Bulk Density on Calibration of Neutron Moisture Probe for Organic Soils,
W82-01861 2G

Upland Marsh for Water Quality Control,
W82-01962 5B

SHIKLOMANOV, I. A.
The Effects of Man on Basin Runoff, and on the Water Balance and Water Stage of the Caspian Sea,
W82-01709 4C

SHIROKOV, V. A.
Methods of Studying Invertebrate Drift in Rivers,
W82-02074 7A

SHMAKOV, V. M.
Hydrologic and Anthropogenic Factors Affecting Water Quality in the Rivers of the Ukrainian Carpathians,
W82-02076 5B

SHUSTOV, YU. A.
Methods of Studying Invertebrate Drift in Rivers,
W82-02074 7A

SIBONY, J.
Disinfection of Drinking Water in Developing Countries,
W82-02091 5F

SID'KO, F. YA.
Phytoplankton Distribution in the Southern and Middle Parts of Lake Baikal,
W82-02078 2H

SIMARD, R. G.
Evaluation of a Precipitation Map Using a Smoothed Elevation-Precipitation Relationship and Optimal Estimates (Kriging),
W82-01892 2B

SIMMONS, J. D.
U.S. Geological Survey Reports on the Water Resources of Florida, 1886-1980, Second Edition,
W82-01778 10C

SIMONS, D. B.
Hydraulic Testing of Plastic Filter Fabrics,
W82-01613 8G

SINAI, G.
A Proposal for Reclamation by Dilution of Irrigation Water,
W82-01943 3C

SINCLAIR, M.
Phytoplankton Distributions Observed During a 3 1/2 Days Fixed-Station in the Lower St. Lawrence Estuary,
W82-01938 2L

SINGER, R. D.
Water Quality Study -- Southwest Minnesota Public Water Supplies,
W82-01795 2K

SINGH, S.
Effect of Profile Soil Moisture and Phosphorus Levels on the Growth and Yield of Anonutrient Uptake by Chickpea,
W82-02042 2I

SINGH, S. N.
Effect of Irrigation Practices and Methods of Sowing-Cum-Irrigation on the Performance of Safflower,
W82-01878 3F

SINGHAL, A. E.
Tying Up TCE,
W82-01866 5G

SINHA, D. S.
The Chambal Project: Problems and Solutions,
W82-01739 4A

SKAAR, D. R.
Fate of Kepone and Mirex in a Model Aquatic Environment: Sediment, Fish, and Diet,
W82-01820 5B

SLACK, R.
Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Taylor Creek, Fla., and Litle River, Ga., 1979 Data Report,
W82-01771 7B

SLAVENS, D. R.
Abiotic Versus Biotic Uptake of Radiophosphorus in Lake Water,
W82-01824 2H

SMIRNOVA, N. N.
Ecological and Physiological Features of the Root System of Inshore Hydrophytes,
W82-01715 5B

SMITH, C. J.
Nitrous Oxide Emission from Simulated Overland Flow Wastewater Treatment Systems,
W82-01624 5D

SMITH, F. B.
The Significance of Wet and Dry Synoptic Regions on Long-Range Transport of Pollution and Its Deposition,
W82-01877 5B

SMITH, R. J.
Acid Rain Agreement,
W82-01933 5B

SMOLEN, M. D.
Nutrient Runoff from Agricultural and Non-Agricultural Watersheds,
W82-01662 5B

SOKOL'SKIY, A. F.
Effect of Fertilizers on the Primary and Bacterial Production of Rearing Ponds in the Volga Delta,
W82-02077 2H

SONG, C. C. S.
Hydraulic Geometry and Minimum Rate of Energy Dissipation,
W82-01918 2J

SONNEN, M. B.
Case Studies of Agricultural Water Conservation,
W82-01667 3F

SOROOSHIAN, S.
Parameter Estimation of Rainfall-Runoff Models with Heteroscedastic Streamflow Errors--The Noninformative Data Case,
W82-01657 2A

SPIRA, W. M.
Gauze Filtration and Enrichment Procedures for Recovery of Vibrio Cholerae From Contaminated Waters,
W82-01815 5A

SPOSITO, G.
The Statistical Mechanical Theory of Groundwater Flow,
W82-01982 2F

SRIKANTHAN, R.
Log Pearson III Distribution - An Empirically-Derived Plotting Position,
W82-01650 2E

Log Pearson III Distribution - Effect of Dependence, Distribution Parameters and Sample Size on Peak Annual Flood Estimates,
W82-01649 2E

Log Pearson III Distribution - Is It Applicable to Flood Frequency Analysis of Australian Streams,
W82-01731 2E

STACHEL, B.
On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 5A

STANLEY, C. W.
Matacil Residue Determination in Foliage, Fish, Soil and Water,
W82-01621 5A

STANNERS, D. A.
Americium in Intertidal Sediments from the Coastal Environs of Windscale,
W82-02098 5B

STAVSKAYA, S. S.
Effect of Sodium Dodecylsulfate on Unicellular Green Algae of the Genus Chlorella,
W82-01920 5C

STOL'BERG, F. B.
Biological Pollution and Pollution Control in Canals Diverting Flow from One River Basin to Another,
W82-01922 5C

STOLLENWERK, K. G.
Composition of Leachage from Surface-Retorted and Unretorted Colorado Oil Shale,
W82-01810 5B

STOLZY, L. H.
A Proposal for Reclamation by Dilution of Irrigation Water,
W82-01943 3C

STORTZ, K. R.
Resonant Oscillation in Duluth-Superior Harbor,
W82-01837 2H

STRATHMANN, H.
Selective Removal of Heavy Metal Ions from Aqueous Solutions by Diafiltration of Macromolecular Complexes,
W82-01900 5D

STRAUB, C. P.
Water Quality Study -- Southwest Minnesota Public Water Supplies,
W82-01795 2K

STRELKOFF, T.
Development of Solutions for Level-Basin Design,
W82-01976 3F

STUDNICKI, M.
Determination of Germanium, Vanadium, and Titanium by Carbon Furnace Atomic Absorption Spectrometry,
W82-01836 5A

SUCHER, J.
Rapid, Quantitative Separation of Chlorophylls and Their Degradation Products by High-Performance Liquid Chromatography,
W82-01619 5A

SUJARITTANONTA, S.
Activated Sludge Nickel Toxicity Studies,
W82-01895 5D

SUMMERS, J. K.
A Sensitivity Analysis of an Ecosystem Model of Estuarine Carbon Flow,
W82-01875 2L

SUZUKI, S.
Ion Flotation-Spectrophotometric Determination of Traces of Chromium (VI),
W82-02007 5A

SWANK, W. T.
Long Term Responses of Streamflow Following Clearcutting and Regrowth,
W82-01610 4C

SWANSON, N. P.
Controlling Runoff for Livestock Feedlots; A State of the Art,
W82-01769 5G

SWIFT, L. W. JR.
Long Term Responses of Streamflow Following Clearcutting and Regrowth,
W82-01610 4C

SYDOR, M.
Resonant Oscillation in Duluth-Superior Harbor,
W82-01837 2H

TAKALA, S.
Penetration and Distribution of Tritiated Water in Soils of a Lysimeter,
W82-01886 2G

TAKAMA, N.
A Multilevel Model and Algorithm for Some Multiobjective Problems,
W82-01884 6A

TAKASE, K.
Integrated Agricultural Development in the Philippines,
W82-01725 6B

TALSMA, T.
Transport of Salts in Catchments and Soils,
W82-01880 2G

TANAKA, K.
Measurement of Heavy Water Concentration with a Density Meter,
W82-02009 5A

TARAPCHAK, S. J.
Abiotic Versus Biotic Uptake of Radiophosphorus in Lake Water,
W82-01824 2H

TAYLOR, B. F.
Potential for Biodegradation of Phthalic Acid Esters in Marine Regions,
W82-01829 5B

TAYLOR, F. J. R.
Phytoplankton Accumulation in Langmuir Cells,
W82-01946 2H

TAYLOR, J.
Variations and Mechanisms of Asbestos Fibre Distribution in Stream Water,
W82-01853 5A

TEED, J. C.
Device for Collecting Replicate Artificial Substrate Samples of Benthic Invertebrates in Large Rivers,
W82-01947 7B

TENNANT, D.
The Influence of Tillage on Soil Water Behavior,
W82-02022 2G

THAYER, G. W.
Gulf of Mexico Wetlands: Value, State of Knowledge and Research Needs,
W82-01902 2L

THINGVOLD, D. A.
Persistence of 3-(Trifluoromethyl)-4-Nitrophenol in Aquatic Environments,
W82-01798 5B

THOMPSON, G. B.
Some Effects of Sewage Discharge Upon Phytoplankton in Hong Kong,
W82-02095 5C

THOMPSON, J. B.
Influence of Trickle and Sprinkle Irrigation on Golden Delicious Apple Quality,
W82-02001 3F

THOMSEN, A. G.
Spatial Simulation of Snow Processes,
W82-01887 2C

THOMSEN, T.
The Application of Radioactive Tracers for Determination of Bed-Load Transport in Alluvial Rivers,
W82-01893 2J

THOMSON, L. J.
Bromide in Canterbury Ground Water,
W82-02056 5B

THURSTON, R. V.
Increased Toxicity of Ammonia to Rainbow Trout (Salmo Gairdneri) Resulting from Reduced Concentrations of Dissolved Oxygen,
W82-01629 5C

TIMERKAYEVA, A. N.
Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 5B

TOMLINSON, L. M.
Operating Policies for a Surface/Ground Water System,
W82-01741 4B

TORDIFFE, E. A. W.
The Relationship Between Macro-Topography and the Groundwater Quality in the Great Fish River Basin, Eastern Cape Province,
W82-01718 2F

TORGERSEN, T.
Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 2H

TOWNS, D. R.
Effects of Artificial Shading on Periphyton and Invertebrates in a New Zealand Stream,
W82-01701 5C

TREADWELL, B. D.
The Use of Remote Sensing for an Integrated Inventory of a Semi-Arid Area,
W82-01910 7B

TRISKA, F. J.
Denitrification Associated With Periphyton Communities,
W82-01814 5B

TRUITT, R. E.
Copper(II)- and Cadmium(II)-Binding Abilities of Some New Hampshire Freshwaters Determined by Dialysis Titration,
W82-01632 5F

TSCHETTER, P.
Relating Population Growth to Shellfish Bed Closures: A Case Study from North Carolina,
W82-01641 5C

TSEYEB, YA. YA.
A Preliminary Study of the Effect of Pumped-Storage Plant Operation on Zooplankton,
W82-01971 5C

TUCKER, W. G.
Environmental Assessment of Industrial Discharges Based on Multiplicative Models,
W82-01808 5B

TUFFLEY, R. E.
Isolation of the Mycobacterium Avium-M. Intracellulare-M. Scrofulaceum Complex from Tank Water in Queensland, Australia,
W82-02069 5A

TULEPOVA, G. B.
Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 5B

TURNER, M. A.
Mercury Methylation by Fish Intestinal Contents,
W82-01830 5C

TURNPENNY, A. W. H.
Effects of Sedimentation on the Gravels of an Industrial River System,
W82-01881 5C

TUZHIKHIN, G. G.
Grout Curtain in the Foundation of the Arch Dam of the Inguri Hydroelectric Station,
W82-01973 8A

UHLMANN, D.
Limnology and Performance of Waste Treatment Lagoons,
W82-02026 5D

ULKEN, A.
On Some Chytrids Found in Estuarine Habitats,
W82-02038 2L

UNCLES, R. J.
Seasonal and Spring-Neap Tidal Dependence of Axial Dispersion Coefficients in the Severn - A Wide, Vertically Mixed Estuary,
W82-01749 2L

USTACH, J. F.
Gulf of Mexico Wetlands: Value, State of Knowledge and Research Needs,
W82-01902 2L

VALENTA, P.
Voltammetric Studies on the Stability of the ZN(II) Chelates with NTA and EDTA and the Kinetics of their Formation in Lake Ontario Water,
W82-01839 2H

VALENTIN, P.
Detection of Organophosphate Insecticide by an Immobilized-Enzyme System,
W82-02025 5A

VAN DE KREEKE, J.
Tide-Induced Residual Flow in Shallow Bays,
W82-02003 2L

VAN DER MARK, H.
Experience with a Simple Method for the Biological Evaluation of Surface Water Quality,
W82-02029 5A

VAN DUIVEDIJK, J.
Flood Control on the Parana and Paraguay Rivers,
W82-01707 2E

VAN EVERDINGEN, R. O.
Morphology, Hydrology and Hydrochemistry of Karst in Permafrost Terrain Near Great Bear Lake, Northwest Territories,
W82-01904 2F

VAN HEEK, L.
Control of Peach Tree Growth and Productivity by Regulated Water Supply, Tree Density, and Summer Pruning,
W82-01883 2I

VAN RENSBURG, J. F. J.
Health Aspects of Organic Substances in South African Waters - Opinions and Realities,
W82-01712 5A

VANDERPLOEG, H. A.
Effect of the Algal Length/Aperture Length Ratio on Coulter Analyses of Lake Seston,
W82-01823 7B

VANMARCKE, E. H.
Probabilistic Stability Analysis of Earth Slopes,
W82-01952 8D

VASIL'YEVA, G. L.
Calculation of Brachionus Rubens Production by the Direct Method and by Edmondson's Method,
W82-01921 2H

VASIUKOVITCH, L. J.
Water Sanitation Legislation Regarded as the Basis of Water Quality Monitoring,
W82-01990 6E

VIJAN, P. N.
Simultaneous Determination of Trace Metals in Sewage and Sewage Effluents by Inductively Coupled Argon Plasma Atomic Emission Spectrometry,
W82-01828 5A

VINCENT, W. F.
Nitrate Accumulation in Aerobic Hypolimnia: Relative Importance of Benthic and Planktonic Nitrifiers in an Oligotrophic Lake,
W82-02023 2H

VINIKOUR, W. S.
Biological Consequences of Stream Routing Through a Final-Cut Strip Mine Pit: Benthic Macroinvertebrates,
W82-01948 4A

VINK, J. S. L.
Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 5G

VOGEL, J. C.
Excess Air in Groundwater,
W82-02099 2F

VOROB'YEV, V. I.
Effect of Fertilizers on the Primary and Bacterial Production of Rearing Ponds in the Volga Delta,
W82-02077 2H

WALDESTAM, S.
Oxygen Bleaching Shows Potential for Reducing Costs, Effluent Problems,
W82-01899 5D

WALKER, D. R.
Deposition of Sulphur Gases from Multiple Scattered Sources in Alberta,
W82-01868 5B

WALKER, W. R.
Furrow Advance Rates Under Surge Flow Systems,
W82-01612 3F

WALLEN, D. G.
Zooplankton Species Diversity in Lake St. Clair, Ontario, Canada,
W82-01937 5C

WANG, L. K.
Mathematical Modeling of Stream Water Quality by a New Moment Method: Field Investigation of a Tidal River,
W82-01995 7B

WARD, P. R. B.
Sediment Transport and a Reservoir Situation Formula for Zimbabwe-Rhodesia,
W82-01736 2J

WARSH, C. E.
Industrial Waste Dumping at Deepwater Sites in the Gulf of Mexico,
W82-01903 5E

WATSON, K.
Simulation of Soil Water Within the Root Zone of a Corn Crop,
W82-01834 2G

WATSON, S.
Relationships Between Nannoplankton and Lake Trophic Status,
W82-01640 5C

WATSON, W. D.
Long-Run Effects of Environmental Regulation,
W82-01848 6A

WEBB, M. G.
Charging Policies for Water Services,
W82-01734 6C

Standards and Charges in the Control of Trade Effluent Discharges to Public Sewers in England and Wales,
W82-01717 6C

WEBER, H. W.
Soil Water Studies on Small Lucerne Plots,
W82-01713 2I

WEBER, J. H.
Copper(II)- and Cadmium(II)-Binding Abilities of Some New Hampshire Freshwaters Determined by Dialysis Titration,
W82-01632 5F

WEFRING, D. R.
Device for Collecting Replicate Artificial Substrate Samples of Benthic Invertebrates in Large Rivers,
W82-01947 7B

WEINER, R. M.
Numerical Taxonomy Analysis of Bacteria Isolated from the Completed 'Most Probable Numbers' Test for Coliform Bacilli,
W82-01911 5A

WELBY, C. W.
A Graphical Approach to Prediction of Groundwater Pollutant Movement,
W82-01634 5B

WELLS, M. R.
A Survey of Trihalomethanes in the Drinking Water System of Murjreesboro, Tennessee,
W82-01817 5B

WELSH, F. W.
Using Zeta Potential to Optimize Coagulating Aid Doses Used to Treat Food Processing Wastes,
W82-01627 5D

WEN, C-G.
Mathematical Modeling of Stream Water Quality by a New Moment Method: Field Investigation of a Tidal River,
W82-01995 7B

WESTALL, J.
Transport of Nonpolar Organic Compounds from Surface Water to Groundwater. Laboratory Sorption Studies,
W82-01873 5B

WHEELER, R. P.
Pollution from Farms,
W82-02039 5D

WHITTON, B. A.
Phytobenthos of the River Tees and Its Tributaries,
W82-02065 2K

WIANCKO, P. M.
Environmental Design and Operation of Nanticoke Thermal Generating Station,
W82-01907 5D

WILKINSON, L. F.
Bromide in Canterbury Ground Water,
W82-02056 5B

WILLIAMS, D. T.
Determination of Hexachlorocyclopentadiene at the Nanogram Per Liter Level in Drinking Water,
W82-01819 5A

A National Survey of Tri(Haloalkyl)-, Trialkyl-, and Triarylphosphates in Canadian Drinking Water,
W82-01989 5B

WILLIAMS, J.
Anomalies in Temperature and Rainfall During Warm Arctic Seasons as a Guide to the Formulation of Climate Scenarios,
W82-01975 2B

WILLIAMS, R.
Effects of Sedimentation on the Gravels of an Industrial River System,
W82-01881 5C

WILLSON, K. E.
Loading Estimates to Lake Erie, 1967-1976,
W82-01852 5A

WILSON, D. J.
Precipitate Flotation Studies with Monolauryl Phosphate and Monolauryldithiocarbamate,
W82-01863 5D

WILSON, J.
Removal of Organics from Water by Granular Activated Carbon and Microorganisms,
W82-01628 5D

WINNER, J. M.
Zooplankton Species Diversity in Lake St. Clair, Ontario, Canada,
W82-01937 5C

WISE, H. E. JR.
Predicting Priority Pollutants from Petrochemical Processes,
W82-01809 5B

WOLANSKI, E. J.
A Mathematical Model of the Hydrologic Regime of the Upper Nile Basin,
W82-01857 2A

WOLDENBERG, M. J.
Hydraulic Geometry and Minimum Rate of Energy Dissipation,
W82-01918 2J

WONG, A.
Toxicity and BOD Effluents Derived from Kraft Pulping of Aged Wood Chips,
W82-01845 5B

WONG, M-H.
Degree of Pollution of Several Major Streams Entering Tolo Harbour, Hong Kong,
W82-02058 5B

WOODFIELD, R.
Standards and Charges in the Control of Trade Effluent Discharges to Public Sewers in England and Wales,
W82-01717 6C

WOODHOUSE, R. A.
River Thermal Standards Costs in the Upper Midwest,
W82-01655 6B

WRIGHT, K. R.
Food and Energy Production: Conjunctive Water Planning,
W82-01856 3C

WRIGHT, S. G.
The Accuracy of Equilibrium Methods of Slope Stability Analysis,
W82-01954 8D

WU, I. P.
Drip Irrigation Uniformity Considering Emitter Plugging,
W82-01860 3F

WYETH, R. K.
A Test Utilizing Sediment Traps, Survey Rods, and Radiographs to Monitor Sediment Accumulation from a Dredging Disposal Operation,
W82-01950 7B

YADAV, J. S.
Effect of Irrigation Practices and Methods of Sowing-Cum-Irrigation on the Performance of Safflower,
W82-01878 3F

YANG, C. T.
Hydraulic Geometry and Minimum Rate of Energy Dissipation,
W82-01918 2J

YAPIJAKIS, C.
A Comprehensive Methodology for Project Appraisal and Environmental Protection in Multinational River Basin Development,
W82-01914 6B

YATES, R.
Extension of the Integrodifferential Approach to Inhomogeneous Multiaquifer Systems,
W82-02017 2F

YESHOV, YU. V.
Abundance Dynamics of Microorganisms in the Decomposition of Macrophytes,
W82-01999 2H

YEVTUSHENKO, N. YU.
Dynamics of Carp Growth and Biosynthetic Processes in the Liver of the Carp Reared in Containers in Heated Waste Water from Themal Power Stations,
W82-01998 5C

YOKSAS, T.
Photometric Investigations of Precipitable Water and Optical Depth Wavelength Exponents in an Urban Area,
W82-01966 2B

YOUNG, R. A.
Estimating Erosion and Sediment Yield on Field-Sized Areas,
W82-01849 2J

ZALL, R. R.
Using Zeta Potential to Optimize Coagulating Aid Doses Used to Treat Food Processing Wastes,
W82-01627 5D

ZAYCEV, L. V.
Investigation of Turbulence and Langmuir Circulation in Lake Ladoga,
W82-02100 2H

ZEKTSER, I. S.
Groundwater Discharge to the Pacific Ocean,
W82-01647 2F

ZHDANOVA, G. A.
A Preliminary Study of the Effect of Pumped-Storage Plant Operation on Zooplankton,
W82-01971 5C

ZHOLDAKOVA, Z. I.
Water Sanitation Legislation Regarded as the Basis of Water Quality Monitoring,
W82-01990 6E

ZIMNY, H.
Plant Biotests in the Bioindication of the Rainfall Pollution in an Oil Refinery Region,
W82-02033 5C

ZUKOWSKA-WIESZCZEK, D.
Plant Biotests in the Bioindication of the Rainfall Pollution in an Oil Refinery Region,
W82-02033 5C

ZULLIG, H.
On The Use of Carotenoid Stratigraphy in Lake Sediments for Detecting Past Developments of Phytoplankton,
W82-01706 2H

ZURAWSKI, A.
Hydrogeology of the Gatlinburg Area, Tennessee,
W82-01782 2F

ZVIBLEMAN, B.
Hydraulic Connection Between Lake Michigan and a Shallow Ground-Water Aquifer,
W82-02010 2F

ZWAHLEN, F.
Evaluation of a Precipitation Map Using a Smoothed Elevation-Precipitation Relationship and Optimal Estimates (Kriging),
W82-01892 2B

LIBRARY U. OF I. URBANA-CHAMPAIGN

ORGANIZATIONAL INDEX

AGENCY FOR INTERNATIONAL DEVELOPMENT, WASHINGTON, DC.
Remote Sensing in Development,
W82-01719 7B

AGENCY FOR INTERNATIONAL DEVELOPMENT, WASHINGTON, DC. BUREAU FOR AFRICA.
A Water Quality Assessment of Development in the Senegal River Basin,
W82-01740 6G

AGRICULTURAL RESEARCH AND EDUCATION CENTER, LAKE ALFRED, FL.
Upland Marsh for Water Quality Control,
W82-01962 5B

AGRICULTURAL STABILIZATION AND CONSERVATION SERVICE, WASHINGTON, DC.
Agricultural Conservation Program: An Evaluation,
W82-02019 3F

AHMADU BELLO UNIV., ZARIA (NIGERIA). DEPT. OF AGRICULTURAL ENGINEERING.
Using the Bamboo (Bambusa Vulgaris) as Field Drainage Material,
W82-01743 4A

AKADEMIA ROLNICZEJ, WARSAW (POLAND). INST. OF ENVIRONMENTAL PROTECTION.
Plant Biotests in the Bioindication of the Rainfall Pollution in an Oil Refinery Region,
W82-02033 5C

AKADEMIYA NAUK SSSR, BOROK. INST. BIOLOGII VNUTRENNYKH VOD.
Abundance Dynamics of Microorganisms in the Decomposition of Macrophytes,
W82-01999 2H

The Use of Leeches to Identify Pesticides in Water,
W82-02075 5A

AKADEMIYA NAUK SSSR, LENINGRAD. INST. OF LAKE STUDIES.
Investigation of Turbulence and Langmuir Circulation in Lake Ladoga,
W82-02100 2H

AKADEMIYA NAUK SSSR, MOSCOW. INST. VODNYKH PROBLEM.
Groundwater Discharge to the Pacific Ocean,
W82-01647 2F

Ways of Successive Refinement of Methods of Calculating the Duty of Water,
W82-02094 2D

AKADEMIYA NAUK SSSR, NOVOSIBIRSK. INST. FIZIKI.
Phytoplankton Distribution in the Southern and Middle Parts of Lake Baikal,
W82-02078 2H

AKADEMIYA NAUK SSSR, PETROZAVODSK. KARELSKII FILIAL.
Methods of Studying Invertebrate Drift in Rivers,
W82-02074 7A

AKADEMIYA NAUK URSR, KIEV. INST. BOTANIKI.
Effect of Sodium Dodecylsulfate on Unicellular Green Algae of the Genus Chlorella,
W82-01920 5C

AKADEMIYA NAUK URSR, KIEV. INST. HIDOBIOLOGII.
Effect of the Liming of Intensively Exploited Ponds on Phytoplankton Development,
W82-01923 2H

AKADEMIYA NAUK URSR, KIEV. INST. HIDROBIOLOGII.
Biological Pollution and Pollution Control in Canals Diverting Flow from One River Basin to Another,
W82-01922 5C

Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 5B

A Preliminary Study of the Effect of Pumped-Storage Plant Operation on Zooplankton,
W82-01971 5C

Dynamics of Carp Growth and Biosynthetic Processes in the Liver of the Carp Reared in Containers in Heated Waste Water from Themal Power Stations,
W82-01998 5C

Finds of Relict Infusoria in Kiev Reservoir,
W82-02079 2H

The Predicted Content of Organic and Biogenic Matter in the Water of Vilyuy Reservoir and the Extent to Which It Has Been Confirmed,
W82-02080 2H

Bacterioplankton and Phytoplankton in the Kiev Sector of Kanev Reservoir During the Period of Its Formation,
W82-02081 2H

Planktonic Infusoria of Kiev and Kremenchug Reservoirs,
W82-02082 2H

AKADEMIYA NAUK URSR, KIEV. INST. HIDROLOGII.
Ecological and Physiological Characteristics of Dikerogammarus Haemobaphes in the Areas in Which Heated Water Is Discharged from the Tripol'ye Power Station,
W82-01970 5C

AKADEMIYA NAUK URSR, KIEV. INST. HYDROBIOLOGII.
Hydrologic and Anthropogenic Factors Affecting Water Quality in the Rivers of the Ukrainian Carpathians,
W82-02076 5B

AKADEMIYA NAUK URSR, KIEV. INST. KIBERNETIKI.
The Modeling of Aquatic Ecological Systems,
W82-01972 5B

ALASKA UNIV., FAIRBANKS. INST. OF MARINE SCIENCE.
Dissolved Hydrocarbons and Related Microflora in a Fjordal Seaport: Sources, Sinks, Concentrations, and Kinetics,
W82-01816 5B

ARGONNE NATIONAL LAB., IL.
Biological Consequences of Stream Routing Through a Final-Cut Strip Mine Pit: Benthic Macroinvertebrates,
W82-01948 4A

ARIZONA UNIV., TUCSON. DEPT. OF ECONOMICS.
Water Management in the Colorado River Basin: An Application of Nonlinear Transportation Algorithms,
W82-01677 6A

ARIZONA UNIV., TUCSON. DEPT. OF HYDROLOGY AND WATER RESOURCES.
An Economic and Institutional Assessment of the Water Problem Facing the Tucson Basin,
W82-01698 6B

ARIZONA UNIV., TUCSON. INST. OF ATMOSPHERIC PHYSICS.
Observations of Two Colorado Thunderstorms by Means of a Zenith-Pointing Doppler Radar,
W82-01967 2B

ARIZONA UNIV., TUCSON. OFFICE OF ARID LANDS STUDIES.
The Use of Remote Sensing for an Integrated Inventory of a Semi-Arid Area,
W82-01910 7B

ARMY ENGINEER WATERWAYS EXPERIMENT STATION, VICKSBURG, MS.
Current Methods of Dynamic Analysis for Seismic Stability of Earth Dams,
W82-01953 8D

ASIAN DEVELOPMENT BANK, MANILA (PHILIPPINES). AGRICULTURE AND RURAL DEVELOPMENT DEPT.
Integrated Agricultural Development in the Philippines,
W82-01725 6B

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Effluent Fees, An Alternative System for Achieving Water Quality: A Case Study,
W82-01665 6F

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Acute Toxicity of Increased pH to Freshwater Shrimp Paratya Curvirostris,
W82-01645 5C

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Ecological Studies of Phytoplankton in the Waikato River and Its Catchment,
W82-01704 5C

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Effects of Artificial Shading on Periphyton and Invertebrates in a New Zealand Stream,
W82-01701 5C

AUSTRALIAN NATIONAL UNIV., CANBERRA. RESEARCH SCHOOL OF EARTH SCIENCES.
Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 2H

AYRES, LEWIS, NORRIS AND MAY, INC., ANN ARBOR, MI.
Tying Up TCE,
W82-01866 5G

BANSILAL AMRITLAL COLL. OF AGRICULTURE, ANAND (INDIA).
Effect of Periods of Moisture Availability on Groundnut Crop in the Saurashtra Region of Gujarat,
W82-01708 2G

BATTELLE PACIFIC NORTHWEST LAB., RICHLAND, WA.
Sediment-Contaminant Transport Model,
W82-01614 5B

BAYREUTH UNIV. (GERMANY, F.R.).
Dissolved Oxygen Dependent Phosphorus Release from Profundal Sediments of Lake Constance (Obersee),
W82-02055 2H

BECHTEL, INC., SAN FRANCISCO, CA.
Statistical Determination of Design Low Flows,
W82-01858 2E

BIDHAM CHANDRA KRISHI VISHWA VIDYALAYA, KALYANI (INDIA).

BIDHAM CHANDRA KRISHI VISHWA VIDYALAYA, KALYANI (INDIA).
Effect of Soil-Moisture Tensions and Preceding Winter Crops on the Yield and Water-Use Efficiency of Succeeding Crop of Tossa Jute,
W82-02045 2I

BIRMINGHAM UNIV. (ENGLAND). DEPT. OF CIVIL ENGINEERING.
Operating Policies for a Surface/Ground Water System,
W82-01741 4B

BREMEN UNIV. (GERMANY, F.R.). DEPT. OF CHEMISTRY.
On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 5A

BRITISH COLUMBIA UNIV., VANCOUVER. DEPT. OF MATHEMATICS.
Phytoplankton Accumulation in Langmuir Cells,
W82-01946 2H

BRITISH METEOROLOGICAL OFFICE, BRACKNELL (ENGLAND).
The Significance of Wet and Dry Synoptic Regions on Long-Range Transport of Pollution and Its Deposition,
W82-01877 5B

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Some Environmental and Social Impacts of the James Bay Hydroelectric Project, Canada,
W82-01908 6G

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Rapid, Quantitative Separation of Chlorophylls and Their Degradation Products by High-Performance Liquid Chromatography,
W82-01619 5A

BUREAU OF RECLAMATION, DENVER, CO. ENGINEERING AND RESEARCH CENTER.
Hydraulic Geometry and Minimum Rate of Energy Dissipation,
W82-01918 2J

Intakes and Outlets for Low-Head Hydropower,
W82-01979 8C

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Use of Knopp's Method to Assess Self-Purification Processes in Water Bodies and Water Courses,
W82-02073 5B

CALIFORNIA STATE DEPT. OF FISH AND GAME, SACRAMENTO. WATER POLLUTION CONTROL LAB.
Acute Toxicities of the Herbicides Komeen and Hydrothol-191 to Golden Shiner (Notemigonus Crysoleucas),
W82-01882 5C

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The California State Water Project--Current Activities and Future Management Plans.
W82-01851 6E

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A Structural Systems Analysis Approach to Determine Optimum Operating Policies for Irrigation and Hydropower Generation for Water Resources, Systems,
W82-01680 6A

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The Accuracy of Equilibrium Methods of Slope Stability Analysis,
W82-01954 8D

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Land-Use Conflict in Wildland Watershed Management: A Multiple Objective Economic Analysis,
W82-01675 6A

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Responses of Grain Sorghum to Variable Water Supply Under Two Irrigation Frequencies,
W82-01944 3F

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Abundance, Life History, and Growth of Introduced Populations of the Opossum Shrimp (Mysis Relicta) in Subalpine California Lakes,
W82-01638 2H

CALIFORNIA UNIV., RIVERSIDE. DEPT. OF SOIL AND ENVIRONMENTAL SCIENCES.
A Proposal for Reclamation by Dilution of Irrigation Water,
W82-01943 3C

The Statistical Mechanical Theory of Groundwater Flow,
W82-01982 2F

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Determination of Free Metal Ion Concentrations Using Bioassays,
W82-01821 5A

CARNEGIE INSTITUTION OF WASHINGTON, DC. GEOPHYSICAL LAB.
Tracing Food Webs with Stable Hydrogen Isotopes,
W82-02021 6G

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Parameter Estimation of Rainfall-Runoff Models with Heteroscedastic Streamflow Errors--The Noninformative Data Case,
W82-01657 2A

CENTER OF ADVANCED STUDY IN MARINE BIOLOGY, PORTO NOVO (INDIA).
Distribution of Vibrio Parahaemolyticus in Finfish Harvested from Porto Novo (S. India) Environs: A Seasonal Study,
W82-01737 5A

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Effect of Different Water Salinity Levels and Organic Matter Application on the Composition of Water Soluble and Exchangeable Bases in a Brackishwater Fish Pond Soil,
W82-02027 2H

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Effect of Irrigation Practices and Methods of Sowing-Cum-Irrigation on the Performance of Safflower,
W82-01878 3F

CHANDRA SHEKHAR AZAD UNIV. OF AGRICULTURE AND TECHNOLOGY, KANPUR (INDIA).
Water Use, Yield and Quality of Rapeseed as Influenced by Spacing, Irrigation and Time of Harvest When Raised in a Multiple-Cropping System,
W82-02031 3F

CHEST CLINIC, BRISBANE (AUSTRALIA).
Isolation of the Mycobacterium Avium-M. Intracellulare-M. Scrofulaceum Complex from Tank Water in Queensland, Australia,
W82-02069 5A

CHICAGO UNIV., IL. DEPT. OF MEDICINE.
Thermophillic and Thermotolerant Fungi Isolated from the Thermal Effluent of Nuclear Power Generating Reactors: Disposal of Human Opportunistic and Veterinary Pathogenic Fungi,
W82-01928 5B

CHINESE UNIV. OF HONG KONG, SHATIN. DEPT. OF BIOLOGY.
Degree of Pollution of Several Major Streams Entering Tolo Harbour, Hong Kong,
W82-02058 5B

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A Multilevel Model and Algorithm for Some Multiobjective Problems,
W82-01884 6A

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Activated Sludge Nickel Toxicity Studies,
W82-01895 5D

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An Integral Transform Method for the Linearized Boussinesq Groundwater Flow Equation,
W82-01984 2F

COLLEGE OF WILLIAM AND MARY, WILLIAMSBURG, VA. DEPT. OF MARINE SCIENCE.
The Effects of Chlorinated Sea Water on the Blue Crab, Callinectes Sapidus,
W82-01679 5C

Petroleum Degradation by Naturally Occurring Populations of Marine Bacteria from Middle Atlantic Outer Continental Shelf Waters,
W82-01683 5G

COLORADO STATE UNIV., FORT COLLINS.
Acute Toxicity of an In Situ Shale Oil Process Wastewater and It's Major Components to Daphnia Magna,
W82-01811 5C

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF CHEMISTRY.
Applications of Stripping Analysis to Metal Determinations in Natural Waters,
W82-01670 1A

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF CIVIL ENGINEERING.
Hydraulic Testing of Plastic Filter Fabrics,
W82-01613 8G

Numerical Analysis of Transient Salt/Fresh-Water Interface in Coastal Aquifers,
W82-01693 2F

Persistence of 3-(Trifluoromethyl)-4-Nitrophenol in Aquatic Environments,
W82-01798 5B

Optimal Design of Border Irrigation Systems,
W82-01977 3F

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF FOREST AND WOOD SCIENCES.
Environmental and Physiological Control of Water Flux Through Pinus Contorta,
W82-01827 2D

COLORADO STATE UNIV., FORT COLLINS. ENGINEERING RESEARCH CENTER.
Evaluating Scour at Culvert Outlets,
W82-01934 4D

COLORADO UNIV AT BOULDER. DEPT. OF GEOLOGICAL SCIENCES.
Composition of Leachage from Surface-Retorted and Unretorted Colorado Oil Shale,
W82-01810 5B

COLUMBIA NATIONAL FISHERY RESEARCH LAB., MO.
Effects of the Aquatic Herbicide 2,4-D DMA on the Ecology of Experimental Ponds,
W82-01949 5C

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CANBERRA (AUSTRALIA). DIV. OF FOREST RESEARCH.
Transport of Salts in Catchments and Soils,
W82-01880 2G

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CANBERRA (AUSTRALIA). DIV. OF MATHEMATICS AND STATISTICS.
Steady Periodic Flow Through a Rectangular Dam,
W82-01983 2F

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, NORTH RYDE (AUSTRALIA). DIV. OF FOOD RESEARCH.
Production of Aromatic Acids During Anaerobic Digestion of Citrus Peel,
W82-02049 5D

CONSTRUCTION ENGINEERING RESEARCH LAB., CHAMPAIGN, IL.
R-Factors for Soil Loss Impact Prediction,
W82-01963 2J

COPENHAGEN UNIV. (DENMARK). DEPT. OF GEOGRAPHY.
The Application of Radioactive Tracers for Determination of Bed-Load Transport in Alluvial Rivers,
W82-01893 2J

CORNELL UNIV., ITHACA, NY.
Nitrous Oxide in Freshwaters of the Great Lakes Basin,
W82-01841 2H

CORNELL UNIV., ITHACA, NY. DEPT. OF FOOD SCIENCE.
Using Zeta Potential to Optimize Coagulating Aid Doses Used to Treat Food Processing Wastes,
W82-01627 5D

COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH, PRETORIA (SOUTH AFRICA). NATURAL ISOTOPES DIV.
Excess Air in Groundwater,
W82-02099 2F

CUTTER LAB., SHAWNEE, KS. BAYVET DIV.
Parasite Ova in Anaerobically Digested Sludge,
W82-02018 5B

DANISH INST. OF APPLIED HYDRAULICS, HOERSHOLM.
Spatial Simulation of Snow Processes,
W82-01887 2C

DARTMOUTH COLL., HANOVER, NH.
A Perspective on Estuarine and Coastal Research Funding,
W82-01803 9A

DELAWARE UNIV., NEWARK. DEPT. OF CHEMICAL ENGINEERING.
Cycling Zone Adsorption Applied to Purification of Brackish Water with Thermally Regenerable Ion-Exchange Resins,
W82-01696 3A

DEPARTMENT OF AGRICULTURE AND FISHERIES, STELLENBOSCH (SOUTH AFRICA).
Soil Water Studies on Small Lucerne Plots,
W82-01713 2I

DEPARTMENT OF AGRICULTURE, LACOMBE (ALBERTA). RESEARCH STATION.
Deposition of Sulphur Gases from Multiple Scattered Sources in Alberta,
W82-01868 5B

DEPARTMENT OF FISHERIES AND OCEANS, WINNEPEG (MANITOBA). FRESHWATER INST.
An Analysis of the Aquatic Macrophyte, Myriophyllum Exalbescens, as an Indicator of Metal Contamination of Aquatic Ecosystems near a Base Metal Smelter,
W82-02016 5A

DEPARTMENT OF FISHERIES AND OCEANS, WINNIPEG (MANITOBA). FRESHWATER INST.
Mercury Methylation by Fish Intestinal Contents,
W82-01830 5C

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, CHRISTCHURCH (NEW ZEALAND). CHEMISTRY DIV.
Bromide in Canterbury Ground Water,
W82-02056 5B

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, TAUPO (NEW ZEALAND). ECOLOGY DIV.
Benthic Macroinvertebrates of Lake Taupo,
W82-01702 2H

DETROIT DEPT. OF WATER SUPPLY, MI. WATER AND SEWER TREATMENT.
Detroit's WWTP: One of the World's Biggest,
W82-01865 5D

DOMTAR LTD. RESEARCH CENTER, SENNEVILLE (ONTARIO).
Removal of Elemental Mercury from Wastewaters Using Polysulfides,
W82-01800 5D

DORCHESTER COUNTY HEALTH DEPARTMENT, CAMBRIDGE, MD.
Influence on Groundwater from the Bermed Infiltration Pond,
W82-01622 5D

DUKE UNIV., DURHAM, NC. DEPT. OF CIVIL ENGINEERING.
Modeling Stormwater Storage/Treatment Transients: Theory,
W82-01980 2A

Modeling Stormwater Storage/Treatment Transients: Applications,
W82-01981 2E

DURHAM UNIV. (ENGLAND). DEPT. OF BOTANY.
Phytobenthos of the River Tees and Its Tributaries,
W82-02065 2K

EAST CAROLINA UNIV., GREENVILLE, NC. DEPT. OF SOCIOLOGY AND ANTHROPOLOGY.
Relating Population Growth to Shellfish Bed Closures: A Case Study from North Carolina,
W82-01641 5C

EBASCO SERVICES, INC., GREENSBORO, NC.
Geologic and Hydrologic Implications of Hazardous Wastes Management Rules on Siting in North Carolina,
W82-01630 5E

EIDGENOESSISCHE ANSTALT FUER WASSERVERSORGUNG, ABWASSERREINIGUNG UND GEWAESSERSCHUTZ, ZURICH (SWITZERLAND).
Transport of Nonpolar Organic Compounds from Surface Water to Groundwater. Laboratory Sorption Studies,
W82-01873 5B

EIDGENOESSISCHE TECHNISCHE HOCHSCHULE, ZURICH (SWITZERLAND). VERSUCHSANSTALT FUER WASSERBAU, HYDROLOGIE UND GLAZIOLOGIE.
Simulation of the Topographic Influence on SLAR Data for Soil Moisture Detection in a Hilly Area,
W82-01605 2G

Can We Model the Rainfall-Runoff Process Today,
W82-01609 2A

ENERGY POLICY STUDIES, INC., OMAHA.
The Lake Tahoe Basin: A Systems Analysiw of Its Characteristics and Human Carrying Capacity,
W82-01807 6A

ENVIRONMENTAL CONTROL CONSULTANCY SERVICES LTD., LONDON (ENGLAND).
Technical and Economic Implications of Installing an Industrial Waste-Water Pretreatment Plant,
W82-02044 5D

ENVIRONMENTAL HEALTH DIRECTORATE, OTTAWA (ONTARIO).
A National Survey of Tri(Haloalkyl)-, Trialkyl-, and Triarylphosphates in Canadian Drinking Water,
W82-01989 5B

ENVIRONMENTAL PROTECTION AGENCY, ANN ARBOR, MI.
Flow Calculations for Household Effluent Disposal in Elevated Sand Mounds,
W82-01660 5E

ENVIRONMENTAL PROTECTION AGENCY, RESEARCH TRIANGLE PARK, NC.
Environmental Assessment of Industrial Discharges Based on Multiplicative Models,
W82-01808 5B

ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, DC.
Predicting Priority Pollutants from Petrochemical Processes,
W82-01809 5B

ENVIRONMENTAL PROTECTION SERVICE, OTTAWA (ONTARIO). WATER POLLUTION CONTROL DIRECTORATE.
Standard Procedure for Testing the Acute Lethality of Liquid Effluents.
W82-01905 5A

ENVIRONMENTAL RESEARCH LAB.-DULUTH, MN.
Determination of Mineral Fiber Concentrations in Fish Tissues,
W82-01822 5C

ENVIROTECH CORP., SALT LAKE CITY, UT.
Technology and Performance of the Hi-Capacity Thickener,
W82-01929 5D

EOTOVS LORAND UNIV., BUDAPEST (HUNGARY). DEPT. OF PHYSICAL CHEMISTRY AND RADIOLOGY.
Penetration and Distribution of Tritiated Water in Soils of a Lysimeter,
W82-01886 2G

ESSO PETROLEUM CO. LTD., LONDON (ENGLAND).
The Value of Ecological Monitoring in the Management of Petroleum Industry Effluent Discharges: Experience in Esso Petroleum Company U.K. Refineries,
W82-01913 5G

EXPERIMENTAL RESEARCH AND TECHNOLOGY, INC., CONCORD, MA.
Pollution Control: Changing Approaches,
W82-01870 6E

FEDERAL ENERGY REGULATORY COMMISSION, ATLANTA, GA. ATLANTA REGIONAL OFFICE.
Water Resources Appraisal for Hydroelectric Licensing: Altamaha River Basin, Georgia,
W82-01764 6D

FEDERAL ENERGY REGULATORY COMMISSION, CHICAGO, IL. CHICAGO REGIONAL OFFICE.
Water Resources Appraisal for Hydroelectric Licensing; Menominee River Basin; Michigan, Wisconsin,
W82-01753 6D

Water Resources Appraisals for Hydroelectric Licensing; Grand River Basin, Michigan,
W82-01759 6D

FEDERAL ENERGY REGULATORY COMMISSION, FORT WORTH, TX. FORT WORTH REGIONAL OFFICE.
Water Resources Appraisals for Hydroelectric Licensing; Lower Red River Basin; Arkansas, Louisiana, Oklahoma and Texas,
W82-01754 6D

FEDERAL ENERGY REGULATORY COMMISSION, NEW YORK. NEW YORK REGIONAL OFFICE.
Water Resources Appraisal for Hydroelectric Licensing; Kennebec River Basin, Maine.
W82-01755 6D

Water Resources Appraisal for Hydroelectric Licensing; Potomac River Basin; Pennsylvania, Maryland, West Virginia, Virginia, and District of Columbia,
W82-01760 6D

Water Resources Appraisal for Hydroelectric Licensing: Penobscot River Basin, Maine,
W82-01763 6D

FEDERAL ENERGY REGULATORY COMMISSION, WASHINGTON, DC. OFFICE OF ELECTRIC POWER REGULATION.
Water Resources Appraisals for Hydroelectric Licensing: Allegheny River Basin; Pennsylvania-New York.
W82-01751 6D

Water Resources Appraisals for Hydroelectric Licensing; Colorado River Basin, Texas.
W82-01752 6D

Water Resources Appraisals for Hydroelectric Licensing; Cumberland River Basin; Kentucky-Tennessee.
W82-01756 6D

Water Resources Appraisals for Hydroelectric Licensing; Tombigbee-Warrior River Basin; Alabama-Mississippi.
W82-01757 6D

Water Resources Appraisals for Hydroelectric Licensing; Black River Basin, New York.
W82-01758 6D

Water Resources Appraisals for Hydroelectric Licensing: Upper Arkansas River Basin; Colorado, Kansas, and New Mexico.
W82-01761 6D

Water Resources Appraisals for Hydroelectric Licensing; Western Great Lakes Tributaries; Michigan, Wisconsin, Indiana and Illinois.
W82-01762 6D

Water Resources Appraisals for Hydroelectric Licensing; Santee River Basin; South Carolina-North Carolina.
W82-01765 6D

Water Resources Appraisals for Hydroelectric Licensing: Tennessee River Basin; Virginia-Tennessee-North Carolina-Mississippi, Georgia-Kentucky-Alabama.
W82-01766 6D

Water Resources Appraisals for Hydroelectric Licensing, Saginaw and Au Sable River Basins Area, Michigan.
W82-01767 6D

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Limitations in Hydrological Interpretations of the Snow Coverage,
W82-01889 2C

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Water Quality Management of Lake Neusiedler, Austria,
W82-02090 5C

FINNISH HYDROLOGICAL OFFICE, HELSINKI.
On the Values and Variability of Degree-Day Melting Factor in Finland,
W82-01735 2C

FISH AND WILDLIFE SERVICE, WASHINGTON, DC. OFFICE OF FISHERY ASSISTANCE.
Impacts of Navigational Dredging on Fish and Wildlife: A Literature Review,
W82-01768 6G

FISHERIES RESEARCH STATION, ABERDEEN (HONG KONG).
Some Effects of Sewage Discharge Upon Phytoplankton in Hong Kong,
W82-02095 5C

FLORIDA INTERNATIONAL UNIVERSITY, MIAMI. DRINKING WATER QUALITY RESEARCH CENTER.
Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
W82-01835 5A

FLORIDA STATE DEPT. OF ENVIRONMENTAL REGULATION, TALLAHASSEE,
Estuarine Dredge and Fill Activities: A Review of Impacts,
W82-01805 2L

FLORIDA UNIV., BELLE GLADE. DEPT. OF AGRICULTURAL ENGINEERING.
Effect of Bulk Density on Calibration of Neutron Moisture Probe for Organic Soils,
W82-01861 2G

FLORIDA UNIV., GAINESVILLE.
The Effects of Secondary Sewage Effluent on the Water Quality, Nutrient Cycles and Mass Balances, and Accumulation of Soil Organic Matter in Cypress Domes,
W82-01687 5G

FLORIDA UNIV., GAINESVILLE. DEPT. OF BOTANY.
Biological and Physical Investigations of Bodies of Water Beneath Dense Water Hyacinth Populations Before and After Chemical Treatment,
W82-01678 5B

FOREST RESEARCH INST., CHRISTCHURCH (NEW ZEALAND).
Hydrology of Okarito Lagoon and the Inferred Effects of Selective Logging in Okarito Forest,
W82-01703 4C

FORSCHUNGSINST. BERGHOF G.M.B.H., TUEBINGEN (GERMANY, F.R.).
Selective Removal of Heavy Metal Ions from Aqueous Solutions by Diafiltration of Macromolecular Complexes,
W82-01900 5D

FRESHWATER BIOLOGICAL ASSOCIATION, CUMBRIA (ENGLAND). WINDERMERE LAB.
The Population Ecology of Iron Bacteria (Genus Ochrobium) in a Stratified Eutrophic Lake,
W82-01997 2H

FRESHWATER BIOLOGICAL ASSOCIATION, WAREHAM (ENGLAND). RIVER LAB.
The Effects of Mine Drainage and Organic Enrichment on Benthos in the River Nent System, Northern Pennines,
W82-02053 5C

GEOLOGICAL SURVEY, ALBANY, NY. WATER RESOURCES DIV.
Surficial Geology of Dugway Quadrangle, Oswego County, New York,
W82-01775 7C

GEOLOGICAL SURVEY, DENVER, CO. WATER RESOURCES DIV.
Sediment Analyses for Selected Sites in the South Platte River in Colorado and Nebraska, and the North Platte and Platte Rivers in Nebraska--Suspended Sediment, Bedload, and Bed Material,
W82-01776 2J

GEOLOGICAL SURVEY, HELENA, MT. WATER RESOURCES DIV.
Selected Drill-Stem-Test Data from the Northern Great Plains Area of Montana,
W82-01774 7C

Selected Hydrogeologic Data from the Northern Great Plains Area of Montana,
W82-01777 7C

Water-Resources Investigations of the U.S. Geological Survey in Montana, October 1980 through September 1981,
W82-01787 7C

GEOLOGICAL SURVEY, HURON, SD. WATER RESOURCES DIV.
Records of Water Levels in Unconsolidated Deposits in Eastern South Dakota,
W82-01788 7C

GEOLOGICAL SURVEY, JACKSON, MS. WATER RESOURCES DIV.
Quality of Water and Time of Travel in Part of Tillatoba Creek Basin, Mississippi, October 1974 to September 1980,
W82-01791 7C

GEOLOGICAL SURVEY, LAKEWOOD, CO. WATER RESOURCES DIV.
Effects of a Cattle Feedlot on Ground-Water Quality in the South Platte River Valley Near Greeley, Colorado,
W82-01790 5B

GEOLOGICAL SURVEY, LINCOLN, NE. WATER RESOURCES DIV.
Groundwater Levels in Nebraska 1980,
W82-01785 2F

GEOLOGICAL SURVEY, MENLO PARK, CA.
Tectonic State: Its Significance and Characterization in the Assessment of Seismic Effects Associated with Reservoir Impounding,
W82-01951 8E

GEOLOGICAL SURVEY, MENLO PARK, CA. WATER RESOURCES DIV.
Addendum to: Sources of Powerplant Cooling Water in the Desert Area of Southern California--Reconnaissance Study,
W82-01773 6B

Denitrification Associated With Periphyton Communities,
W82-01814 5B

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Low-Flow Frequency and Flow Duration of Tennessee Streams,
W82-01779 2E

Hydrogeology of the Gatlinburg Area, Tennessee,
W82-01782 2F

GEOLOGICAL SURVEY, RESTON, VA. WATER RESOURCES DIV.
Organic Substances in Water,
W82-01783 5A

Infectious Waterborne Diseases,
W82-01784 5A

Microbiology of the Aquatic Environment,
W82-01786 5C

Multi-Saline Sample Distillation Apparatus for Hydrogen Isotope Analyses: Design and Accuracy,
W82-01789 3A

Biota and Biological Parameters as Environmental Indicators,
W82-01794 5C

GEOLOGICAL SURVEY, TACOMA, WA. WATER RESOURCES DIV.
Low-Flow Characteristics of Streams in the Deschutes River Basin, Washington,
W82-01781 2E

Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01792 7C

GEOLOGICAL SURVEY, TALLAHASSEE, FL. WATER RESOURCES DIV.
U.S. Geological Survey Reports on the Water Resources of Florida, 1886-1980, Second Edition,
W82-01778 10C

Hydrogeology of Well-Field Areas Near Tampa, Florida, Phase 1--Development and Documentation of a Two-Dimensional Finite-Difference Model for Simulation of Steady-State Ground-Water Flow,
W82-01780 6A

GEOLOGICAL SURVEY, URBANA, IL. WATER RESOURCES DIV.
Stage-Discharge Relations at Dams on the Illinois and Des Plaines Rivers in Illinois,
W82-01793 4A

GEORGIA INST. OF TECH., ATLANTA. SCHOOL OF CIVIL ENGINEERING.
Mixing Zone Analysis for River Plumes,
W82-01961 5B

GEORGIA UNIV., ATHENS. DEPT. OF ZOOLOGY.
The Relative Importance of Protozoans, Rotifers, and Crustaceans in a Freshwater Zooplankton Community,
W82-01840 2H

GORKII STATE UNIV. (USSR).
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W82-02072 2H

GOSUDARSTVENNYI GIDROLOGICHESKII INST., LENINGRAD (USSR).
The Effects of Man on Basin Runoff, and on the Water Balance and Water Stage of the Caspian Sea,
W82-01709 4C

GOVIND BALLABH PANT UNIV. OF AGRICULTURE AND TECHNOLOGY, PANTNAGAR (INDIA).
Note on the Role of Irrigation Frequencies on the Regrowth of Berseem,
W82-01745 2I

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Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 2A

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Properties of the Sorptivity for Exponential Diffusivity and Application to the Measurement of the Soil Water Diffusivity,
W82-01897 2G

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Various Kinetic Energy Characteristics of Hail-patterns in the Grossversuch IV Experiment,
W82-01732 2B

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W82-01623 5C

HARWELL LAB., OXON (ENGLAND). ENVIRONMENTAL AND MEDICAL SCIENCES DIV.
The Dynamics of Anaerobic Phenol Biodegradation in Lower Greenland,
W82-02071 5B

HARYANA AGRICULTURAL UNIV., HISSAR (INDIA).
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W82-02042 2I

HAWAII UNIV., AT MANOA, HONOLULU. WATER RESOURCES RESEARCH CENTER.
Simple In Situ Determination of Hydraulic Conductivity by Power Function Descriptions of Drainage,
W82-01666 2G

HEALTH AND WELFARE CANADA, OTTAWA (ONTARIO).
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W82-01819 5A

HILL (G.H.), MANCHESTER (ENGLAND).
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W82-02068 8A

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W82-02084 5B

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W82-01906 3C

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Recent Changes in Level of Lake Victoria,
W82-01711 4A

IFE UNIV. (NIGERIA). DEPT. OF GEOGRAPHY.
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W82-01710 2F

ILLINOIS STATE UNIV., NORMAL. DEPT. OF ECONOMICS.
Water Quality and the Demand for Recreation,
W82-01942 6D

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF AGRICULTURAL ECONOMICS.
The Economics of Cooperation Over Collective Bads,
W82-01909 6A

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF CIVIL ENGINEERING.
Substrate Flux into Biofilms of Any Thickness,
W82-01964 5D

INDIANA UNIV. AT BLOOMINGTON. DEPT. OF CHEMISTRY.
Organic Compounds Found Near Dump Sites in Niagara Falls, New York,
W82-01802 5B

INSTITUT FUER MEERESFORSCHUNG, BREMERHAVEN (GERMANY, F.R.). DEPT. OF BOTANY.
On Some Chytrids Found in Estuarine Habitats,
W82-02038 2L

INSTITUT FUER WASSERWIRTSCHAFT, BERLIN (GERMAN D.R.).
Experience with Lake and Reservoir Restoration Techniques in the German Democratic Republic,
W82-02054 2H

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W82-01749 2L

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W82-01714 2J

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W82-02002 2J

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Water Sanitation Legislation Regarded as the Basis of Water Quality Monitoring,
W82-01990 6E

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W82-01720 2L

INSTITUTE OF PAPER CHEMISTRY, APPLETON, WI.
Device for Collecting Replicate Artificial Substrate Samples of Benthic Invertebrates in Large Rivers,
W82-01947 7B

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT, WASHINGTON, DC. POLICY PLANNING DIV.
Long-Run Effects of Environmental Regulation,
W82-01848 6A

INTERNATIONAL INST. OF TROPICAL AGRICULTURE, IBADAN (NIGERIA).
Leaching of Fertilizer Ions in a Ultisol from the High Rainfall Tropics: Leaching Through Undisturbed Soil Columns,
W82-01721 2G

IOWA STATE UNIV., AMES.
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W82-01685 6A

A Model of the Antarctic Sink for Stratospheric Water Vapor,
W82-01686 2A

IOWA UNIV., IOWA CITY. DEPT. OF CIVIL ENGINEERING.
River Thermal Standards Costs in the Upper Midwest,
W82-01655 6B

IOWA UNIV., IOWA CITY. INST. OF HYDRAULIC RESEARCH.
Cooling Potential of Missouri River in Missouri,
W82-01654 5B

IRKUTSKII GOSUDARSTVENNYI UNIV. (USSR). BIOLOGICAL AND GEOGRAPHICAL RESEARCH INST.
Toxicant Accumulation in Hydrobiont Tissues Following Effluent Discharge,
W82-01919 5C

Calculation of Brachionus Rubens Production by the Direct Method and by Edmondson's Method,
W82-01921 2H

IRRIGATED AGRICULTURE RESEARCH AND EXTENSION CENTER, PROSSER, WA.
Influence of Trickle and Sprinkle Irrigation on Golden Delicious Apple Quality,
W82-02001 3F

JOHN HOPKINS UNIV., BALTIMORE, MD. DIV. OF GEOGRAPHIC MEDICINE.
Gauze Filtration and Enrichment Procedures for Recovery of Vibrio Cholerae From Contaminated Waters,
W82-01815 5A

JOHNSON CO., HASLETT, MI.
Screened Auger Aids Investigation,
W82-02096 7B

KAMARAJ UNIV., MADURAI (INDIA). SCHOOL OF BIOLOGICAL SCIENCES.
Seasonal and Diurnal Changes of Chlorophyll in a Tropical Fresh Water Impoundment,
W82-02052 2H

KANSAS STATE GEOLOGICAL SURVEY, LAWRENCE.
Measurement of Irrigated Acreage in Western Kansas from Landsat Images,
W82-01939 7B

KASPIISKII NAUCHNO-ISSLEDOVATELSKII INST. RYBNOGO KHOZYAISTVA, ASTRAKHAN (USSR).
Effect of Fertilizers on the Primary and Bacterial Production of Rearing Ponds in the Volga Delta,
W82-02077 2H

KENTUCKY UNIV., LEXINGTON. DEPT. OF AGRONOMY.
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W82-01834 2G

KERNFORSCHUNGSANLAGE JUELICH, G.M.B.H. (GERMANY, F.R.). INST. FUER CHEMIE.
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W82-01839 2H

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W82-01924 2H

KYUSHU UNIV., FUKUOKA (JAPAN). DEPT. OF ORGANIC SYNTHESIS.
Extraction of Copper with Liquid Surfactant Membranes,
W82-01896 5D

LAMONT-DOHERTY GEOLOGICAL OBSERVATORY, PALISADES, NY.
Salt Dispersion in the Hudson Estuary,
W82-01615 2L

Summer Ice and Carbon Dioxide,
W82-01843 2C

LANCASTER UNIV., BAILRIGG (ENGLAND). DEPT. OF ENVIRONMENTAL SCIENCES.
Americium in Intertidal Sediments from the Coastal Environs of Windscale,
W82-02098 5B

LANCHESTER POLYTECHNIC, CONVENTRY (ENGLAND). DEPT. OF GEOGRAPHY.
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W82-01646 7A

LAVAL UNIV. (QUEBEC). DEPT. OF CHEMISTRY.
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W82-01639 5B

Spatial and Temporal Variations in Cesium-137 and Carbon in Sediments of Saguenay Fjord (Variations Spatiales et Temporelles du Cesium-137 et du Carbone dans des Sediments du Fjord du Saguenay),
W82-01644 2J

LAW ENGINEERING TESTING CO., MARIETTA, GA.
Geologic Aspects of Waste Disposal Site Evaluations,
W82-02011 5E

LEEDS UNIV. (ENGLAND). DEPT. OF CIVIL ENGINEERING.
A Selective Medium for the Enumeration of Streptococcus Bovis by Membrane Filtration,
W82-01620 5A

LEICESTER UNIV. (ENGLAND). DEPT. OF ECONOMICS.
Charging Policies for Water Services,
W82-01734 6C

LEWIS AND CLARK COLL. PORTLAND, OR. NORTHWESTERN SCHOOL OF LAW.
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W82-01804 6E

LIMOGES UNIV. (FRANCE). FONDATION DE L'EAU LIMOGES.
Combining Sewer Water Purification Processes to Treat Effluents Produced by Transient Populations,
W82-01992 5D

LIVINGSTON COLL., NEW BRUNSWICK, NJ. DEPT. OF URBAN STUDIES.
Planning with Great Uncertainty: A Review and Case Study of the Safe Drinking Water Controversy,
W82-01606 5A

LOUISIANA STATE UNIV., BATON ROUGE. DEPT. OF GEOLOGY.
Diffusion of Sediment on the Lee of Dune-Like Bedforms: Theoretical and Numerical Analysis,
W82-01842 2J

LOUISIANA STATE UNIV., BATON ROUGE. LAB. FOR WETLAND SOILS AND SEDIMENTS.
Nitrous Oxide Emission from Simulated Overland Flow Wastewater Treatment Systems,
W82-01624 5D

Nitrate Reduction to Ammonium and Organic Nitrogen in an Estuarine Sediment,
W82-01625 5B

LOZIER ENGINEERS, INC., ROCHESTER, NY.
Simulating Effects of Combined Sewer Overflows,
W82-01864 6A

LULEA UNIV. (SWEDEN). DIV. OF WATER RESOURCES ENGINEERING.
Evaporation from a Snow Cover--Review and Discussion of Measurements,
W82-01888 2D

LUXEMBOURG FOUNDATION UNIV., ARLON.
Direct Evidence of Water-Soluble Organic Matter Leaching in Brown Earths and Slightly Podzolized Soils,
W82-02034 2G

LYON-1 UNIV., VILLEURBANNE (FRANCE). DEPT. DE BIOLOGIE ANIMAUX ET ZOOLOGIE.
A Simple Device for Quantitative Pseudoperiphyton Sampling,
W82-01894 7B

MADHYA PRADESH IRRIGATION DEPT., BHOPAL (INDIA).
The Chambal Project: Problems and Solutions,
W82-01739 4A

MADRAS UNIV. (INDIA). CENTRE OF ADVANCED STUDY IN BOTANY.
Aquatic Microbiology with Reference to Tannin Degradation,
W82-02028 5B

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Effect of an Aerial Application of Carbaryl on Brook Trout (Salvelinus Fontinalis),
W82-01818 5C

MARYLAND DEPT. OF NATURAL RESOURCES, ANNAPOLIS.
The Hazards of Hazardous Waste Management,
W82-01940 6E

MARYLAND TECHNICAL ADVISORY SERVICE, COLLEGE PARK.
Public Opinion and Interest Group Positions on Chesapeake Bay Issues: Implications for Resource Management,
W82-01642 6B

MARYLAND UNIV., COLLEGE PARK.
Investigations into the Dynamics of Water Movement on a Low Relief Landscape on the Eastern Shore of Maryland,
W82-01673 2F

Analysis of the Origin of Water Which Forms Large Aufeis Fields on the Arctic Slope of Alaska Using Ground and Landsat Data,
W82-01690 2C

MARYLAND UNIV., COLLEGE PARK. DEPT. OF CHEMISTRY.
A Gel Partition Model for Organic Desorption from a Pond Sediment,
W82-01844 5A

MARYLAND UNIV., COLLEGE PARK. DEPT. OF MICROBIOLOGY.
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W82-01911 5A

MASSACHUSETTS INST. OF TECH., CAMBRIDGE.
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W82-01936 2K

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W82-01916 3F

Probabilistic Stability Analysis of Earth Slopes,
W82-01952 8D

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W82-01796 4A

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W82-01640 5C

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The Spreading of Thin Liquid Films on a Water-Air Interface,
W82-01955 1B

The Containment of an Oil Slick by a Boom Placed Across a Uniform Stream,
W82-01956 1B

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Power Spectral Analysis of a Forcemain Failure Caused by Waterhammer,
W82-01826 7B

MICHIGAN STATE UNIV., EAST LANSING. DEPT. OF AGRICULTURAL ENGINEERING.
Drip Irrigation Uniformity Considering Emitter Plugging,
W82-01860 3F

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The Role of Phototrophic Bacteria in the Sulfur Cycle of a Meromictic Lake,
W82-01831 2H

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W82-01833 5F

MICHIGAN UNIV., ANN ARBOR. DEPT. OF ATMOSPHERIC AND OCEANIC SCIENCE.
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W82-01958 2J

MICHIGAN UNIV., ANN ARBOR. DEPT. OF CIVIL ENGINEERING.
Mathematical Model for Regional Land Subsidence Due to Pumping 1. Integrated Aquifer Subsidence Equations Based on Vertical Displacement Only,
W82-01926 2F

Mathematical Model for Regional Land Subsidence Due to Pumping 2 Integrated Aquifer Subsidence Equations for Vertical and Horizontal Displacements,
W82-01927 2F

MICHIGAN UNIV., ANN ARBOR. DEPT. OF ENVIRONMENTAL AND INDUSTRIAL HEALTH.
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W82-01832 2H

MICHIGAN UNIV., ANN ARBOR. GREAT LAKES AND MARINE WATERS CENTER.
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W82-01959 2H

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W82-01817 5B

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W82-01994 5G

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W82-01801 5B

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W82-01724 8A

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W82-02097 5B

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International Cooperation to Protect the Baltic,
W82-02087 6E

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Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 5G

MINNESOTA UNIV., DULUTH. DEPT. OF PHYSICS.
Resonant Oscillation in Duluth-Superior Harbor,
W82-01837 2H

MINNESOTA UNIV., MINNEAPOLIS. DEPT. OF GEOLOGY AND GEOPHYSICS.
Contourites in Lake Superior,
W82-01935 2H

MINNESOTA UNIV., MINNEAPOLIS. SCHOOL OF PUBLIC HEALTH.
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W82-01795 2K

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Fate of Kepone and Mirex in a Model Aquatic Environment: Sediment, Fish, and Diet,
W82-01820 5B

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Matacil Residue Determination in Foliage, Fish, Soil and Water,
W82-01621 5A

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W82-01899 5D

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Log Pearson III Distribution - Effect of Dependence, Distribution Parameters and Sample Size on Peak Annual Flood Estimates,
W82-01649 2E

Log Pearson III Distribution - An Empirically-Derived Plotting Position,
W82-01650 2E

Log Pearson III Distribution - Is It Applicable to Flood Frequency Analysis of Australian Streams,
W82-01731 2E

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W82-01629 5C

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W82-02083 5C

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W82-01707 2E

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W82-02061 6C

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W82-01968 2B

NATIONAL HYDROLOGY RESEARCH INST., CALGARY (ALBERTA).
Morphology, Hydrology and Hydrochemistry of Karst in Permafrost Terrain Near Great Bear Lake, Northwest Territories,
W82-01904 2F

NATIONAL HYDROLOGY RESEARCH INST., OTTAWA (ONTARIO).
Scale-Dependent Dispersion in a Stratified Granular Aquifer,
W82-01986 2F

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Health Aspects of Organic Substances in South African Waters - Opinions and Realities,
W82-01712 5A

Comparison of Liquid-Liquid Extraction and Resin Adsorption for Concentrating Mutagens in Ames Salmonella/Microsome Assays on Water,
W82-01812 5A

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Measurement of Heavy Water Concentration with a Density Meter,
W82-02009 5A

NATIONAL MARINE FISHERIES SERVICE, BEAUFORT, NC. SOUTHEAST FISHERIES CENTER.
Gulf of Mexico Wetlands: Value, State of Knowledge and Research Needs,
W82-01902 2L

NATIONAL OCEAN SURVEY, ROCKVILLE, MD. OCEAN DUMPING AND MONITORING DIV.
Industrial Waste Dumping at Deepwater Sites in the Gulf of Mexico,
W82-01903 5E

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, ANN ARBOR, MI. GREAT LAKES ENVIRONMENTAL RESEARCH LAB.
A Method of Objective Analysis for Currents in a Lake with Application to Lake Ontario,
W82-01616 2H

Effect of the Algal Length/Aperture Length Ratio on Coulter Analyses of Lake Seston,
W82-01823 7B

Abiotic Versus Biotic Uptake of Radiophosphorus in Lake Water,
W82-01824 2H

Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 2H

Quantification of the Lake Trophic Typologies of Naumann (Surface Quality) and Thienemann (Oxygen) with Special Reference to the Great Lakes,
W82-02004 2H

NATIONAL RESEARCH INST. FOR OCEANOGRAPHY, STELLENBOSCH (SOUTH AFRICA).
Variations in Trace Metal Content of the Mussel Choromytilus Meridionalis (Kr.) with Season and Sex,
W82-01969 5A

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Charging for Water Supply in England and Wales in the 1980s,
W82-01722 6C

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W82-01852 5A

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W82-01854 5A

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Glacier Surveys in Alberta - 1979,
W82-01855 2C

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Variations and Mechanisms of Asbestos Fibre Distribution in Stream Water,
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The National Water Policy Review and Western Water Rights Law Reform: An Overview,
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Eutrophication of the Salt Valley Reservoirs, 1968-73. I. The Effects of Eutrophication on Standing Crop and Composition of Phytoplankton,
W82-01653 5C

Eutrophication of the Salt Valley Reservoirs 1968-73. III. The Macroinvertebrate Community: Its Development, Composition, and Change in Response to Eutrophication,
W82-01797 5C

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W82-01632 5F

NEW UNIV. OF ULSTER, COLERAINE (NORTHERN IRELAND). SCHOOL OF BIOLOGICAL AND ENVIRONMENTAL STUDIES.
Effect of the Copper Content of Distillery Spent Wash on Its Utilization for Single-Cell Protein Production by Geotrichum Candidum, Hansenula Anomala and Candida Kruzei,
W82-01750 5C

NEW YORK STATE DEPT. OF PUBLIC SERVICE, ALBANY. OFFICE OF ENVIRONMENTAL PLANNING.
Occult Hemoglobin as an Indicator of Impingement Stress in Fishes,
W82-01931 5C

NEWCASTLE UPON TYNE UNIV. (ENGLAND). DEPT. OF ECONOMICS.
Economic Instruments for Controlling Effluent Discharges to the River Tees Estuary,
W82-02060 2L

NORGES LANDBRUKSHOEGSKOLE, VOLLEBEKK.
Discharge Measurements by a New-Formed Relative Salt-Dilution Method in Small Turbulent Streams,
W82-01891 7B

Groundwater Chemistry of Some Selected Areas in Southeaster Norway,
W82-02020 2K

NORGES LANDBRUKSHOEGSKOLE, VOLLEBEKK. DEPT. OF GEOLOGY.
Groundwater Discharge Through Springs with Well-Defined Outlets--A Case Study from Jeloya-Moss, S. Norway,
W82-01748 2F

NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF MARINE EARTH, AND ATMOSPHERIC SCIENCES.
A Graphical Approach to Prediction of Groundwater Pollutant Movement,
W82-01634 5B

Perspective on Management and Disposal of Hazardous Wastes,
W82-01635 5E

NORTH CAROLINA STATE UNIV. AT RALEIGH. PESTICIDE RESIDUE RESEARCH LAB.
Investigation of Selective Uptake of Polychlorinated Biphenyls by Spartina Alterniflora Loisel,
W82-01813 5B

NORTHERN IRELAND DEPARTMENT OF AGRICULTURE, COLERAINE, FISHERIES RESEARCH LABORATORY.
Effects of Pollution Upon the Benthos of Belfast Lough,
W82-02059 5C

OAK RIDGE NATIONAL LAB., TN. ENVIRONMENTAL SCIENCES DIV.
The Natural Acidity of Some Unpolluted Waters in Southeastern Alaska and Potential Impacts of Acid Rain,
W82-01867 5B

Chromium Levels in Fish from a Lake Chronically Contaminated with Chromates from Cooling Towers,
W82-01941 5B

OKLAHOMA STATE UNIV., STILLWATER.
Predicting Storm Runoff from Small Grassland Watersheds with the USDAHL Hydrologic Model,
W82-01672 2E

OKLAHOMA STATE UNIV., STILLWATER. DEPT. OF AGRONOMY.
Double and Monocropped Wheat and Grain Sorghum Under Different Tillage and Row Spacings,
W82-01862 2I

OLD DOMINION UNIV. NORFOLK, VA.
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W82-01674 2L

OLD DOMINION UNIV., NORFOLK, VA. DEPT. OF BIOLOGICAL SCIENCES.
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W82-01661 5A

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Disinfection of Drinking Water in Developing Countries,
W82-02091 5F

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W82-01907 5D

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W82-02005 5B

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W82-01828 5A

ORANGE FREE STATE UNIV., BLOEMFONTEIN (SOUTH AFRICA). DEPT. OF GEOLOGY.
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W82-01718 2F

ORANGE FREE STATE UNIV., BLOEMFONTEIN (SOUTH AFRICA). DEPT. OF MICROBIOLOGY.
Composition of Fruit and Vegetable Processing Wastes,
W82-01601 5D

OREGON GRADUATE CENTER, BEAVERTON.
Kinetics for the Aquatic Environment,
W82-01631 2K

Kinetics for the Aquatic Environment,
W82-01806 2K

OREGON STATE UNIV., CORVALLIS. DEPT. OF GEOGRAPHY.
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W82-01681 5A

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W82-01879 2F

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W82-01700 2H

OTAGO UNIV. (NEW ZEALAND).
Note on Random Raindrops and Sampling Error,
W82-02032 2B

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK. DEPT. OF CIVIL ENGINEERING.
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W82-01664 2E

PENNWALT LTD. (ENGLAND).
Centrifugal Dewatering,
W82-01912 5E

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A Comprehensive Methodology for Project Appraisal and Environmental Protection in Multinational River Basin Development,
W82-01914 6B

PRINCETON UNIV., NJ. DEPT. OF CIVIL ENGINEERING.
Hydraulic Modeling for Waste Stabilization Ponds,
W82-01965 5D

PURDUE UNIV., LAFAYETTE, IN. DEPT. OF AGRICULTURAL ENGINEERING.
Estimating Erosion and Sediment Yield on Field-Sized Areas,
W82-01849 2J

PURDUE UNIV., LAFAYETTE, IN. SCHOOL OF CIVIL ENGINEERING.
A Stochastic Cluster Model of Daily Rainfall Sequences,
W82-01651 2B

QUEBEC UNIV., RIMOUSKI. DEPT. OF OCEANOGRAPHY.
Phytoplankton Distributions Observed During a 3 1/2 Days Fixed-Station in the Lower St. Lawrence Estuary,
W82-01938 2L

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Kinetics and Diffusion Processes in Colour Removal from Effluent Using Wood as an Adsorbent,
W82-02047 5D

RENSSELAER POLYTECHNIC INST., TROY, NY. DEPT. OF CHEMISTRY AND ENVIRONMENTAL ENGINEERING.
Generalized Computer Simulation Model for the Impact Assessment of Industrial Water Use on Fish Populations,
W82-01915 5C

RESOURCES FOR THE FUTURE, WASHINGTON, DC.
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W82-01847 6E

RHODES UNIV., GRAHAMSTOWN (SOUTH AFRICA). INST. FOR FRESHWATER STUDIES.
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W82-02070 2H

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Sediment Transport and a Reservoir Situation Formula for Zimbabwe-Rhodesia,
W82-01736 2J

RIJKSINSTITUUT VOOR ZUIVERING VAN AFVALWATER, LELYSTAD (NETHERLANDS).
Experience with a Simple Method for the Biological Evaluation of Surface Water Quality,
W82-02029 5A

ROME UNIV. (ITALY). IST. D'IGIENE.
PCB and HCB in the Sediments and Waters of the Tiber Estuary,
W82-02057 2L

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Potential for Biodegradation of Phthalic Acid Esters in Marine Regions,
W82-01829 5B

Tide-Induced Residual Flow in Shallow Bays,
W82-02003 2L

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W82-01695 5A

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W82-01648 5G

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W82-01611 2G

Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Taylor Creek, Fla., and Litle River, Ga., 1979 Data Report,
W82-01771 7B

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W82-02013 5B

SCIENCE AND EDUCATION ADMINISTRATION, LINCOLN, NE.
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W82-01769 5G

SCIENCE AND EDUCATION ADMINISTRATION, MORRIS, MN. NORTH CENTRAL SOIL CONSERVATION RESEARCH LAB.
Crop Residue Removal and Tillage; Effects on Soil Erosion and Nutrient Loss in the Corn Belt,
W82-01770 2J

SCIENCE AND EDUCATION ADMINISTRATION, PHOENIX, AZ. WATER CONSERVATION LAB.
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W82-01976 3F

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Nitrate Accumulation in Aerobic Hypolimnia: Relative Importance of Benthic and Planktonic Nitrifiers in an Oligotrophic Lake,
W82-02023 2H

SERVICE HYDROLOGIQUE NATIONAL, BERN (SWITZERLAND).
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W82-01892 2B

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W82-02035 5G

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W82-01960 5B

SNOWY MOUNTAINS ENGINEERING CORP., COOMA (AUSTRALIA).
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W82-01857 2A

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W82-01636 5E

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W82-02046 2F

SOIL CONSERVATION SERVICE, WASHINGTON, DC.
Impressions of Soil and Water Conservation in China,
W82-01730 4D

Resource Inventory--Sheet, Rill and Wind Erosion,
W82-01850 2J

SONNEN (M. B.) CO., INC., WALNUT CREEK, CA.
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W82-01667 3F

SOUTH CAROLINA UNIV., COLUMBIA. BELLE W. BARUCH INST. FOR MARINE BIOLOGY.
A Sensitivity Analysis of an Ecosystem Model of Estuarine Carbon Flow,
W82-01875 2L

SOUTH CAROLINA UNIV., COLUMBIA. DEPT. OF CHEMISTRY.
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W82-01656 5A

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W82-01742 6A

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W82-01610 4C

STANFORD UNIV., CA. DEPT. OF CIVIL ENGINEERING.
The Technology Transfer Process in Water Resources R&D Management,
W82-01694 6A

Effect of Reagent Mixing Rate on Adsorption Process for Am-Fe2O3.H2O,
W82-01799 5F

STANFORD UNIV., CA. DEPT. OF GEOLOGY.
Non-Equilibrium Water/Rock Interactions,
W82-01684 1A

STORA KOPPARBERG-BERGVIK, SKUTSKAR (SWEDEN).
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W82-02006 5D

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A New Method for Assessing the Lethal Impact of Short-Term, High-Level Discharges of Pollutants on Aquatic Animals,
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The Mercury Cycle,
W82-01869 5B

SYRACUSE UNIV., NY. DEPT. OF CIVIL ENGINEERING.
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W82-01618 5D

TECHNISCHE UNIV., DRESDEN (GERMAN D.R.).
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W82-02026 5D

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W82-02030 2H

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W82-01825 5C

TERRAQUA APS, KALUNDBORG (DENMARK).
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W82-01890 2F

TEXAS AGRICULTURAL EXPERIMENTAL STATION, LUBBOCK.
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W82-01859 3F

TEXAS UNIV. AT DALLAS, RICHARDSON.
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W82-01669 6B

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W82-02014 5G

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W82-02040 6E

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W82-02039 5D

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W82-02043 5D

THEMAG ENGENHARIA LTDA., SAO PAOLO (BRAZIL).
Irrigation for Brazil's Poligono Das Secas,
W82-01744 3F

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W82-01987 5B

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W82-02007 5A

TRINITY COLL., DUBLIN (IRELAND).
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W82-01876 5D

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W82-01996 5C

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W82-01716 5B

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W82-02012 5A

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W82-02017 2F

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W82-02050 5D

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W82-01881 5C

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W82-01930 2L

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W82-01723 2I

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W82-01746 2L

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W82-01671 3F

Watershed Constituent Loading Analysis Utilizing Empirical Hydro-Chemical Modeling Techniques,
W82-01676 5B

Random Differential Equations in Water Quality Modeling,
W82-01688 6A

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The Flowering of Wastewater Treatment,
W82-02015 5D

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Furrow Advance Rates Under Surge Flow Systems,
W82-01612 3F

Water Requirements and Man-Induced Climate Change,
W82-01633 2D

Simplified Method for Rainfall Intensities,
W82-01978 2B

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W82-01945 3F

VANDERBILT UNIV., NASHVILLE, TN.
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W82-01692 5D

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Precipitate Flotation Studies with Monolauryl Phosphate and Monolauryldithiocarbamate,
W82-01863 5D

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W82-02066 6E

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W82-01872 6F

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W82-01883 2I

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W82-01689 5A

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W82-01662 5B

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W82-02025 5A

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W82-02048 5A

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W82-01898 2G

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W82-02093 3F

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W82-01643 2J

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W82-01705 2H

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W82-01668 2G

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W82-02085 2B

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W82-02024 6E

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W82-02022 2G

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W82-01682 5G

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W82-01691 5G

Pollution Permits and Markets for Water Quality,
W82-01699 6A

WISCONSIN UNIV.-MILWAUKEE. CENTER FOR GREAT LAKES STUDIES.
Effects of Thermocline Displacement Upon Subsurface Chlorophyll Maxima in Lake Michigan,
W82-01957 2H

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Water Reuse: Ultrafiltration of Industrial and Municipal Wastewaters,
W82-01652 5D

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Hydraulic Connection Between Lake Michigan and a Shallow Ground-Water Aquifer,
W82-02010 2F

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Food and Energy Production: Conjunctive Water Planning,
W82-01856 3C

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Photometric Investigations of Precipitable Water and Optical Depth Wavelength Exponents in an Urban Area,
W82-01966 2B

WYOMING UNIV., LARAMIE. DEPT. OF ZOOLOGY AND PHYSIOLOGY.
Periphytic Community Response to Chronic Nutrient Enrichment by a Reservoir Discharge,
W82-01658 5C

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Standards and Charges in the Control of Trade Effluent Discharges to Public Sewers in England and Wales,
W82-01717 6C

YORK WATER CO., PA.
Perseverance Produces County Park,
W82-01932 6D

YORKSHIRE WATER AUTHORITY (ENGLAND).
Recording Underground,
W82-02036 8A

ZURICH SERVICE DES EAUX (SWITZERLAND).
Water Pollution: A Risk to the Future in the Case of the Rhine (Eaux Polluees' Avenir en Danger Dans le Cas du Rhin),
W82-02067 5G

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ACCESSION NUMBER INDEX

W82-01601 5D
W82-01602 7B
W82-01603 6E
W82-01604 4D
W82-01605 2G
W82-01606 5A
W82-01607 5C
W82-01608 5G
W82-01609 2A
W82-01610 4C
W82-01611 2G
W82-01612 3F
W82-01613 8G
W82-01614 5B
W82-01615 2L
W82-01616 2H
W82-01617 2A
W82-01618 5D
W82-01619 5A
W82-01620 5A
W82-01621 5A
W82-01622 5D
W82-01623 5C
W82-01624 5D
W82-01625 5B
W82-01626 5D
W82-01627 5D
W82-01628 5D
W82-01629 5C
W82-01630 5E
W82-01631 2K
W82-01632 5F
W82-01633 2D
W82-01634 5B
W82-01635 5E
W82-01636 5E
W82-01637 5A
W82-01638 2H
W82-01639 5B
W82-01640 5C
W82-01641 5C
W82-01642 6B
W82-01643 2J
W82-01644 2J
W82-01645 5C
W82-01646 7A
W82-01647 2F
W82-01648 5G
W82-01649 2E
W82-01650 2E
W82-01651 2B
W82-01652 5D
W82-01653 5C
W82-01654 5B
W82-01655 6H
W82-01656 5A
W82-01657 2A
W82-01658 5C
W82-01659 6E
W82-01660 5E
W82-01661 5A
W82-01662 5B
W82-01663 5C
W82-01664 2E
W82-01665 6F
W82-01666 2G
W82-01667 3F
W82-01668 2G
W82-01669 6B
W82-01670 1A
W82-01671 3F
W82-01672 2E
W82-01673 2F
W82-01674 2L
W82-01675 6A
W82-01676 5B
W82-01677 6A
W82-01678 5B
W82-01679 5C
W82-01680 6A
W82-01681 5A
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W82-01685 6A
W82-01686 2A
W82-01687 5G
W82-01688 6A
W82-01689 5A
W82-01690 2C
W82-01691 5G
W82-01692 5D
W82-01693 2F
W82-01694 6A
W82-01695 5A
W82-01696 3A
W82-01697 5F
W82-01698 6B
W82-01699 6A
W82-01700 2H
W82-01701 5C
W82-01702 2H
W82-01703 4C
W82-01704 5C
W82-01705 2H
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W82-01750 5C
W82-01751 6D
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W82-01769 5G
W82-01770 2J
W82-01771 7B
W82-01772 2A
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W82-01775 7C
W82-01776 2J
W82-01777 7C
W82-01778 10C
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W82-01862 2I
W82-01863 5D
W82-01864 6A
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W82-01867 5B
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W82-01869 5B
W82-01870 6E
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W82-01873 5B
W82-01874 5F
W82-01875 2L
W82-01876 5D
W82-01877 5B
W82-01878 3F
W82-01879 2F
W82-01880 2G
W82-01881 5C
W82-01882 5C
W82-01883 2I
W82-01884 6A
W82-01885 2C
W82-01886 2G
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W82-01888 2D
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W82-01890 2F
W82-01891 7B
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W82-01893 2J
W82-01894 7B
W82-01895 5D
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W82-01897 2G
W82-01898 2G
W82-01899 5D
W82-01900 5D
W82-01901 6B
W82-01902 2L
W82-01903 5E
W82-01904 2F
W82-01905 5A
W82-01906 3C
W82-01907 5D
W82-01908 6G
W82-01909 6A
W82-01910 7B
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W82-01914 6B
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W82-01916 3F
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W82-01929 5D
W82-01930 2L
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W82-01934 4D
W82-01935 2H
W82-01936 2K

W82-01937 5C
W82-01938 2L
W82-01939 7B
W82-01940 6E
W82-01941 5B
W82-01942 6D
W82-01943 3C
W82-01944 3F
W82-01945 3F
W82-01946 2H
W82-01947 7B
W82-01948 4A
W82-01949 5C
W82-01950 7B
W82-01951 8E
W82-01952 8D
W82-01953 8D
W82-01954 8D
W82-01955 1B
W82-01956 1B
W82-01957 2H
W82-01958 2J
W82-01959 2H
W82-01960 5B
W82-01961 5B
W82-01962 5B
W82-01963 2J
W82-01964 5D
W82-01965 5D
W82-01966 2B
W82-01967 2B
W82-01968 2B
W82-01969 5A
W82-01970 5C
W82-01971 5C
W82-01972 5B
W82-01973 8A
W82-01974 5D
W82-01975 2B
W82-01976 3F
W82-01977 3F
W82-01978 2B
W82-01979 8C
W82-01980 2A
W82-01981 2E
W82-01982 2F
W82-01983 2F
W82-01984 2F
W82-01985 5C
W82-01986 2F
W82-01987 5B
W82-01988 7B
W82-01989 5B
W82-01990 6E
W82-01991 5G
W82-01992 5D
W82-01993 5C
W82-01994 5G
W82-01995 7B
W82-01996 5C
W82-01997 2H
W82-01998 5C
W82-01999 2H
W82-02000 4A
W82-02001 3F
W82-02002 2J
W82-02003 2L
W82-02004 2H
W82-02005 5B
W82-02006 5D
W82-02007 5A
W82-02008 5A
W82-02009 5A
W82-02010 2F
W82-02011 5E
W82-02012 5A
W82-02013 5B
W82-02014 5G
W82-02015 5D
W82-02016 5A
W82-02017 2F
W82-02018 5B
W82-02019 3F
W82-02020 2K
W82-02021 6G
W82-02022 2G
W82-02023 2H
W82-02024 6E
W82-02025 5A
W82-02026 5D
W82-02027 2H
W82-02028 5B
W82-02029 5A
W82-02030 2H
W82-02031 3F
W82-02032 2B
W82-02033 5C
W82-02034 2G
W82-02035 5G
W82-02036 8A
W82-02037 6A
W82-02038 2L
W82-02039 5D
W82-02040 6E
W82-02041 5D
W82-02042 2I
W82-02043 5D
W82-02044 5D
W82-02045 2I
W82-02046 2F
W82-02047 5D
W82-02048 5A
W82-02049 5D
W82-02050 5D
W82-02051 5C
W82-02052 2H
W82-02053 5C
W82-02054 2H
W82-02055 2H
W82-02056 5B
W82-02057 2L
W82-02058 5B
W82-02059 5C
W82-02060 2L
W82-02061 6C
W82-02062 6G
W82-02063 2E
W82-02064 2E
W82-02065 2K
W82-02066 6E
W82-02067 5G
W82-02068 8A
W82-02069 5A
W82-02070 2H
W82-02071 5B
W82-02072 2H
W82-02073 5B
W82-02074 7A
W82-02075 5A
W82-02076 5B
W82-02077 2H
W82-02078 2H
W82-02079 2H
W82-02080 2H
W82-02081 2H
W82-02082 2H
W82-02083 5C
W82-02084 5B
W82-02085 2B
W82-02086 7A
W82-02087 6E
W82-02088 6D
W82-02089 6B
W82-02090 5C
W82-02091 5F
W82-02092 5G
W82-02093 3F
W82-02094 2D
W82-02095 5C
W82-02096 7B
W82-02097 5B
W82-02098 5B
W82-02099 2F
W82-02100 2H

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- ENGINEERING WORKS
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- SCIENTIFIC AND TECHNICAL INFORMATION

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- SUBJECT INDEX
- AUTHOR INDEX
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